

Final Supplement to

ANESTHESIA & ANALGESIA[®]

Abstracts of Posters presented at the
2015 Annual Meeting of the
International Anesthesia Research Society

Honolulu, Hawaii

March 21-24, 2015

This Supplement Will Appear Online Only



ANESTHESIA & ANALGESIA®

The Gold Standard in Anesthesiology

The official scientific journal of the International Anesthesia Research Society®, The Society of Cardiovascular Anesthesiologists, the Society for Pediatric Anesthesia, the Society for Ambulatory Anesthesia, the International Society for Anaesthetic Pharmacology, the Society for Technology in Anesthesia, the Anesthesia Patient Safety Foundation, the Society of Critical Care Anesthesiologists, the Society for Obstetric Anesthesia and Perinatology, and the Society of Anesthesia and Sleep Medicine

STEVEN L. SHAFER
EDITOR-IN-CHIEF
Palo Alto, California

CHARLES W. HOGUE, JR.
ASSOCIATE EDITOR-IN-CHIEF FOR
CARDIOVASCULAR ANESTHESIOLOGY
Society of Cardiovascular Anesthesiologists
Baltimore, Maryland

FRANKLIN DEXTER
STATISTICAL EDITOR
Iowa City, Iowa

JEAN-FRANCOIS PITTET
CORRESPONDENCE EDITOR
INCOMING EDITOR-IN-CHIEF
Birmingham, Alabama

NANCY A. NUSSMEIER
ASSOCIATE EDITOR-IN-CHIEF
Anesthesia & Analgesia Case Reports
Boston, Massachusetts

JAMES G. BOVILL
GUEST EDITOR-IN-CHIEF
International Society for Anaesthetic Pharmacology
Leiden, The Netherlands

NANCY LYNLY
SENIOR MANAGING EDITOR
San Francisco, California

JEANETTE ESAU
ONLINE MANAGING EDITOR
San Francisco, California

ANA MORALES
REVIEW SYSTEMS MANAGER
San Francisco, California

SECTION EDITORS

SORIN J. BRULL
PATIENT SAFETY
Anesthesia Patient Safety Foundation
Jacksonville, Florida

MAXIME CANNESON
TECHNOLOGY, COMPUTING,
AND SIMULATION
Society for Technology in Anesthesia
Orange, California

GREGORY J. CROSBY
NEUROSCIENCE IN ANESTHESIOLOGY
AND PERIOPERATIVE MEDICINE
Pediatric Neuroscience
Boston, Massachusetts

FRANKLIN DEXTER
ECONOMICS, EDUCATION, AND POLICY
Iowa City, Iowa

JAMES DiNARDO
PEDIATRIC ANESTHESIOLOGY
PEDIATRIC NEUROSCIENCE
Society for Pediatric Anesthesia
Boston, Massachusetts

TONG J. GAN
AMBULATORY ANESTHESIOLOGY AND
PERIOPERATIVE MANAGEMENT
Society for Ambulatory Anesthesia
Stony Brook, New York

JEFFREY B. GROSS
CONTINUING MEDICAL EDUCATION
Farmington, Connecticut

EUGENE A. HESSEL, II
MEDIA REVIEWS
Lexington, Kentucky

DAVID HILLMAN
RESPIRATION AND SLEEP MEDICINE
Perth, Western Australia

MARKUS W. HOLLMANN
PRECLINICAL PHARMACOLOGY
International Society for
Anaesthetic Pharmacology
Amsterdam, The Netherlands

TERESE T. HORLOCKER
REGIONAL ANESTHESIA
Rochester, Minnesota

YUGUANG HUANG
SCIENTIFIC DIRECTOR
Chinese Language Edition
Beijing, China

KEN B. JOHNSON
ANESTHETIC CLINICAL PHARMACOLOGY
International Society for
Anaesthetic Pharmacology
Salt Lake City, Utah

J. LANCE LICHTOR
MEDIA REVIEWS
New Haven, Connecticut

SPENCER S. LIU
PAIN MEDICINE
New York, New York

MARTIN J. LONDON
PERIOPERATIVE ECHOCARDIOGRAPHY
AND CARDIOVASCULAR EDUCATION
Society of Cardiovascular
Anesthesiologists
San Francisco, California

JIANREN MAO
PAIN AND ANALGESIC MECHANISMS
Boston, Massachusetts

NAVEEN NATHAN
COVER EDITOR AND ILLUSTRATOR
Chicago, Illinois

EDWARD C. NEMERGUT
GRADUATE MEDICAL EDUCATION
Charlottesville, Virginia

AVERY TUNG
CRITICAL CARE, TRAUMA,
AND RESUSCITATION
Society of Critical Care
Anesthesiologists
Chicago, Illinois

HUGO VAN AKEN
GLOBAL HEALTH
Münster, Germany

CYNTHIA A. WONG
OBSTETRIC ANESTHESIOLOGY
Society for Obstetric Anesthesia
and Perinatology
Chicago, Illinois

EDITORIAL BOARD

W. SCOTT BEATTIE
Toronto, Ontario, Canada

HONORIO T. BENZON
Chicago, Illinois

RICHARD BRULL
Toronto, Ontario, Canada

MAY L. CHIN
Washington, D.C.

MARIE CSETE
Pasadena, California

GETÚLIO R. DE OLIVEIRA FILHO
Florianópolis, Brazil

ANGELA ENRIGHT
Victoria, British Columbia, Canada

GIRISH P. JOSHI
Dallas, Texas

SANDRA KOPP
Rochester, Minnesota

KATE LESLIE
Melbourne, Australia

GREGORY LIGUORI
New York, New York

ROBERT MCCARTHY
Chicago, Illinois

JILL MHYRE
Little Rock, Arkansas

PAUL S. PAGEL
Elm Grove, Wisconsin

CARL E. ROSOW
Boston, Massachusetts

JOHN W. SEAR
Oxford, England

STANTON K. SHERMAN
Boston, Massachusetts

NIKOLAOS J. SKUBAS
New York, New York

ROMAN SNIKINSKI
Atlanta, Georgia

THOMAS R. VETTER
Birmingham, Alabama

ANESTHESIA & ANALGESIA®

The Gold Standard in Anesthesiology

ASSOCIATE EDITORIAL BOARD

TIMOTHY ANGELOTTI
Stanford, California

IOANNA APOSTOLIDOU
Minneapolis, Minnesota

ALAIN BORGEAT
Zurich, Switzerland

JOHN F. BUTTERWORTH, IV
Richmond, Virginia

KUMAR BUVANENDRAN
Chicago, Illinois

WILLIAM CAMANN
Boston, Massachusetts

MARK CHANEY
Chicago, Illinois

FRANCES CHUNG
Toronto, Ontario, Canada

STEVEN COHEN
Baltimore, Maryland

JARROD DALTON
Cleveland, Ohio

GILDASIO DE OLIVEIRA JR.
Chicago, Illinois

ANTHONY DOUFAS
Stanford, California

RICHARD DUTTON
Park Ridge, Illinois

RACHEL ESHIMA MCKAY
San Francisco, California

JEFFREY FELDMAN
Philadelphia, Pennsylvania

WEI DONG GAO
Baltimore, Maryland

PAUL HEERDT
New York, New York

LEE KOETZNER
Dayton, New Jersey

AARON KOPMAN
New York, New York

TOM C. KREJCIE
Chicago, Illinois

A. STEPHANE LAMBERT
Ottawa, Ontario, Canada

HELEN V. LAURO
Brooklyn, New York

JERROLD H. LEVY
Durham, North Carolina

TIMOTHY W. MARTIN
Little Rock, Arkansas

KELLY MCQUEEN
Nashville, Tennessee

MOHAMED NAGUIB
Cleveland, Ohio

VANCE G. NIELSEN
Tucson, Arizona

JEFFREY PASTERNAK
Rochester, Minnesota

KENT H. REHFELDT
Rochester, Minnesota

RAYMOND C. ROY
Winston-Salem, North Carolina

PHILIP E. SCUDERI
Winston-Salem, North Carolina

MARTIN SMITH
London, United Kingdom

PALOMA TOLEDO
Chicago, Illinois

RICHARD WEISKOPF
San Francisco, California

GUEST EDITORS 2015

MARTIN S. ANGST
Stanford, California

PHILIP BICKLER
San Francisco, California

JAY B. BRODSKY
Stanford, California

VINCENT W.S. CHAN
Toronto, Ontario, Canada

JEREMY COLLINS
Stanford, California

JOSEPH P. CRAVERO
Lebanon, New Hampshire

PETER J. DAVIS
Pittsburgh, Pennsylvania

FRANCOIS DONATI
Montreal, Quebec, Canada

MARCEL E. DURIEUX
Charlottesville, Virginia

EDMOND I EGER, II
San Francisco, California

JAMES EISENKRAFT
New York, New York

RICHARD H. EPSTEIN
Philadelphia, Pennsylvania

DAVID FARAONI
Boston, Massachusetts

PAMELA FLOOD
Stanford, California

KAZUHIKO FUKUDA
Kyoto, Japan

THOMAS GAL
Charlottesville, Virginia

TONY GIN
Shatin, Hong Kong

PETER GLASS
Stony Brook, New York

GEORGE M. HALL
London, United Kingdom

FRANK HERBSTREIT
Essen, Germany

IGOR KISSIN
Boston, Massachusetts

ARTHUR LAM
Seattle, Washington

ADAM LERNER
Georgetown, Massachusetts

RONALD S. LITMAN
Philadelphia, Pennsylvania

DAVID LUO
Irvine, California

CARL LYNCH, III
Charlottesville, Virginia

ALAN MARCO
Dayton, Ohio

MASSIMILIANO MEINERI
Toronto, Ontario, Canada

MICHAEL J. MURRAY
Phoenix, Arizona

JOHN C. ROWLINGSON
Charlottesville, Virginia

EDWARD R. SHERWOOD
Nashville, Tennessee

PETER SLINGER
Toronto, Ontario, Canada

MARTIN STECHERT
San Francisco, California

OLIVER THEUSINGER
Zürich, Switzerland



International Anesthesia
Research Society
<http://www.iars.org>



Society of Cardiovascular
Anesthesiologists
<http://www.scahq.org>



Society for Ambulatory
Anesthesia
<http://www.SAMBAHQ.org>



Society for Pediatric Anesth
<http://www.pedsanesthesia.org>



International Society for
Anaesthetic Pharmacology
<http://www.isaponline.org>



Society for Technology in
Anesthesia
<http://www.AnesTech.org>



Anesthesia Patient Safety
Foundation
<http://www.apsf.org>



Society of Critical Care
Anesthesiologists
<http://www.SOCCA.org>



Society for Obstetric Anesthesia and
Perinatology
<http://www.SOAP.org>



Society of Anesthesia and Sleep Medicine
<http://www.sasmhq.org>

ANESTHESIA & ANALGESIA, (ISSN 0003-2999), is issued monthly for the IARS in two indexed volumes per year by Lippincott Williams & Wilkins, Inc. 16522 Hunters Green Parkway, Hagerstown, MD 21740-2116. Business offices are located at Two Commerce Sq, 2001 Market Street, Philadelphia, PA 19103. Production offices are located at 351 West Camden Street, Baltimore, MD 21201-2436. Periodicals postage paid at Hagerstown, MD and at additional mailing offices. Printed in the USA on acid-free paper. © 2015 by the International Anesthesia Research Society. **Postmaster:** Send address changes to Anesthesia & Analgesia, Lippincott Williams & Wilkins, P.O. Box 1550 Hagerstown, MD 21741.

ANESTHESIA & ANALGESIA®

The “Gold Standard” in Anesthesiology

The official scientific journal of the International Anesthesia Research Society®, the Society of Cardiovascular Anesthesiologists, the Society for Pediatric Anesthesia, the Society for Ambulatory Anesthesia, the International Society for Anaesthetic Pharmacology, the Society for Technology in Anesthesia, the Anesthesia Patient Safety Foundation, the American Society of Critical Care Anesthesiologists, the Society for Obstetric Anesthesia and Perinatology, and the Society of Anesthesia and Sleep Medicine

Abstracts of Posters Presented at the International Anesthesia Research Society IARS 2015 Annual Meeting Honolulu, Hawaii March 21-24, 2015

Subspecialty Abstracts (by category):

Airway Management	S-1 – S-20
Ambulatory Anesthesia	S-21 – S-28
Anesthetic Pharmacology	S-29 – S-54
Cardiovascular Anesthesiology	S-55 – S-92
Critical Care	S-93 – S128
Economics, Education and Policy	S-129 – S-153
Liver	S-154 – S-157
Neuroscience in Anesthesiology and Perioperative Medicine	S-158 – S-196
Obstetric Anesthesiology	S-197 – S-208
Pain Mechanisms	S-209 – S-220
Pain Medicine	S-221 – S-237
Patient Safety	S-238 – S-266
Pediatric Anesthesiology	S-267 – S-290
Perioperative Anesthesia	S-291 – S-318
Regional Anesthesia	S-319 – S-345
Sleep Medicine	S-346 – S-348
Technology, Computing and Simulation, Equipment Monitoring	S-349 – S-380
Trauma	S-381 – S-383

Resident Abstracts (by category):

Airway Management	S-400, S-401, S431
Ambulatory Anesthesia	S-403
Anesthetic Pharmacology	S-404 – S-406
Cardiovascular Anesthesiology	S-407 – S-412
Critical Care	S-413 – S-422
Economics, Education and Policy	S-402, S-423 – S-430
Geriatric Anesthesia	S-432 – S-434
Liver	S-433 – S-434
Medically Challenging Case Report	S-435 – S-481
Neuroscience in Anesthesiology and Perioperative Medicine	S-482 – S-489
Obstetric Anesthesiology	S-490 – S-492
Pain Mechanisms	S-493
Pain Medicine	S-494 – S-501
Patient Safety	S-502 – S-510
Pediatric Anesthesiology	S-511 – S-513
Perioperative Anesthesia	S-514 – S-523
Regional Anesthesia	S-524 – S-526
Sleep Medicine	S-527
Technology, Computing and Simulation, Equipment Monitoring	S-528 – S-531
Trauma	S-532
Best Medically Challenging Case (Liver)	MC-102
Author Index	S-533 – S-544

Authors submitting abstracts have certified that if human research is reported, approval by an institutional human research committee has been obtained, or if animal research is reported, the usual standards and guidelines for animal care have been followed. Material published in this supplement has not undergone review by the Editorial Board of Anesthesia and Analgesia. Any of the abstracts in this supplement may have been transmitted by the author to IARS in various forms of electronic medium. IARS has used its best efforts to receive and format electronic submissions for publication in this supplement but has not reviewed each abstract for the purpose of textual error correction and is not liable in any way for any formatting, textual or grammatical error or inaccuracy.

Subspecialty Abstracts

Airway Management

S-1.**EFFICACY OF V-GEL™ SUPRA GLOTTIC AIRWAY OVER LARYNGEAL MASK AIRWAY FOR RABBIT AIRWAY MANAGEMENT**

AUTHORS: H. Makino¹, K. Hokamura², T. Kimura¹, S. Kawashima¹, T. Katoh¹, K. Umemura¹, S. Sato¹

AFFILIATION: ¹Anesthesiology and Intensive Care, Hamamatsu University School of Medicine, Hamamatsu, Japan, ²Pharmacology, Hamamatsu University School of Medicine, Hamamatsu, Japan.

INTRODUCTION: Rabbits are widely used in experimental research. Rabbit endotracheal intubation is difficult because of the rabbits' narrow pharyngeal inlet and small larynx. Researchers usually perform tracheostomy in rabbits under general anesthesia; however, in some studies, such as serial imaging studies, tracheostomy is not preferable. Spontaneous breathing via a face mask may not preserve the airway, and controlled ventilation is difficult when the face mask is applied. In rabbits, repeated intubation attempts might cause laryngeal trauma, which could then result in airway obstruction following extubation. Some researchers have reported the benefit of the laryngeal mask airway (LMA) for airway management in rabbits. Recently, a novel supraglottic airway device, v-gel® (Docsinnovent, UK), designed for rabbits became available. We compared v-gel with LMA for airway management in rabbits under general anesthesia.

METHODS: Hamamatsu University School of Medicine Institutional Review Board approved this prospective trial. Male Japanese white rabbits weighing 2.6 ± 0.1 kg ($n = 3$) were used. For general anesthesia in rabbits, an anesthesia machine (Apollo, Dräger, Germany) was used. General anesthesia was induced by 5% isoflurane in 100% oxygen in a small anesthetic chamber. When the animal became unresponsive to a mouth opening, the rabbit was placed in the left lateral position. General anesthesia was maintained using a small face mask with 2% isoflurane without muscle relaxant. Standard monitoring (ECG, SPO₂, and left femoral arterial blood pressure) was applied.

LMA size 1 (Disposable Laryngeal Mask Straight, Ambu, Denmark) or v-gel size R3 (for rabbit body weight from 1.8 kg to 3.5 kg) (Fig. 1, right: LMA size 1, left: v-gel size R3) was inserted alternately in a randomized order. All devices were inserted by an anesthesiologist with 15 years of experience (HM). The time from insertion to adequate placement was recorded. Insertion success and adequate placement was determined by auscultation (smooth spontaneous breathing sound) and capnography attached to the Apollo machine. After 10 min of spontaneous breathing, animals were mechanically ventilated for 10 min. The conditions of spontaneous breathing and mechanical ventilation, such as airway pressure, air leak, air leak sound from the stethoscope placed on the neck, and gastric insufflation (gastric insufflation sound and the presence of abdominal distension), were evaluated and compared.

RESULTS: V-gel tends to have a shorter insertion time (v-gel: 15.3 ± 8.7 s vs LMA: 23.6 ± 5.1 s). Airway conditions during spontaneous breathing of both groups were almost the same and appropriate. In the v-gel group, adequate mechanical ventilation was performed. However in the LMA group, gastric insufflation and abdominal distension due to device misplacement was observed (v-gel: 0/3 vs LMA: 3/3).

CONCLUSIONS: A shorter insertion time and less gastric insufflation due to misplacement during mechanical ventilation might make v-gel a more favorable option than LMA for airway management in rabbits under general anesthesia.



S-2.

SIMPLE, FAST AND EASY INSERTION TECHNIQUE OF THE PROSEAL LARYNGEAL MASK AIRWAY: SANDWICH TECHNIQUE HUMAN

AUTHORS: M. Aoyagi

AFFILIATION: Anesthesia and Analgesia Service, Yoh Hospital for Primary Care, Chiba, Japan

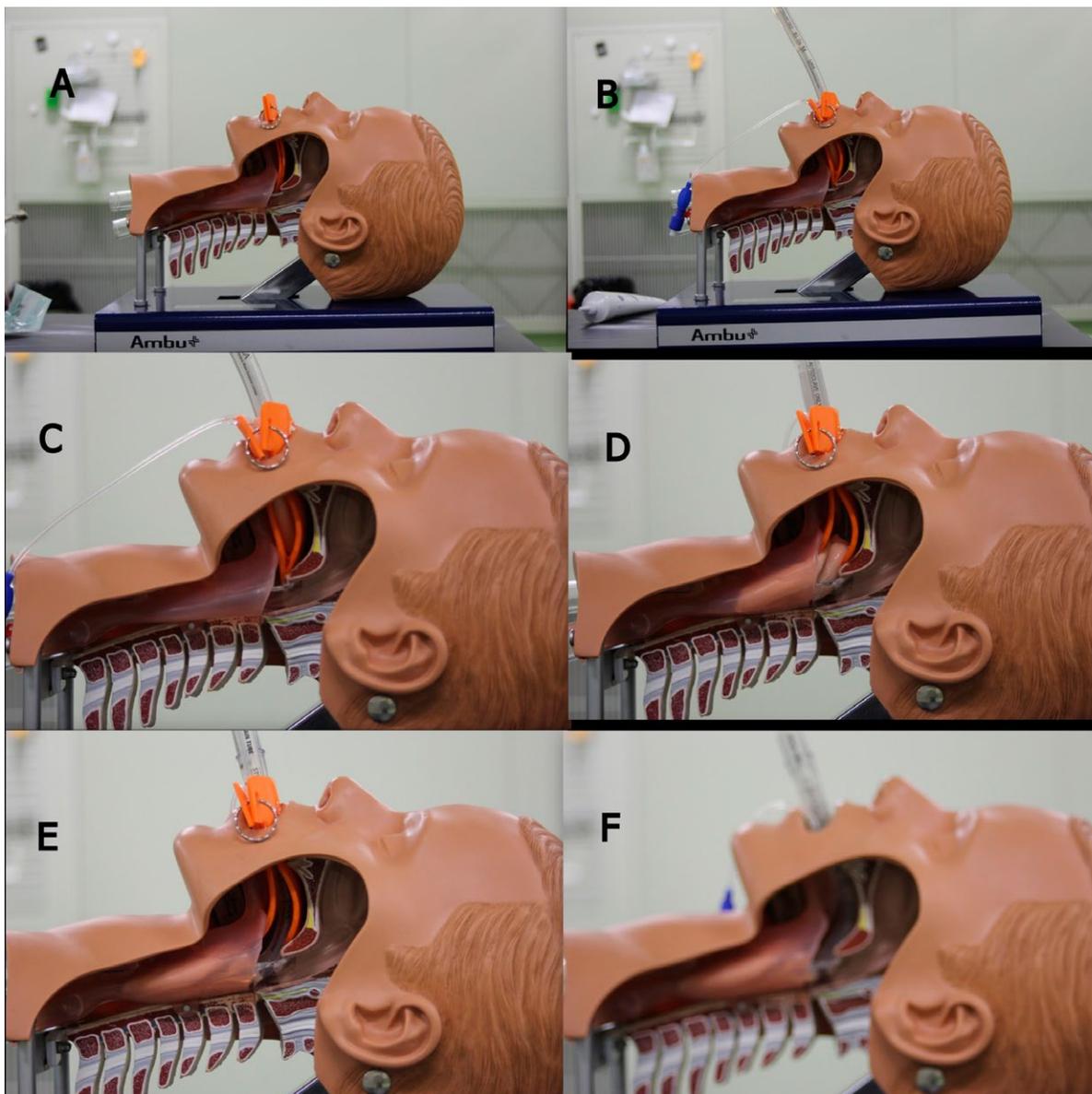
INTRODUCTION: ProSeal laryngeal mask airway (PLMA) is an airway device that is relative easy to place by novice. The author makes a insertion assist device that makes more easy to place of PLMA (Sandwich technique).

METHOD: Sandwich technique shows Figure (Sandwich insertion technique; (A) Put a pair of cards into the mouth. (B) Separate cards with index finger and put the partially inflated cuff of PLMA into the slit of the cards. (C—E) Holding the midportion of the airway tube, push the tube down vertically until resistance is felt. (F) Remove

cards out holding the tube.) With approval from the local ethics committee and informed consent, 50 adult patients were placed PLMA using this technique. The following characteristics were evaluated: (1) ease of the PLMA insertion; (2) insertion time; (3) ventilatory condition; (4) trace of bleeding.

RESULTS: The overall insertion success rate and the success rate at first attempt were 100%, respectively. The overall insertion time were within ten seconds. There was no case with trace of bleeding.

CONCLUSIONS: The results show that PLMA insertion can be easily succeeded using this Sandwich technique. Many techniques of PLMA placement were reported but more complicated. Brain's digital technique is best, but needs some skill. This technique make simple, safe and speedy placement of PLMA. And also can be applied to special cases; (1) restricted mouth opening; (2) neutral in-line position; (3) inexperienced hands; (4) lateral approach insertion in prone position.



S-3.**BUDESONIDE SUSPENSION FOR INHALATION REDUCES RESPIRATORY SYMPTOMS AFTER ENDOTRACHEAL INTUBATION AMONG PATIENTS UNDERGOING GYNECOLOGICAL SURGERY: A RANDOMIZED CONTROLLED TRIAL****AUTHORS:** Y. Bai¹, T. Miller², L. Law³, T. Gan⁴**AFFILIATION:** ¹Department of Anesthesiology, Tangshan Maternal and Child Healthcare Hospital, H, Tangshan, China, ²Department of Anesthesiology, Duke, Durham, NC, ³Department of Anesthesiology, Duke University, Durham, NC, ⁴Department of Anesthesiology, Stony Brook University, Stony Brook, NY**ABSTRACT INTRODUCTION:** The common post-intubation respiratory symptoms after surgery under general anesthesia (GA) include sore throat, cough, sputum and hoarseness of voice. A previous randomized controlled trial (RCT) showed that applying glucocorticoid gel on endotracheal tubes effectively reduced the incidence and severity of postoperative sore throat. However, no RCT has studied inhalational budesonide as a treatment to reduce those post-intubation respiratory symptoms.**METHODS:** Patients enrolled in the study were ages 18 to 62 years old, American Society of Anesthesiologists' physical status I or II, and scheduled for gynecological surgery under GA. They were randomly assigned into either the budesonide group or the placebo group. In the post-anesthesia care unit (PACU), patients in the budesonide group inhaled budesonide suspension 1mg in 5ml normal saline for 5 minutes whereas patients in the placebo group inhaled only 5ml normal saline. During the 24 hours (h) after extubation, the incidence of sore throat, cough, hoarseness of voice, sputum, and fever was recorded at 1h, 6h and 24h.**RESULT:** 182 patients were included in our study (91 in each group). Compared with placebo, budesonide significantly decreased the incidence of cough and sore throat at 1h, 6h and 24h postoperatively. Budesonide also reduced hoarseness of voice and the severity of sore throat at 6h, and sputum production at 24h, but had no effect on the incidence of fever.**CONCLUSIONS:** Budesonide suspension for inhalation safely and effectively reduces the incidence of respiratory symptoms after endotracheal intubation: cough, sore throat, hoarseness of voice, and sputum.**REFERENCES:**

1. Arnold M. Sobel Md, Ben Sheiner MD, Robert Boyer MD: possible prevention of complications following endotracheal anesthesia. *Anesthesia & Analgesia* 1964, 43(5):504-509.
2. Jung TH, Rho JH, Hwang JH, Lee JH, Cha SC, Woo SC: The effect of the humidifier on sore throat and cough after thyroidectomy. *Korean Journal of Anesthesiology* 2011, 61(6):470-474.
3. Hisham AN, Roshilla H, Amri N, Aina en: post-thyroidectomy sore throat following endotracheal intubation. *Anz J Surg* 2001, 71(11):669-671.
4. Christensen AM, Willemoes-Larsen H, Lundby L, Jakobsen KB: Postoperativethroat complaints after tracheal intubation. *British Journal of Anaesthesia* 1994, 73(6):786-787.
5. McHardy FE, Chung F: Postoperative sore throat: cause, prevention and treatment. *Anaesthesia* 1999, 54(5):444-453.
6. Maruyama K, Sakai H, Miyazawa H, Toda N, Iinuma Y, Mochizuki N, Hara K, Otagiri T: Sore throat and hoarseness after total intravenous anaesthesia. *British Journal of Anaesthesia* 2004, 92(4):541-543.

S-4.

USEFULNESS OF McGRATH® MAC VIDEO LARYNGOSCOPE FOR TRAINING JUNIOR RESIDENTS TO PERFECT ENDOTRACHEAL INTUBATION

AUTHORS: W. Shirasaka¹, K. Ikeshita¹, M. Nomura¹, S. Toriyama¹, T. Yamashita², Y. Tani³;

AFFILIATION: ¹Anesthesia, Yao Tokusuyukai General Hospital, Yao, Japan, ²Anesthesia, Yao Tokusuyukai General Hospital, Yao-shi Osaka, Japan, ³Anesthesia, Yao Tokusuyukai General Hospital, Yao-shi, Osaka, Japan.

INTRODUCTION: Various devices have been developed in recent years to simplify endotracheal intubation. These devices are effective not only in the management of difficult airway¹, but also in tracheal intubation training. In this prospective study, we evaluated the usefulness of McGRATH® MAC video laryngoscope (Figure 1) in training junior resident to master successful tracheal intubation.

METHODS: The subjects were 5 junior residents who started their tracheal intubation training at our department in 2013. Informed consent was obtained from the patients. Each resident performed tracheal intubation with a conventional Macintosh laryngoscope and McGRATH® in turns (100 attempts in total; 50 attempts with each device). We compared the rate of successful tracheal intubation using the conventional Macintosh laryngoscope (Group C) with that by McGRATH® (Group MG). Tracheal intubation was considered successful when it was completed within 1 minute, whereas successful intubation requiring more than 1 minute and esophageal intubation were considered failures. Cases of difficult airway (Cormack and Lehane grade III or IV) were excluded from the study. The results were compared using the Student's t-test, Mann Whitney U test, and Chi-squared test. P < 0.05 denoted statistical significance.

RESULTS: Patients' demographics were similar in the two groups. The success rate of tracheal intubation on the first to 30th attempts was significantly higher in Group MG than Group C. However, no significant differences were noted after the 31st attempts (Figure 2). In cases of Mallampati class 3 or 4, the success rate was significantly higher in Group MG than Group C (Figure 3). Incorrect esophageal intubation was recorded in 4 (1.6%) cases of Group C and none in Group MG.

CONCLUSIONS: McGRATH® enhances tracheal intubation conducted by junior residents compared with conventional Macintosh laryngoscope, and is an excellent tool in learning the skill of proper and accurate endotracheal intubation.

REFERENCES:

1. Taylor AM, et al. The McGrath Series 5 videolaryngoscope vs the Macintosh laryngoscope: a randomised, controlled trial in patients with a simulated difficult airway. *Anaesthesia*. 2013;68:142-7.



Figure 1. McGRATH® MAC video laryngoscope

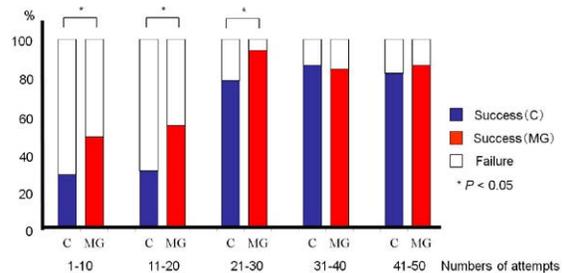


Figure 2. Success rate of tracheal intubation related to numbers of attempts

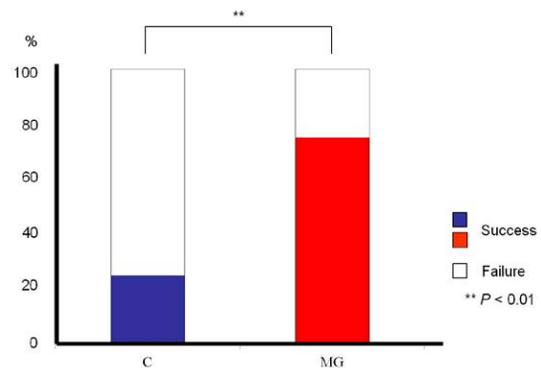


Figure 3. Success rate of tracheal intubation in Mallampati class 3/4

S-5.**MCGRATH® VIDEOLARYNGOSCOPE INSERTION LENGTH FOR PEDIATRIC PATIENTS****AUTHORS:** M. Nishi**AFFILIATION:** Anesthesia, Ishikawa Prefectural Central Hospital, Kanazawa, Japan

INTRODUCTION: When performing tracheal intubation on pediatric patients, the laryngoscope blade must be selected in accordance with the patient's physique and blade insertion length must be adjusted while confirming field of vision with the device. Careless blade insertion can cause intraoral and pharyngeal damage. Prior awareness of the depth of insertion may reduce the risk of such damage. Understanding insertion length in advance could also allow for swift visual recognition of the glottis, thereby reducing tracheal intubation time and non-ventilation time.

This study investigated appropriate blade insertion length to achieve the position with the best field of vision using the new McGrath® videolaryngoscope on pediatric patients.

METHODS: A total of 170 ASA-PS 1 or 2 patients scheduled for minor surgery at our hospital were recruited. Children for whom airway management was predicted to be difficult were excluded.

After general anesthesia was induced, the subjects' mouths were passively opened and incisor intervals were measured. The McGrath® blade was inserted and the site at which the mandibular central incisors came into contact with the blade at the depth where the best field of vision could be achieved on the LCD display was marked. Distance from the blade tip was then measured after tracheal intubation. The site of contact with the mandibular ridge was measured in infant subjects who did not yet have all their teeth. The relationships of opening diameter (incisor interval distance) and blade insertion length with subject age, height and body weight were investigated.

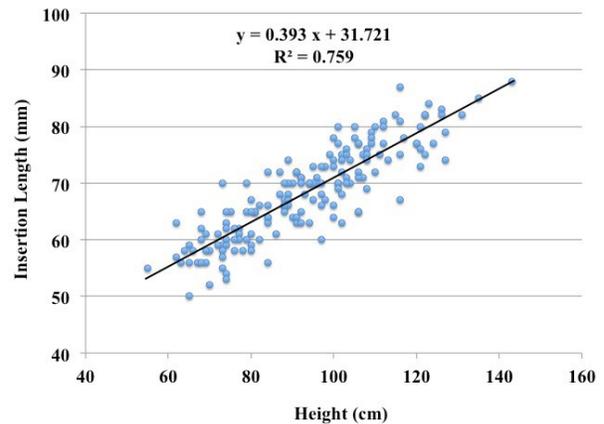
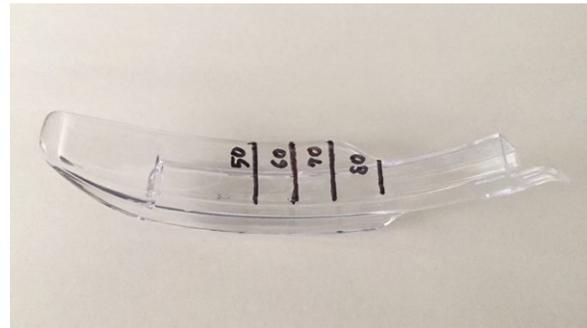
RESULTS: The clinical characteristics of the patients are shown in Table 1. The McGrath® videolaryngoscope could be used to achieve a good field of view of grade 1 or 2 for all subjects and tracheal intubation was possible with 1 or 2 actions for all subjects. Blade insertion length exhibited the strongest correlation with subject height, with a regression line of Length (mm) = 0.393*Height (cm) + 31.7 (r = 0.87) (figure 1). Opening diameter exhibited hardly any diameter according to age, body weight or height.

DISCUSSION: When the McGrath® videolaryngoscope is not inserted intraorally under direct vision like a conventional laryngoscope, it tends to be operated blindly until the glottis is visually confirmed. If a blade with markings from the tip could be practically applied, the risk of intraoral and pharyngeal injury could be reduced and tracheal intubation time could be reduced (Figure 2).

CONCLUSION: MG blade insertion length for pediatric patients can be estimated with Length (mm) = 0.4*Height (cm) + 32.

REFERENCES:

1. Br J Anaesth. 2011;107:769-73.
2. Anesthesiology. 2008; 108:1004-8.

**Table 1****Figure 2.**

S-6.

BIOMECHANICAL POSTURE ANALYSIS IN TRACHEAL INTUBATION PERFORMED BY NOVICE AND EXPERT ANESTHESIOLOGISTS

AUTHORS: T. Kamiya¹, Y. Kasuya¹, M. Nagai¹, H. Ishii², M. Zecca³, A. Takanishi⁴, M. Ozaki¹

AFFILIATION: ¹Anesthesiology, Tokyo Women's Medical University, Tokyo, Japan, ²Research Institute for Science and Engineering, Waseda University, Tokyo, Japan, ³School of Electronic, Electrical and Systems Engineering, Loughborough University, Loughborough, United Kingdom, ⁴Faculty of Science and Engineering, Waseda University, Tokyo, Japan

INTRODUCTION AND GENERAL PURPOSE OF THE STUDY: Tracheal intubation is the first basic skill to be acquired for anesthesia residents. However objective evaluation methods of airway management performance have not been established. Empirically saying, we have been aware of uncertain tendency that novices are performing tracheal intubation with unsophisticated posture. The purpose of this study was to analyze the precise posture difference during the tracheal intubation between novice anesthesia resident and experienced anesthesiologists.

METHODS: Tracheal intubation onto the standard mannequin was conducted using Macintosh type laryngoscope with standard I.D. 7.0 mm tracheal tube, and was recorded by a video camera for measuring the posture. With more than 3 year experience and more than 300 times of tracheal intubation experiences anesthesiologist were defined as an "Expert". With less than 3 months experienced residents were defined as "Novice". Each subject repeated tracheal intubation procedure 6 times. From the visual analysis of the video recordings, procedure was divided into three phases of interest: Phase 1, opening mouth and inserting a laryngoscope into mouth; Phase 2, raising tongue and epiglottis with laryngoscope; Phase 3, inserting a tube. Data on the posture were extracted from the video camera and analyzed. The posture was modeled by a closed quadrangle. The θ_1 to θ_4 parameters and the Plumber, Pcervical spine, Peye and Pvocal cord positions for posture evaluation were defined in Figure1. Group means of each θ_1 to θ_4 were compared for significance using one-way ANOVA. Standard deviations of each parameter among 6 repeated trials were also calculated.

RESULTS AND MAJOR FINDINGS: Six novice residents and 5 experienced anesthesiologists were studied. The averaged θ_3 value of the experts (113.7 degree) was significantly smaller than that of the novices (139.4 degree), and showed that while the direction of the line of sight (Peye - Pvocal cord) for experts was perpendicular to their face plane, that for novices was not so, as shown in Figure 2. The averaged θ_1 , θ_2 and θ_4 did not show large difference between experts and novices. The standard deviation of θ_1 for novices (24.5 degree) was much bigger than that for experts (3.8 degree).

The novices tended to take a view of the vocal cord with only their eyes turned up, while the experts take a view in front. The differences of angles of line of sight to face plane between experts and novices are considered to be caused by the difference in gazing steadily at the vocal cords. And the upper body of the novices tends to bend forward or backward while Phase 2 and Phase 3, while the upper body of the experts remains upright (Figure 3). The differences in postural dispersion between experts and novices are considered to be caused by the assurance of imaged position from which they should find vocal cord.

CONCLUSION: The angle of sight line to face plane and the angle of the upper body showed great differences just before insertion of the tube between novices and experts.

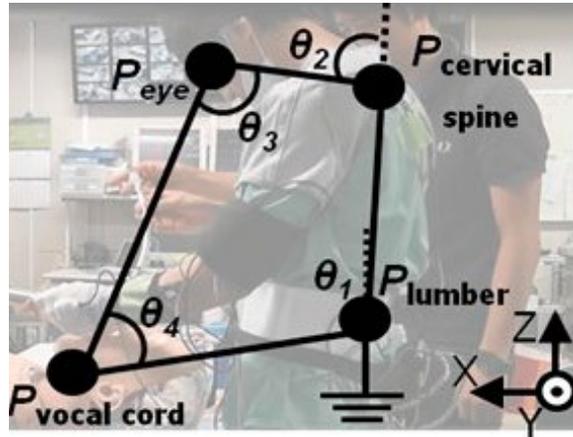


Figure 1

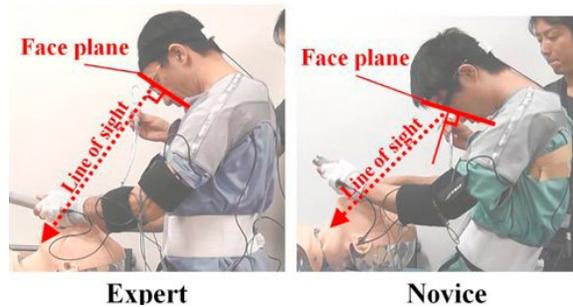


Figure 2

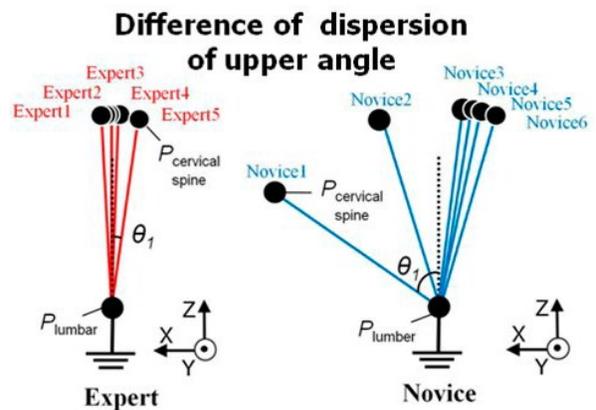


Figure 3

S-7.

OUTCOME OF ONE LUNG VENTILATION DURING MINIMALLY INVASIVE ESOPHAGECTOMY

AUTHORS: P. Rahman

AFFILIATION: Anesthesiology, UC San Diego, San Diego, CA

INTRODUCTION: Overall morbidity after esophagectomy remains high¹. Currently , minimally invasive esophagectomy (MIE) is being favored for surgical management of esophageal cancer^{2,3}. However , there are concerns of adverse outcome after prolonged one lung ventilation (OLV) during MIE .

METHODS: 35 patients who had MIE were included during 2007-11 . Lung isolation with OLV performed in 28 (80%) patients , 7 (20%) patients had laparoscopic transhiatal esophagectomy , did not require OLV.

RESULT: Of the 35 patients , none suffered in hospital mortality . Leucocytosis and fever was noted in 7 (20%) patient , 2 (6%) patient found to have pneumonia , 3 (9%) patient had respiratory failure requiring prolonged mechanical ventilation . Cardiac arrhythmia was common 8 (23%) after 24 hours , most common arrhythmia being atrial fibrillation. 4 (11%) patient had demonstrated graft leakage .

DATA ANALYSIS: Prior history of chemotherapy and or radiation were found to have increased odd of development of postoperative leukocytosis and fever , Pre existing cardiac disease was strong indicator of post operative cardiac arrhythmia . However, Length of anesthesia time , surgery time and one lung ventilation time did not increase odd of occurrence of fever and leukocytosis , cardiac arrhythmia and graft leakage.

DISCUSSION: There are concerns for higher complications among patients undergoing minimally invasive esophagectomy because of prolonged surgery and anesthesia time , resulting in prolonged OLV time . Risks of one lung ventilation has been described including physical consideration of lateral decubitus position ; other common problems include proper isolation of the lungs by utilizing a dual lumen endotracheal tube or bronchial blocker , and potential for dynamic pulmonary hyperinflation , and hypoxia^{4,5}.

Despite prolonged mechanical ventilation and OLV time during MIE, anesthesia technic including airway management with one lung ventilation was not associated with increased in morbidities in our study.

CONCLUSIONS: Duration of one lung ventilation was not associated with increased perioperative complications after minimally invasive esophagectomy .

REFERENCES:

1. Ng J. Update on anesthetic management for esophagectomy . Current Opinion in Anesthesiology 2011; 24:37-43
2. Nagpal K, Ahmed K, Vats A, et al. Is minimally invasive surgery beneficial in the management of esophageal cancer? A meta-analysis Surg Endosc 2010; 24:1621-1629.
3. Biere SS, Cuesta MA, van der Peet DL. Minimally invasive versus open esophagectomy for cancer: a systematic review and meta-analysis. Minerva Chir 2009; 64:121-133.
4. S Tandon, S V Baudouin : Perioperative risk factors for acute lung injury after elective esophagectomy Br J Anes 2001; 86: 633-38
5. McKeivith JM, Pennefather SH. Respiratory complications after oesophageal surgery. Curr Opin Anaesthesiol 2010; 23:34-40.

Table 1 Demographic Data

Number of patients (n)	35
Age	65.5 (±10.16)
Male (mean ±SD)	66.9 (±9.14)
Female(mean ±SD)	63.3(±11.3)
Sex (M: F)	2.5 :1
History	
Smoking	(21/35)60%
Pulmonary diseases	(9/35) 26%
Cardiovascular disease	(9/35) 26%
Diagnosis	
Adenocarcinoma	(28/35) 80%
Squamous cell carcinoma	(4/35) 11%
End stage Achalasia	(2/35) 6%
Other	(1/35) 3%
ASA Class	
ASA II	(9/35) 26%
ASA III	(25/35)71%
ASA IV	(1/35)3%
Prior treatment	
Chemoradiation	(12/35) 34%
Endoscopic procedure	(8/35) 23%

S-8.

OUT OF OPERATING ROOM AIRWAY MANAGEMENT (OORAM); THE DEPARTMENT OF VETERANS AFFAIRS (VA) PROGRAM OF TRAINING AND CREDENTIALING OF PROVIDERS

AUTHORS: T. M. Fuhrman, D. Jovanovic, J. Warren

AFFILIATION: Anesthesiology Service (123), Bay Pines VAHS, Bay Pines, FL

INTRODUCTION: The VA system has over 100 hospitals. In those hospitals, over 11,000 times a year, an emergency airway management event occurs outside of the operating room. Yet Anesthesia personnel (MDs or CRNAs) are in-hospital around the clock in < 30% of VA hospitals. December 2012 the VA issued a Directive mandated that Airway Management training for non-anesthesia providers be instituted by December 2103. This abstract describes the basics of this training and our experience since implementation of the Directive.

METHODS: All non-anesthesia Airway Providers (Critical Care, Emergency Room physicians and Respiratory Therapists) must take an online course with power point and video presentations. This course covers basic airway management, equipment and airway evaluation. Then the learners must take a 4 hr simulation session which addresses the online material; requires a demonstration of the ability to secure a definitive airway on manikins; and then includes patient scenarios necessitating utilization of that knowledge. Finally the providers must demonstrate airway management skills on patients in the OR.

Data on every OORAM event is recorded on an airway-template in the patient chart and all of the events have been tabulated as they occur. Information gathered includes: airway provider, reason for airway management need; intubation technique, pharmacologic agents used and number of intubation attempts.

RESULTS: Respiratory Therapists provide almost all of our Out of OR airway management with excellent results. Only one event required rescue by Anesthesia. Two other events required a second person to perform a intubation, in both cases a Respiratory Therapist successfully intubated after ER physicians could not.

Year	#Intub	Emergent	Elective	MD	RT	1st Pass%
2014	116	72/62%	44/37.9%	19/16.4%	97/83.6%	91%
2013	118	100/84.7%	18/15.7%	7/5.9%	111/94.1%	86.5%
2008-12	664	473/77%	141/23%	69/11%	545/89%	88%

Evenings and night intubations: 47.1% '08-'13 48.2% '14
OVERALL 47.2%

CONCLUSIONS: The VA has a new program to provide trained and credentialed airway management providers for Out-of OR airway events. In our hospital, it is a highly successful practice providing excellent patient care at a significant cost savings over continual In-House Anesthesia personnel.

This material is the result of work supported with resources and the use of facilities of the VA Healthcare System. The contents of this presentation do not represent the views of the Department of Veterans Affairs or the United States Government.

S-9.**CONNECTING MAPLESON F (JACKSON-REES) SYSTEM TO THE NASAL AIRWAY MAINTAINS ADEQUATE OXYGENATION FOR MORBIDLY OBESE PATIENTS DURING DEEP SEDATION****AUTHORS:** W. Chee**AFFILIATION:** Department of Anesthesiology, Montefiore Medical Center, Department of Anesthesiology, Manhasset, NY**INTRODUCTION:** Administration of deep sedation for morbidly obese patients is a great concern for anesthesiologists with maintaining adequate oxygenation.¹ On the other hand, a decision to intubate such the patients for relatively brief and non-invasive procedures may not be clearly beneficial in terms of a risk-benefit analysis.

Various methods have been described in improving oxygenation including the use of a nasal facemask with a semi-closed circuit or a nasal airway with a self-inflating (Ambu) bag.^{2,3} This paper describes application of the Mapleson F (Jackson-Rees) circuit connecting to the nasal airway to improve oxygenation, thus evading need for intubation during off-site anesthesia procedures.

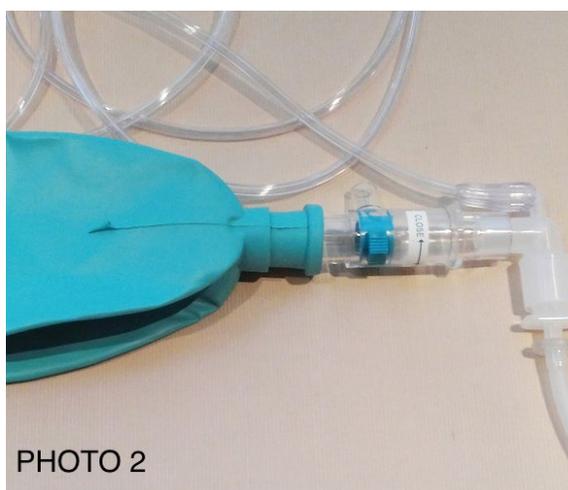
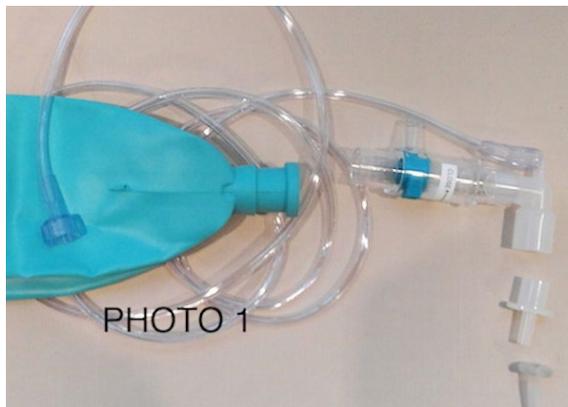
METHODS: A Maple F (Jackson-Rees) system was assembled using a 3 liter reservoir bag from the standard anesthesia circuit, a Jackson-Rees Modification piece (King Systems Ref 60740), a connecting adaptor (e.g., from an endotracheal tube) and a nasal airway. [Photo 1] The assembled set was prepared as a rescue device for patients with morbid obesity (BMI>40) with or without obstructive sleep apnea (OSA) scheduled for esophagogastroduodenoscopy (EGD) or transesophageal echocardiography (TEE). [Photo 2] Decrease in SpO₂ reading more than 3% or below 96% triggered for insertion of a nasal airway and attachment of the prepared Mapleson circuit.

RESULTS: Total 6 patients (4 for EGD, 2 for TEE) with the BMI over 40 were assisted with the Mapleson circuit attached to the nasal airway. All the STOP-Bang scores of the patients were greater than 3. 3 of the 6 patients used a CPAP machine at home. After application of the device all recovered from the initially decreased oxygen saturation reading to 100% within 20 seconds and maintained it throughout the procedure. No adverse events occurred including nose bleeding, laryngospasm, aspiration, intubation or early termination of the procedure.

DISCUSSIONS/CONCLUSIONS: For morbidly obese patients various methods have been described in oxygenation without intubation. For example, a pediatric facemask with a regular anesthesia circuit was used as a CPAP machine; an Ambu-bag was used to deliver oxygen through the nasal airway. The Mapleson F (Jackson-Rees) system provides higher oxygen concentration while a nasal airway helps bypassing the upper airway obstruction and channels the higher oxygen flow toward the tracheal inlet.^{1,4} Unlike an Ambu bag the movement of the reservoir bag can facilitate visual monitoring of the gas exchange without holding the device. By occluding the contralateral nostril and adjusting the venting window, CPAP can be generated. In conclusion, use of Mapleson F (Jackson-Rees) system for the nasal airway can be easily prepared and effectively improve oxygenation in morbidly obese patients undergoing off-site procedures.

REFERENCES:

1. J Anaesthesiol ClinPharmacol 2014;30:71-7
2. Anesth 2008;108:998-1003
3. Scientific Educational Exhibit. ASA 2014 Annual Meeting.
4. Basics of Anesthesia (6th Ed.); 204-206, Elsevier. Philadelphia



S-10.**PRE-WARMING OF THE I-GEL® FACILITATES SUCCESSFUL INSERTION AND VENTILATION EFFICACY WITH MUSCLE RELAXATION: A CLINICAL RANDOMIZED STUDY****AUTHORS:** N. Komasa, I. Nishihara, S. Tatsumi, T. Minami**AFFILIATION:** Anesthesiology, Osaka Medical College, Takatsuki, Japan**INTRODUCTION:** We hypothesized that the i-gel® cuff may mold to the laryngeal structure faster if pre-warmed. We performed this study to investigate this hypothesis by comparing the airway-sealing pressure and leakage volume amount between i-gel® devices pre-warmed to 42°C and those kept at room temperature (approximately 23°C).**METHODS:** After obtaining written informed consent and, IRB approval, patients aged 20 to 85 years who were to have general anesthesia were assigned at random by using an envelope method to one of two groups: 42°C pre-warmed group (W group; 34 patients) and control group (C group; 34 patients). Without any premedication, anesthesia was induced with propofol and remifentanyl. Rocuronium was administered as a muscle relaxant. The i-gel® was warmed to 42°C in a heating cabinet with an automatic temperature control for 30 min before insertion in the W group, while it was stored at room temperature (approximately 23°C) for the C group. Successful insertion was confirmed by normal capnograph curves, and a sealing pressure of >15 cm H₂O.Patients were ventilated with a tidal volume of 8 ml/ kg at 8 breaths per minute until 30 min after the initiation of mechanical ventilation. The χ^2 test was applied for the number of insertion attempts. Two-way repeated measures analysis of variance was used to compare sealing pressure and leak volume 30 s and 30 min after insertion. Data are presented as mean \pm SD and 95% confidence interval. A P-value of <0.05 was considered statistically significant.**RESULTS:** The number of insertion attempts was one for 31 cases and two for three cases in the W group and one for 24 cases and two for 10 cases in the C group. All insertions were successful through the second insertion. The number of successful ventilations in the first trial was significantly higher in the W group (31 cases) than the C group (24 cases) (P = 0.001). After successful insertion, the sealing pressure was significantly higher in the W group than the C group (P = 0.001).

In both groups, the leak volume was significantly smaller after 30 min of mechanical ventilation than after 30 s (P < 0.001). Furthermore, the leak volume was significantly smaller after 30 s in the W group than the C group (P = 0.002), but not after 30 min (P = 0.69).

DISCUSSION: The sealing pressure was significantly higher, and the leak volume was significantly smaller with warming the i-gel® to 42°C. Furthermore, the leak volume was significantly smaller in the W group 30 s after mechanical ventilation, whereas the difference between the W and C groups disappeared after 30 min. Though the difference of sealing pressure and leakage volume may not be clinically significant, we believe that the higher insertion success rate is a benefit to pre-warming of the i-gel. These data suggest that pre-warming the i-gel® to 42°C would enable the cuff to fit the pharyngeal structure effectively.

In conclusion, an i-gel® pre-warmed to 42°C provided a higher successful insertion rate and sealing pressure and a smaller leak volume upon mechanical ventilation, as compared with an i-gel® kept at room temperature. With the i-gel®, pre-warming to 42°C may be beneficial for definite airway management.

S-11.

FEASIBILITY OF AWAKE NASOPHARYNGEAL ENDOSCOPY FOR AIRWAY ASSESSMENTS IN THE PREOPERATIVE ANAESTHETIC CLINIC

AUTHORS: H. R. Abdullah¹, N. Goldenberg², C. Deb³, D. T. Wong³

AFFILIATION: ¹Anesthesiology, Singapore General Hospital, Singapore, Singapore, ²Anesthesiology, University of Toronto, Toronto, ON, Canada, ³Anesthesiology, Toronto Western Hospital, Toronto, ON, Canada

INTRODUCTION: Airway assessment is an integral part of preoperative evaluation as complications in airway management is one of the most devastating in medicine. However, prediction of difficult laryngoscopy from individual components of bedside airway examination remains poor in its specificity and sensitivity¹. Traditional airway examination may not reveal abnormalities at the base of tongue, epiglottis, glottis aperture, or the larynx. It may not divulge enough information to predict the difficulty of performing a flexible bronchoscope guided intubation, a common primary or back-up technique for managing difficult airway. The utility of preoperative flexible endoscopic airway examination in patients undergoing head and neck surgery has been studied and noted to provide more information and was able to influence a change in the patient’s airway management plan^{2,3}. This procedure however, requires expertise, time and careful logistics planning if it were to be incorporated into the workflow of a busy clinic. We aim to study the feasibility of performing nasopharyngeal endoscopy (NPE) in the preoperative clinic for cases of suspected difficult airway.

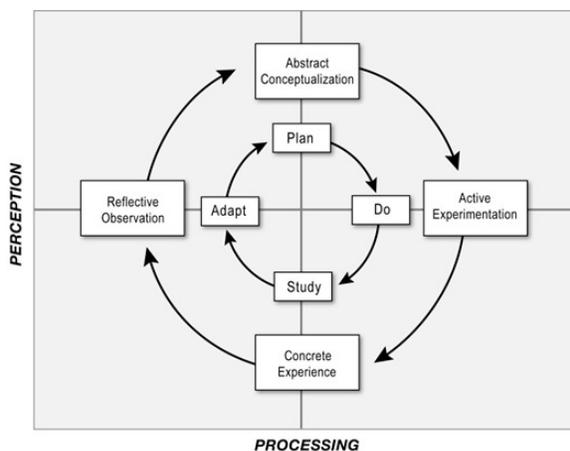
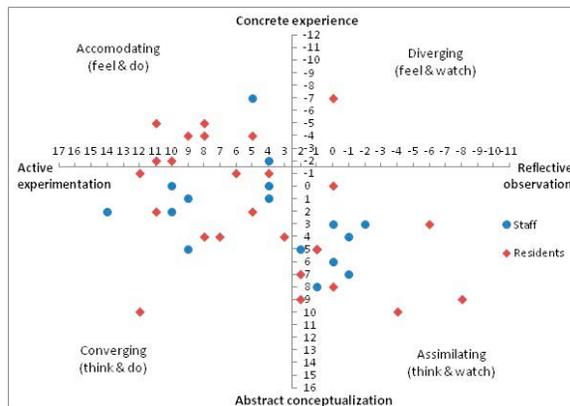
METHODS: On approval of the Research Ethics Board, 12 patients from the preoperative clinic with risks for difficult airway were selected to undergo awake nasopharyngeal endoscopy to assess the airway. Time taken and ease of the endoscopy was recorded and the following findings were sought: (1) a single-plane optical path to the laryngeal inlet, (2) a mass or other anatomic distortion that might prevent correct seating of a supraglottic airway (SGA) device, and (3) an anterior airway lesion that could be traumatized by direct or video laryngoscopy². Preparation and completion time were recorded as well. Patients were asked to rate their perception of the time taken and their level of comfort throughout the procedure while the endoscopists were asked to rate their perceived ease of the procedure and its utility.

RESULTS: Mean duration for the preparation of the endoscope was 194.5 (SD 26.8) seconds and for the procedure itself was 120 (SD 51.4) seconds. 58.3% of patients reported that it was faster than expected while the other 41.7% reported it was just as expected. 16.7% rated “no discomfort” during the procedure, 75 % reported that the examination was “tolerable” and 8.3% rated the procedure as “uncomfortable”. The ease of incorporating NPE into the preoperative clinic workflow was perceived as “easy” 50% of the time and “manageable” the other 50% of the time by the endoscopists. No complications were observed.

CONCLUSIONS: We conclude that performing an awake NPE in the preoperative clinic setting is feasible. Further research should be encouraged to explore the full clinical utility of the procedure in predicting difficult airway and difficult flexible endoscopy. Whilst its usefulness has been demonstrated among the head and neck surgery patients², we suspect its application may be extended to other population as well.

REFERENCES:

1. Anesthesiology 2005; 103(2):429-37
2. Anesth Analg 2011; 112(3):602-7
3. Anesth Analg 2011;112(3):519-520



S-12.**INTRAOPERATIVE APPLICATION OF THE STANDARD QUANTITATIVE ENDOTRACHEAL TUBE CUFF LEAK TEST FOR PRONE MECHANICALLY VENTILATED PATIENTS**

AUTHORS: S. Krelinger¹, L. M. Adiutori², D. Ekundayo³, G. Edelman³

AFFILIATION: ¹Anesthesiology, University of Illinois, Chicago, IL, ²Anesthesiology, University of Illinois at Chicago, Chicago, IL, ³Anesthesiology, University of Illinois at Chicago, Chicago, IL

INTRODUCTION: Postoperative airway edema and need for reintubation are potential complications following extensive prone spine surgery. Currently no standard methodology exists to assess postoperative airway compromise in this patient subset. Common postoperative tests include physical examination and a qualitative endotracheal tube occlusion leak test. Additionally, a quantitative endotracheal cuff leak test can be employed which has been validated in patients in the intensive care unit for risk stratification for respiratory compromise after extubation¹. It is known that a leak of greater than 15% is predictive of successful extubation in the ICU². Studies have not been performed using this methodology in the operating room. This study investigates using a quantitative postoperative endotracheal cuff leak test to predict postoperative airway obstruction more accurately and, therefore, to determine the safety of patient extubation following prone spine surgery.

METHODS: Twenty-eight adult patients scheduled for elective spine surgery in the prone position were enrolled in this pilot study. A quantitative endotracheal tube cuff leak test^{1,2} was performed twice during the surgery. The first test followed induction and intubation prior to prone positioning; the second test was performed at the conclusion of surgery following return to the supine position. Percentage cuff leak was defined as: $100 \times (\text{TV}(\text{cuff inflated}) - \text{TV}(\text{cuff deflated})) / \text{TV}(\text{cuff inflated})$. Data gathered post-operatively included airway edema, respiratory distress, incidence of postoperative re-intubation, and timing of extubation for those who remained intubated following surgery. The incidence and extent of postoperative airway obstruction as indicated by the quantitative leak test was determined, and multivariate logistic regression modeling used to identify potential contributing risk factors. A negative cuff leak test was defined as a leak of < 15% of tidal volume.

RESULTS: The overall incidence of a negative cuff leak test was 43%. No patients in this study required reintubation. Significant risk factors for a negative cuff leak test included: age, female gender, duration of anesthesia, duration of surgery, ETT size, total fluids and positive fluid balance.

CONCLUSIONS: Following prone spine surgery, a large portion of patients have a non-reassuring postoperative endotracheal tube cuff leak test. We observed that none of our patients with a negative cuff leak required reintubation. Risk factors for a negative leak test have been identified. This study was underpowered to conclude that the quantitative leak test is of minimal value in this setting; however, further study is currently underway.

REFERENCES:

1. Chung, YH, Chao, TY, CHIU, CT, Lin, MC: The cuff-leak test is a simple tool to verify severe laryngeal edema in patients undergoing long-term mechanical ventilation. *Critical Care Medicine* 2006; 34(2):409-414
2. De Bast, Y, De Backer, D, Moraine, JJ, Lemaire, M, Vandenberght, C, Vincent, JL: The cuff leak test to predict failure of tracheal extubation for laryngeal edema. *Intensive Care Medicine* 2002; 28:1267-1272

S-13.**RANDOMIZED CONTROLLED TRIAL COMPARING THE MCGRATH MAC VIDEO LARYNGOSCOPE WITH KING VISION VIDEO LARYNGOSCOPE IN ADULT PATIENTS**

AUTHORS: B. D. Alvis¹, D. Hester², M. Higgins², P. St. Jacques²

AFFILIATION: ¹Anesthesiology Critical Care Medicine, Vanderbilt Medical Center, Nashville, TN, ²Anesthesiology, Vanderbilt Medical Center, Nashville, TN

INTRODUCTION: The past two decades have seen the advent of many new airway management devices.^{1,2} Due to the rapidity of device development and the brief time of their clinical availability, little efficacy and comparative testing has been performed on these devices. In this study we compare the performance of the McGrath MAC and King Vision laryngoscope systems for endotracheal intubation in adult patients with predicted normal airways when used by beginning users. Our hypothesis was that, the McGrath MAC device would require fewer intubation attempts and shorter intubation times than the King Vision when performed by novice users.

METHODS: The study is a randomized controlled trial in a general adult operating suite at an academic medical center. We enrolled sixty-six adult surgical patients with predicted easy intubation. The patients were randomized to undergo endotracheal intubation with either the McGrath MAC video laryngoscope or the King Vision video laryngoscope using the channeled blade attachment. The primary outcomes were success on first attempt and time of intubation. The laryngoscopic view, lowest observed oxygen saturation, number of attempts, assist maneuvers, and documented airway trauma events were also recorded.

RESULTS: The median time for successful intubation was significantly shorter in the McGrath MAC group compared to the King Vision group (17 vs. 38 seconds; $p < 0.001$). There was a higher first attempt success rate (intubation in less than 90 seconds) in the McGrath MAC group compared to the King Vision group (100% vs. 89%, $P < 0.01$). Also, more patients in the King Vision group had an oxygen desaturation below 90% compared to the McGrath MAC group (3 vs 0; $p < 0.034$). There were no significant differences between groups in the quality of laryngoscopic view, number of attempts, requirement for assist maneuvers, or airway trauma.

CONCLUSIONS: The McGrath MAC video laryngoscope allowed for significantly shorter times to endotracheal intubation, higher success rates on first attempt, and fewer desaturations compared to the King Vision video laryngoscope when used by beginning users.

REFERENCES:

1. Video-laryngoscopes in the adult airway management: a topical review of the literature. *Acta Anaesthesiol Scand* 2010;54:1050-61.
2. Randomized controlled trial of the A.P. Advance, McGrath, and Macintosh laryngoscopes in normal and difficult intubation scenarios: a manikin study. *Br J Anaesth* 2011;107:983-8.

S-14.**REVIEW OF AIRWAY DATA AND MANAGEMENT IN A TERTIARY CARE CENTER: IS THERE A NEED FOR SURGICAL AIRWAY TRAINING?**

AUTHORS: B. O'Hara¹, S. Walls¹, A. Banerjee¹, M. D. McEvoy², L. C. Fowler²

AFFILIATION: ¹Anesthesiology, Vanderbilt University Medical Center, Nashville, TN, ²Anesthesiology, Vanderbilt University Medical Center, Nashville, TN

INTRODUCTION: Increasing obesity in the population, critically ill patients and remote sedation has lead to increasing number of emergency situations requiring difficult airway management. There is no established required surgical airway training amongst anesthesiology residents. This retrospective analysis establishes the incidence of difficult airways in a large academic medical center and equipment used. Current anesthesia faculty and residents were also surveyed to evaluate the need for future airway training in an anesthesia residency program. Studies show that residents with cadaver-based airway instruction show increased confidence in performing a cricothyrotomy by 70% (Hatton, 2006). European studies show less than 50% of included providers adhere to difficult airway standards of obtaining surgical airway access (Green, 2009). Such skills can encourage the use of life saving airway management techniques through increased teaching and hands-on training.

METHODS: IRB approval was obtained for access of over 6,000 airway records from a collaborative perioperative database over a 5-year period. A survey was conducted with 88 anesthesia attendings and faculty responses regarding surgical airway management and previous training.

RESULTS: Of the 6,286 airway records obtained, 4,277 airway procedure notes were complete. The total rate of labeled difficult airway was 11%. There were 5 failed airways with patient deaths. Anesthesia personnel responded to 54% of airways. The anesthesia service labeled only 3 % of airways as difficult, a lower percent than emergency medicine, surgical and medicine services who responded to the airway emergencies. The rate of portable video laryngoscope (VL) usage was 4.6% compared to direct laryngoscope usage at 6.8% in difficult airways. 24% of difficult airways requiring multiple attempts were successful after changing to a VL. Of attending and resident anesthesia physicians surveyed, 32% percent were comfortable performing emergency airway interventions.

CONCLUSIONS: Anesthesia providers respond to a majority of difficult emergency airways. Portable VL usage should be included in emergency airway equipment supplies, consistent with recent practice guidelines survey data (Apfelbaum, 2013). Future studies evaluating the usefulness of an advanced airway curriculum, including surgical training and simulation, are needed to improve competency of anesthesia providers.

REFERENCES:

Apfelbaum, J. e. (2013). Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology* , 251-270.

Green, L. (2009). Can't intubate, can't ventilate! A survey of knowledge and skills in a large teaching hospital. . *European Journal of Anesthesiology* , 480-3.

Hatton, K. e. (2006). Educating anesthesiology residents to perform percutaneous cricothyrotomy, retrograde intubation, and fiberoptic bronchoscopy using preserved cadavers. *Anesthesia and Analgesia*, 1205-8.

S-15.**PRELIMINARY RESULTS OF A RANDOMIZED CONTROLLED PILOT TRIAL ASSESSING THE EFFECT OF CRICOID PRESSURE ON THE RISK OF ASPIRATION**AUTHORS: J. K. Bohman¹, R. Kashyap¹, Z. He², D. J. Kor¹AFFILIATION: Anesthesiology, Mayo Clinic, Rochester, MN,
²Gastroenterology, AI duPont Hospital for Children, Wilmington, DE

INTRODUCTION: Gastric-to-pulmonary microaspiration (aspiration without grossly visible gastric material) has been associated with significant morbidity including acute respiratory distress syndrome (ARDS) and hospital acquired pneumonia (HAP).¹⁻⁵ One proposed technique to prevent aspiration is cricoid pressure. Recently, there has been growing evidence which questions the effectiveness of cricoid pressure.^{6,7} Currently, cricoid pressure for patients with risk factors for microaspiration (obesity, GERD and diabetes) is used variably.⁸ Airway pepsin A has been shown to be a very specific biochemical marker for gastric-to-pulmonary aspiration.⁹ By randomizing patients at risk for microaspiration (but not macroaspiration) to cricoid pressure versus no cricoid pressure and measuring airway pepsin A immediately after elective intubation, we sought to provide a very sensitive and specific assessment of the effectiveness of cricoid pressure to prevent aspiration during elective induction of anesthesia and intubation.

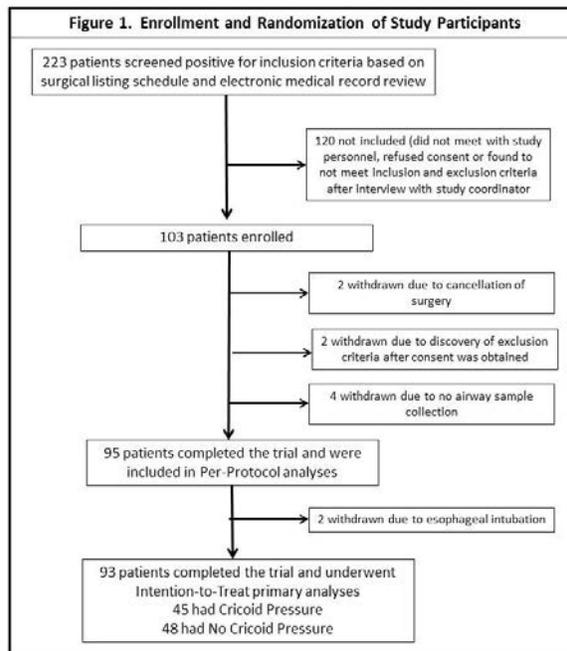
METHODS: A randomized controlled pilot trial was completed. Surgical listings were screened to identify patients at risk for microaspiration and satisfied all inclusion and exclusion criteria (Table 1). Prior to enrollment, educational materials outlining current cricoid pressure recommendations were distributed to all involved anesthesia providers.

To ensure patient safety, anesthesia providers were explicitly instructed to adjust or remove cricoid pressure if they believed its application was putting their patient at risk. Immediately following intubation a sterile suction catheter was passed down the ET tube to suction secretions in the lower airways and tested for the presence of Pepsin A.

RESULTS: Between August 5, 2014 and October 3, 2014, 95 patients completed the trial procedures (Figure 1). There were 7 of 95 patients (7.4%) who deviated from protocol and crossed over to the other treatment arm (all crossed over from the cricoid arm to the no cricoid arm). To date, pepsin A results are available for 76 of the patients (17 sample results for pepsin A are currently pending). The results of pepsin A measurement and the incidence of HAP, ARDS, difficult mask ventilation and difficult direct laryngoscopy are presented in Table 2.

There was only 1 case of HAP and 1 case of ARDS within 7 days of the index intubation. The case of HAP occurred in the no cricoid arm and the case of ARDS occurred in the cricoid arm. The patient who developed HAP had a lower airway sample which was positive for pepsin A. The patient who developed ARDS had a lower airway sample which was negative for pepsin A.

CONCLUSIONS: Over a 60 day period, our group completed the screening and enrollment phase of this randomized trial for a total of 95 patients. No clear evidence of increased harm (increased risk of gastric-to-pulmonary aspiration, difficult mask ventilation, difficult direct laryngoscopy, development of HAP or ARDS) was detected in either arm of the trial. These findings suggest that a larger, multicenter trial cricoid pressure for elective intubation of patients with risk factors for microaspiration would be feasible.

**REFERENCES:**

1. Pepe PE, Potkin RT, Reus DH, Hudson L D, Carrico CJ: Clinical predictors of the adult respiratory distress syndrome. *American journal of surgery* 1982;144:124-30
2. Bice T, Li G, Malinchoc M, Lee AS, Gajic O. :Incidence and risk factors of recurrent acute lung injury. *Critical care medicine* 2011;39:1069-73
3. Safdar N, Crnich CJ, Maki DG: The pathogenesis of ventilator-associated pneumonia: its relevance to developing effective strategies for prevention. *Respiratory care* 2005;SO:725-39; discussion 739-41
4. Harding SM: Gastroesophageal reflux, asthma, and mechanisms of interaction. *The American journal of medicine* 2001;111(Suppl 8A):8S-12S
5. Bonacin D, Fabijanic D, Radic M, Puljiz Z, Trgo G, Bratanic A, Hozo I, Tocilj J: Gastroesophageal reflux disease and pulmonary function: a potential role of the dead space extension. *Medical science monitor: international medical journal of experimental and clinical research* 2012;18:CR271-5
6. Smith KJ, Ladak S, Choi PT, Dobranowski J: The cricoid cartilage and the esophagus are not aligned in close to half of adult patients. *Canadian journal of Anaesthesia = Journal Canadien d'anesthesie* 2002; 49:503-7
7. Smith KJ, Dobranowski J, Yip G, Dauphin A, Choi PT: Cricoid pressure displaces the esophagus: an observational study using magnetic resonance imaging. *Anesthesiology* 2003;99:60-4
8. Ehrenfeld JM, Cassidy EA, Forbes VE, Meraldo NO, Sandberg WS: Modified rapid sequence induction and intubation: a survey of United States current practice. *Anesthesia and Analgesia* 2012;115:95-101
9. Moriyama A, Kageyama T, Takahashi K: Identification of monkey lung procathepsin 0-11 as a pepsinogen-C-like acid protease zymogen. *European journal of biochemistry/FEBS* 1983;132:687-92

S-15 • continued

Table 1. Patient Selection Criteria	
Inclusion Criteria	Exclusion Criteria
Age at least 18 years	Emergency surgery
Obesity (BMI>30), diabetes mellitus or GERD	Known or suspected difficult airway
Planned general endotracheal intubation	Any risk factor for <u>macroaspiration</u> : -esophageal stricture, hiatal hernia, achalasia, non-fasting status, esophageal diverticulum, small bowel obstruction, decreased level of consciousness, gravid status
	Refusal of provider or patient to participate

Table 2. Outcomes				
	All patients	Cricoid	No Cricoid	p-value
Intention-to-Treat Analysis				
Pepsin A present, n (%; 95%CI)	11 (14.5; 8.3-24.1)	5 (13.9; 6.1-28.7)	6 (15.0; 7.1-29.1)	0.891
HAP, n (%; 95%CI)	1 (1.1; 0.2-5.9)	0 (0.0)	1 (2.2; 0.4-11.8)	
ARDS, n (%; 95%CI)	1 (1.1; 0.2-5.9)	1 (2.2; 0.4-11.8)	0 (0.0)	
Per-Protocol Analysis				
Pepsin A present, n (%; 95%CI)	11 (14.5; 8.3-24.1)	4 (12.9; 5.1-28.9)	7 (15.6; 7.7-28.8)	0.745
Difficult mask, n (%; 95%CI)	35 (36.8; 27.8-46.9)	13 (33.3; 20.6-49.0)	22 (39.3; 27.6-52.4)	0.553
Difficult DL, n (%; 95%CI)	8 (9.6; 5.0-17.9)	4 (10.8; 4.3-24.7)	4 (8.7; 3.4-20.3)	0.746
*DL = direct laryngoscopy				

S-16.**A NEW AIRWAY MANAGEMENT IN
NEUROANESTHESIOLOGY: I-GEL LARYNGEAL MASK
AIRWAY COMBINED WITH TRACHEAL TUBE FOR
PATIENTS UNDERGOING POSTERIOR FOSSA SURGERY****AUTHORS:** C. Tang^{1,2}, F. Kang¹, X. Huang¹, J. Li¹**AFFILIATION:** ¹Anesthesiology, Southern District of Anhui Provincial Hospital, Hefei, China, ²Department of Anesthesiology, Li Ka Shing Faculty of Medicine, University of Hong Kong, Hong Kong, China**INTRODUCTION AND GENERAL PURPOSE OF THE STUDY:**

Systemic hemodynamic changes induced by extubation and emergence may increase the risk of postoperative intracranial hemorrhage and cerebral edema^{1,2}, especially for posterior fossa surgery patients. We compared the safety characteristics, systemic hemodynamic variables and cough incidence during the induction and emergence of posterior fossa surgery patients from general anesthesia either according to this new I-gel combined with endotracheal tube technique or those of a traditional endotracheal tube airway technique in a prospective randomized clinical trial.

METHODS: Sixty-six patients undergoing posterior fossa surgery were randomly allotted to receive either endotracheal tube (Group TT), or I-gel combined with endotracheal tube (Group TI). In Group TI, after anesthesia induction, we inserted I-gel then endotracheal tube through its air duct, and used the endotracheal tube to ventilate during intraoperative. After sutured the scalp, removed the endotracheal tube and maintained ventilation with I-gel. Heart rate (HR), mean arterial pressure (MAP), peak airway pressure (Ppeak), end-tidal carbon dioxide tension (ETCO₂), arterial oxygen partial pressure (PaO₂), arterial carbon dioxide partial pressure (PaCO₂), plasma β -endorphin (β -EP) and cortisol (Cor) concentrations, blood glucose level (BG), operation time, spontaneous breathing recovery time, modify observer's assessment of alertness/sedation (MOAA/S) score, and adverse events were recorded.

RESULTS AND MAJOR FINDINGS: No differences were found between groups at baseline. Group TI had lower MAP and HR during intubation and extubation, the highest mean intergroup difference of 12.73 mm Hg in MAP and 22.0 beats/min in HR ($P < 0.0001$). Vasoactive drugs were administered to more TT-group patients than TI-group patients (13 [43.3%] vs. 2 [6.7%] patients, respectively; $P = 0.000$). Ppeak, ETCO₂, PaO₂ and PaCO₂ were similar during intraoperative period; Group TI had better PaO₂ and PaCO₂ during emergence. Plasma β -EP and Cor concentrations and BG level were lower during intraoperative period than at baseline in both groups ($P < 0.0001$); they rose during emergence, and the Cor concentration even higher than at baseline (TT Group $P < 0.0001$; TI Group $P = 0.0008$). The percent increase tended to be higher in Group TT ($p < 0.05$). The stress reaction of extubation was greater than that of intubation, and also the strongest point during the whole process. Group TI had a lighter stress reaction during both induction and emergence ($p < 0.05$). Spontaneous breathing recovery time and eye opening time were not significant ($P = 0.084$ and $P = 0.426$). However, I-gel removal time was longer ($P = 0.000$), but the MOAA/S score was higher ($P = 0.032$). No serious bucking and hypertension were seen in Group TI.

CONCLUSIONS: I-gel combined with endotracheal tube can be used in patients undergoing posterior fossa surgery safely, a more favorable hemodynamic profile during intubation and emergence, and moreover, the patient recovered uneventfully.

REFERENCES:

1. Anesth Analg. 2002; 94:650-654.
2. Neurosurg Rev. 2011; 34: 393-407.3.

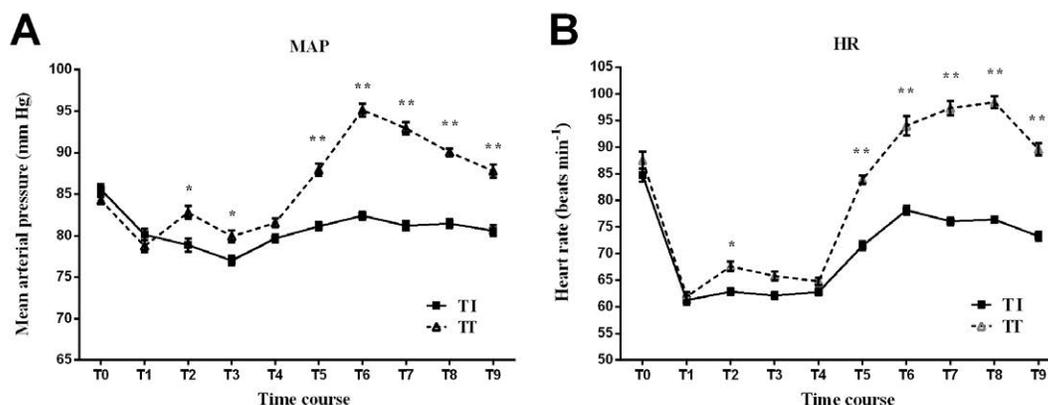


FIGURE 1. Changes in mean hemodynamic variables in patients with an endotracheal tube (TT) or an I-gel combined with endotracheal tube (TI) during the study; bars indicate the SEM. Both the groups had significant reduction in Mean arterial pressure (MAP) and heart rate (HR) from their respective baseline values till the end of the surgery. Patients in Group TI had a greater fall in comparison to Group TT over a period of time ($P < 0.0001$). During emergence from anesthesia, MAP and HR were significantly higher than at baseline in Group TT ($P < 0.0001$), and the intergroup differences were also significant ($*P < 0.05$; $**P < 0.0001$). Baseline (T0); before anesthetic induction (T1); endotracheal tube intubation (T2); 3min after intubation (T3); end of surgery, before awakening (TT group) or before endotracheal tube removed (TI group) (T4); after entered the PACU (T5); and throughout emergence from anesthesia at 1, 5, 15, and 30 minutes after extubation or I-gel removal (according to group assignment) (T6-9).

S-17.

NASO-TRACHEAL INTUBATION COULD BE PERFORMED FASTER USING THE MCGRATH™ MAC VIDEO LARYNGOSCOPE WITHOUT ANY COMPLICATIONS COMPARED TO THE MACINTOSH LARYNGOSCOPE

AUTHORS: J. Kawaguchi, K. Koshika, T. Ouchi, R. Serita, T. Koitabashi

AFFILIATION: Department of Anesthesiology, Tokyo Dental College Ichikawa General Hospital, Ichikawa, Chiba, Japan

Systemic hemodynamic changes induced by extubation and emergence may increase the risk of postoperative intracranial hemorrhage and cerebral edema^{1,2}, especially for posterior fossa surgery patients. We compared the safety characteristics, systemic hemodynamic variables and cough incidence during the induction and emergence of posterior fossa surgery patients from general anesthesia either according to this new I-gel combined with endotracheal tube technique or those of a traditional endotracheal tube airway technique in a prospective randomized clinical trial.

METHODS: Sixty-six patients undergoing posterior fossa surgery were randomly allotted to receive either endotracheal tube (Group TT), or I-gel combined with endotracheal tube (Group TI). In Group TI, after anesthesia induction, we inserted I-gel then endotracheal tube through its air duct, and used the endotracheal tube to ventilate during intraoperative. After sutured the scalp, removed the endotracheal tube and maintained ventilation with I-gel. Heart rate (HR), mean arterial pressure (MAP), peak airway pressure (Ppeak), end-tidal carbon dioxide tension (ETCO₂), arterial oxygen partial pressure (PaO₂), arterial carbon dioxide partial pressure (PaCO₂), plasma β-endorphin (β-EP) and cortisol (Cor) concentrations, blood glucose level (BG), operation time, spontaneous breathing recovery time, modify observer's assessment of alertness/sedation (MOAA/S) score, and adverse events were recorded.

RESULTS AND MAJOR FINDINGS: No differences were found between groups at baseline. Group TI had lower MAP and HR during intubation and extubation, the highest mean intergroup difference of 12.73 mm Hg in MAP and 22.0 beats/min in HR (P < 0.0001). Vasoactive drugs were administered to more TT-group patients than TI-group patients (13 [43.3%] vs. 2 [6.7%] patients, respectively; P =0.000). Ppeak, ETCO₂, PaO₂ and PaCO₂ were similar during intraoperative period; Group TI had better PaO₂ and PaCO₂ during emergence. Plasma β-EP and Cor concentrations and BG level were lower during intraoperative period than at baseline in both groups (P < 0.0001); they rose during emergence, and the Cor concentration even higher than at baseline (TT Group P < 0.0001; TI Group P = 0.0008). The percent increase tended to be higher in Group TT (p<0.05). The stress reaction of extubation was greater than that of intubation, and also the strongest point during the whole process. Group TI had a lighter stress reaction during both induction and emergence (p<0.05). Spontaneous breathing recovery time and eye opening time were not significant (P =0.084 and P =0.426). However, I-gel removal time was longer (P =0.000), but the MOAA/S score was higher (P =0.032). No serious bucking and hypertension were seen in Group TI.

CONCLUSIONS: I-gel combined with endotracheal tube can be used in patients undergoing posterior fossa surgery safely, a more favorable hemodynamic profile during intubation and emergence, and moreover, the patient recovered uneventfully.

REFERENCES:

1. Anesth Analg. 2002; 94:650-654.
2. Neurosurg Rev. 2011; 34: 393-407.3.

Table 1. Demographic characteristics of the patients

	Group McGrath (n = 12)	Group Macintosh (n = 12)	P-value
Age(yr/o)	44.2±12.3	44.8±13.3	0.14
Gender male/femel(n)	8/4	8/4	1.0
Body mass index (kg/m2)	22.8±3.0	23.3±3.6	0.37
Mallampati score 1/2(n)	10/2	10/2	1.0
Thyromental distance(cm)	8.5±1.4	7.8±1.4	0.12
Intercisor distance(cm)	4.9±0.8	5.2±0.6	0.15

Table 2. Intubation data

	Group McGrath (n = 12)	Group Macintosh (n = 12)	P-value
Anesthesia time(min)	102.0±25.6	111.1±26.8	0.19
Duration of laryngoscopy(sec)	17.0±7.2	12.8±4.3	0.01
Sore throat (3 hours later)+/- (n)	2/8	1/9	0.53
Sore throat (on the next day)+/- (n)	3/7	1/9	0.26
Hoarseness(3 hours later)+/- (n)	0/10	0/10	1.0
Hoarseness (on the next day)+/- (n)	0/10	0/10	1.0

S-18.**THE CHANGES OF RETROPHARYNGEAL SPACE AND RETROTRACHEAL SPACE IN PATIENTS UNDERGOING MULTILEVEL ANTERIOR CERVICAL SURGERY**

AUTHORS: C. Tsuji¹, Y. Terao¹, H. Ishizaki², T. Egashira¹, M. Fukusaki¹, T. HARA²;

AFFILIATION: ¹Anesthesiology, Nagasaki Rosai Hospital, Sasebo, Japan, ²Anesthesiology, Nagasaki University, Nagasaki, Japan

INTRODUCTION: Upper airway complications after multilevel anterior cervical spine surgery were potentially life threatening condition. The causes of postoperative airway swelling are tissue swelling of the pharynx in the most cases and hematoma in some cases^{1,2}. This study was conducted to clarify the postoperative time course of upper airway swelling after multilevel anterior cervical spine surgery.

METHODS: This study was approved by the Institutional Ethics Committee and conducted in the intensive care unit of Nagasaki Rosai Hospital from May 2012 to September 2014. We examined consecutive 28 patients who underwent multilevel anterior cervical fusion for degenerative diagnoses and traumatic injury, retrospectively. Informed consent was waived because study procedure was routine examination after multilevel anterior cervical spine surgery. The pathologies of the patients were 8 cervical disc hernias, 10 cervical myelopathies, 3 bone fractures, 1 cervical dislocation, 1 cervical tumor, 3 ossifications of posterior longitudinal ligaments, and 2 monomelic amyotrophies. The anterior procedure included 3 or 4 levels of cervical discectomy or corpectomy with bone graft fusion. Lateral views of radiograph of the cervical spine were taken preoperatively, immediately after surgery and on the first postoperative day (IPOD) and a few days after surgery (2,3POD). The distance of prevertebral soft tissue was measured at the third cervical (C3) vertebral level (retropharyngeal space) and the sixth cervical (C6) vertebral level (retrotracheal space) on the lateral view of radiograph of the cervical spine. Results were presented as median (interquartile range). Intragroup comparisons were made by Friedman test followed by Wilcoxon test. A p value < 0.05 was considered statistically significant.

RESULTS: Preoperative retropharyngeal space (C3) was [4.8mm (4.2, 5.9)] and retrotracheal space (C6) was [13.4mm (12.5, 14.7)]. The retropharyngeal space [9.8mm (8.3, 13.1)] and retrotracheal space [18.4mm (16.8, 20.6)] immediately after operation increased, compared with preoperative values. Moreover, the retropharyngeal space [14.1mm (8.9, 17.7)] at IPOD significantly increased, compared with preoperation and immediately after operation. But the retrotracheal space [19.1mm (14.7, 21.8)] at IPOD did not increase, compared with immediately after operation. There were no significant changes between IPOD and 2,3POD both retropharyngeal space and retrotracheal space. Two of the patients required reintubation during ICU stay. Four of the patients had clinical symptoms including dyspnea, nasal obstruction and dysphagia.

CONCLUSIONS: The retropharyngeal space after multilevel anterior cervical spine surgery enlarged at IPOD than that immediately after operation. Attention to upper airway swelling after multilevel anterior cervical spine surgery was needed during postoperative period as well as immediately after operation.

REFERENCES:

1. Spine.2014.; 39:134-9. 2. Int Orthop. 2006;30:290-4.

S-19.**COMPARISON OF THE STORZ C-MAC D BLADE AGAINST THE GLIDESCOPE, EFFICACY IN THE PREDICTED DIFFICULT AIRWAY: STAGE TRIAL: A MULTI-CENTERED RANDOMIZED CONTROLLED TRIAL**

AUTHORS: M. Aziz¹, R. Abrons², D. Cattano³, E. Bayman², M. Todd², A. M. Brambrink¹

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, OHSU, Portland, OR, ²Anesthesiology, University of Iowa, Iowa City, IA, ³Anesthesiology, University of Texas at Houston, Houston, TX

INTRODUCTION: Intubation success on first attempt in patients with predicted difficult airway is improved when using video assisted direct laryngoscopy (C-MAC, Karl Storz, Tuttlingen, Germany) compared to a conventional direct laryngoscopy.¹ Nowadays, two videolaryngoscopy systems are specifically recommended for perioperative management of the difficult airway: The GlideScope video laryngoscope (Verathon, Bothell, WA) and the C-MAC video laryngoscope with D-blade. However, it remains unknown whether the two systems indeed perform equally in a real-world environment.

METHODS: This is a multi-center, prospective, randomized, controlled trial involving experienced anesthesia providers in 3 large academic centers in the United States. The design was structured as a non-inferiority trial with a hypothesis that the C-MAC with D-blade performs non-inferiorly to the Glidescope. Assuming the first attempt success rate with Glidescope is 93%², C-MAC D-blade will be considered non-inferior to Glidescope if the first attempt success rate with C-MAC D-blade is 89% or better. Inclusion criteria included adult patients requiring oral intubation for elective surgery with at least one of the following predictors of difficult direct laryngoscopy: 1) Mallampati scale score 3 or 4, 2) Neck circumference >40cm in males or >38cm in females, and 3) Mouth opening less than 3cm. Success rates are reported with 90.35% asymptomatic confidence interval. The upper confidence bound of the difference on first attempt success rate should be <0.04 to achieve non-inferiority.

RESULTS: 1,100 patients were consented, enrolled, and randomized in the trial. The treatment groups were similar according to demographics and airway examination features. Based on the intention-to-treat analyses, the primary intubation success rate for the Glidescope group was 96.2% and for the C-MAC group was 93.43%. The 90.35% confidence interval of the difference on the first attempt success rates is 0.55% to 4.98%. Therefore, the study failed to reject the primary hypothesis that C-MAC D-blade is non-inferior to Glidescope based on the first attempt intubation success. The success rate for C-MAC upon multiple attempts was non-inferior to Glidescope (98.34% vs. 98.38%, 90.35% CI of the difference -0.0123-0.0132).

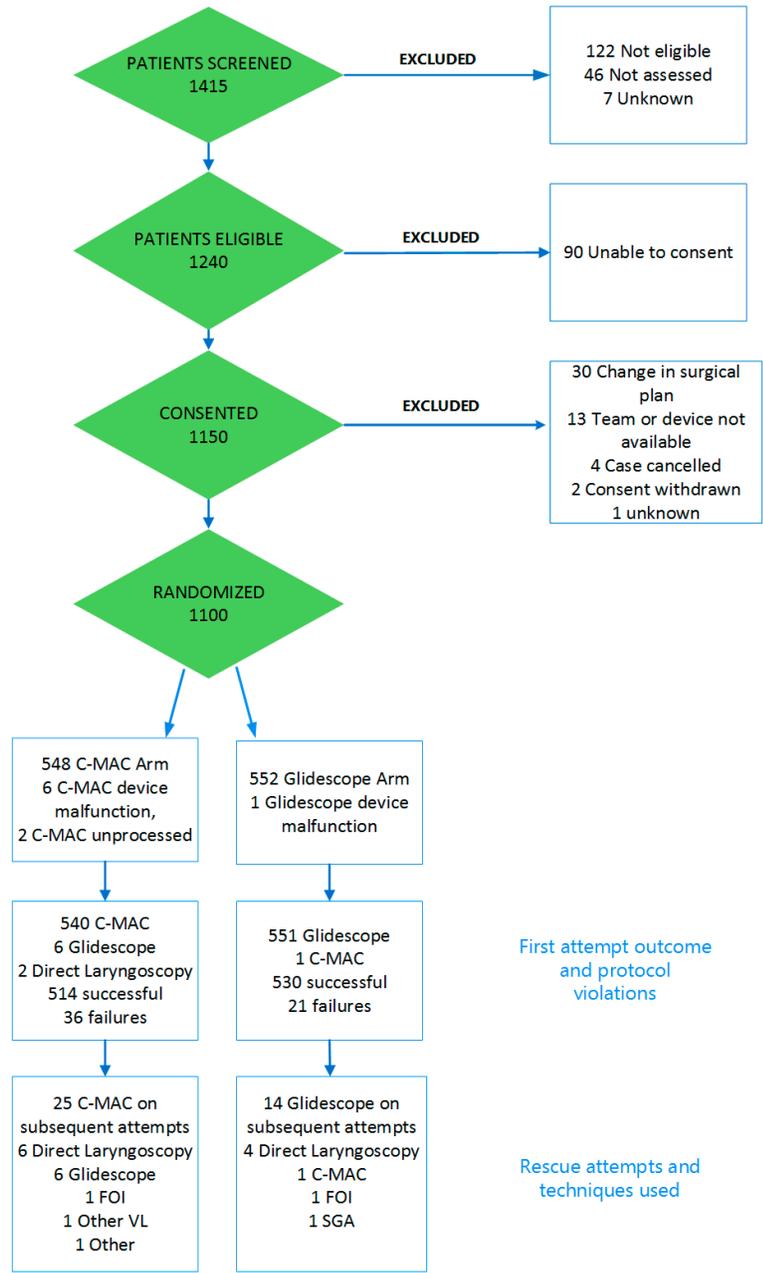
CONCLUSION: Although performance with these two video laryngoscope devices was similar, non-inferiority of the C-MAC against the Glidescope could not be demonstrated statistically amongst the study population for the primary outcome. However, when analyzing more than one laryngoscopy attempt, the C-MAC was non-inferior to the Glidescope.

REFERENCES:

1. Aziz MF, Dillman D, Fu R, Brambrink AM. Comparative effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. *Anesthesiology*. 2012;116(3):629-636.
2. Aziz MF, Healy D, Kheterpal S, Fu RF, Dillman D, Brambrink AM. Routine clinical practice effectiveness of the glidescope in difficult airway management: An analysis of 2,004 glidescope intubations, complications, and failures from two institutions. *Anesthesiology*. 2011;114(1):34-41.

S-19 • CONTINUED ON NEXT PAGE

S-19 • continued



S-20.

THE INCIDENCE AND RISK FACTORS OF DIFFICULT LARYNGEAL MASK VENTILATION IN A SOUTH-EAST ASIAN POPULATION

AUTHORS: T. Saito¹, W. Liu², S. Tsong-Huey Chew³, L. Ti⁴

AFFILIATION: ¹Anesthesia, Dokkyo Medical University Koshigaya Hospital, Koshigaya City, Japan, ²Anesthesia, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore, Singapore, ³Anesthesia, Department of Anesthesiology, Singapore General Hospital, Singapore, Singapore, Singapore, ⁴Anesthesia, Department of Anesthesia, National University Health System, Singapore, Singapore, Singapore

INTRODUCTION: Difficulty or failure in managing the airway remains the major factor underlying morbidity and mortality in anesthesia. Difficult airway practice guidelines have incorporated the use of the laryngeal mask airway (LMA) as part of the armamentarium to provide and maintain ventilation and oxygenation^{1,2}. The LMA is unique as it can be used for rescue ventilation and failed intubation. The incidence of difficult mask ventilation (DMV) is 5% of general anesthetics, whereas difficult laryngoscopy (DL) is 5.8%, and the combined incidence of DMV and DL is 0.4%³. However, there is a paucity of studies on the incidence and risk factors of difficult LMA ventilation. Therefore, we embarked on this clinical audit to ascertain the incidence and identify the risk factors of difficult LMA ventilation.

METHODS: With Institutional Review Board approval, we retrospectively reviewed 14 480 patients aged ≥18 years undergoing general anesthesia at a major tertiary hospital.

The primary outcome was difficult LMA ventilation, which was defined as the inability to provide adequate ventilation because of ≥1 of the following problems: inadequate LMA seal, excessive gas

leak, excessive resistance to the ingress or egress of gas. Signs of inadequate ventilation include absent/inadequate chest movement, absent/inadequate breath sound, auscultatory signs of severe obstruction, cyanosis, gastric air entry or dilation, decreasing/inadequate oxygen saturation, absent/inadequate exhaled carbon dioxide, absent/inadequate spirometric measures of exhaled gas flow. Failed LMA was defined as any acute airway event occurring between insertion of LMA and completion of surgical procedure that required LMA removal and rescue endotracheal tube placement.

After univariate analysis, variables found to be statistically significant (p-value <0.05) were included into the multivariate logistic regression model to identify the independent risk factors and estimate the odds of having a difficult LMA ventilation (Table 1).

RESULTS: 74 cases were identified as difficult LMA ventilation. 29 cases experienced a failed LMA. Multivariate analysis identified four adjusted risk factors of difficult LMA ventilation: age >45 years, male sex, short thyromental distance, and limited neck movement. Significant adverse respiratory events manifesting desaturation, hypercapnea, laryngospasm, and bronchospasm were seen in 17 cases (21.5%). Desaturation (SpO₂ <80%) and hypercapnea (EtCO₂ >50mmHg) were seen in 7.6% and

16.4% of difficult LMA cases respectively. In two of the cases, laryngospasm, that required intubation, occurred.

CONCLUSIONS: The incidence of difficult LMA ventilation was 0.5%. Four factors, namely age >45 years, male sex, short thyromental distance, and limited neck movement, were independent risk factors for difficult LMA ventilation.

REFERENCES:

1. Apfelbaum JL et al. Anesthesiology 2013; 118: 251-70.
2. Henderson JJ et al. Anesthesia 2004; 59: 675-94.
3. Kheterpal S et al. Anesthesiology 2013; 119:1360-9.

Table 1. Multivariate analysis of perioperative risk factors associated with difficult LMA ventilation

Perioperative variables	Odds Ratio	95% Confidence Interval	p-value
Age >45 years	1.708	1.017-2.868	0.043
Male sex	1.757	1.077-2.866	0.024
Short thyromental distance	4.354	2.318-8.179	<0.001
Limited neck movements	2.758	1.021-7.447	0.045

Subspecialty Abstracts

Ambulatory Anesthesia

S-21.

WITHDRAWN.

S-22.**INCIDENCES OF UNPLANNED ADMISSIONS FROM AN OUTPATIENT ORTHOPEDIC SURGERY CENTER****AUTHORS:** G. Cuff¹, J. Bosco², M. Day²**AFFILIATION:** ¹Anesthesiology, NYU School of Medicine, New York, NY, ²Orthopedic Surgery, NYU School of Medicine, New York, NY**INTRODUCTION:** Performance of outpatient surgery at a stand-alone surgery center not physically associated with a tertiary care hospital may allow for streamlined surgical care of ambulatory patients. However such facilities are not equipped to handle many postoperative complications. Complications requiring transfer to hospital greatly increase the cost of surgical care. Interventions to minimize these transfers will become increasingly important in the settings of cost containment and episodic payment.**METHODS:** After IRB review and approval, we retrospectively reviewed the medical records of patients undergoing orthopedic surgery in our outpatient surgical center from March 2010 to February 2014. The data of patients who necessitated unplanned admission to our inpatient hospital were recorded in our outpatient surgery quality control database during that time period. An analysis of each case was done to determine the reason for transfer to admission status and actions taken by ambulatory surgery and hospital staff. Patient demographics, procedure characteristics, conditions necessitating transfer and interventions before and after transfer were analyzed.**RESULTS:** Over this four-year period, 37 of 15,471 (2.4/1000 incidence) patients were transferred to a hospital setting from our ambulatory surgery center. The average body mass index (BMI) of patients requiring transfer was 27. 1. Seventy-three percent of cases involved general anesthesia, with or without a regional block. Asthma and diabetes were the most common patient comorbidities (each present in 3 patients). Twenty-three percent of patients were assigned an American Society of Anesthesiologists (ASA) score of 1. Seventy-seven percent of patients transferred were ASA 2. No patients were ASA 3 or greater. Pulmonary (24%) and cardiac (24%) issues were the most common reason for transfer, followed by postoperative pain (13.5%). None of the medical issues causing admission were pre-existing conditions.**CONCLUSIONS:** Cardiac and pulmonary complications are the most common reason for transfer to hospital. Adequate pain control is a patient-centered outcome that may also reduce the incidence of transfer to hospital after ambulatory surgery. As the amount and complexity of surgery performed in out-patient settings increases, we must increase our understanding of the incidence and risk factors leading to unplanned admissions following these surgeries.

S-23.

ARAVEBTRAL BLOCK FOR INGUINAL HERNIORRHAPHY: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

AUTHORS: L. Law¹, M. Tan¹, Y. Bai¹, T. Miller¹, T. Gan²

AFFILIATION: ¹Anesthesiology, Duke University, Durham, NC, ²Anesthesiology, Stony Brook University, Stony Brook, NY

INTRODUCTION: Paravertebral block (PVB) is a safe and effective analgesic technique for thoracotomy and mastectomy. However, no meta-analysis or systematic review has focused on PVB for inguinal herniorrhaphy. Our study compares PVB with general anesthesia-systemic analgesia (GA+SysA), spinal anesthesia (SpA) and other peripheral nerve block (PNB).

METHODS: We analyzed thirteen randomized controlled trials (RCTs) from PubMed, MEDLINE, CENTRAL, EMBASE, and CINAHL up to July 2014, without language restriction, comparing PVB with GA+SysA (135 vs 133 patients), SpA (156 vs 151 patients) and other PNB (154 vs 152 patients). We investigated pain scores, incidence of postoperative nausea and vomiting (PONV), length of hospital stay (LOS), postanesthesia care unit (PACU) bypassing rate, consumption of postoperative analgesia, vitals signs, and incidence of urinary retention.

RESULTS: Our meta-analysis showed that PVB provided better postoperative pain control at 0-24h, reduced PONV, LOS, and higher PACU bypassing rate compared to GA+SysA.

Compared to SpA, PVB decreased the consumption of postoperative analgesia while maintaining comparable pain control. PVB also resulted in less postoperative vomiting, higher mean arterial pressure, higher heart rate, less patients required ephedrine, and less urinary retention than SpA.

Meta-analysis was not conducted for PVB versus other PNB due to clinical heterogeneity. Our review of RCTs revealed that PVB provided a better postoperative pain control and decreased postoperative analgesic requirement than ilio-ilioinguinal block and transversus abdominus plane block.

CONCLUSIONS: This meta-analysis shows that PVB provides effective analgesia for inguinal herniorrhaphy. PVB has a comparable failure rate to SpA. However, it takes a longer time to perform and requires higher doses of propofol for sedation. The choice between GA+SysA, SpA, PVB and other PNB should be based on patient preference, the availability of skilled personnel, time available to perform the block before surgery and patients' medical conditions. PVB is an effective option for analgesia.

Table 1: Summary of result from meta-analysis

Outcome	PVB vs GA+SysA	PVB vs SpA
Pain at Rest (0-6 h)	WMD = -2.33 (-3.67, -0.98)	Not Significant (N.S.)
Pain at Rest (6-24 h)	WMD = -1.38 (-2.73, -0.02)	N.S.
Pain at Rest (24-72 h)	N.S.	Insufficient Data
Postoperative Analgesics Required	N.S.	WMD = -76.27mg Tramadol (-128.88, -23.65)
Postoperative Nausea	RR 0.19 (0.05,0.75)	RR 0.34 (0.14,0.81)
Postoperative Vomiting	RR 0.11 (0.03,0.46)	Insufficient Data
Length of Hospital Stay	WMD = -8.17h (-12.68, -3.66)	N.S.
PACU bypass rate	RR 6.14 (3.05,12.38)	Insufficient Data
Time to Perform Block	Not Applicable	WMD = 5.33min (1.42,9.25)
Intraoperative Propofol	Not Applicable	WMD = 32.03mg (22.93,41.13)
Mean Arterial Pressure	Insufficient Data	WMD = 3.03mmHg (0.99,5.07)
Heart Rate	Insufficient Data	WMD = 3.81min-1 (0.31,7.32)
Arterial O2 Saturation	Insufficient Data	N.S.
Ephedrine Requirement	Insufficient Data	RR 0.09 (0.01,0.69)
Urinary Retention	Insufficient Data	RR 0.20 (0.05,0.77)

S-24.**THE EFFECTS OF MAGNESIUM SULFATE ON THE ONSET TIME AND DURATION OF LOW-DOSE ROCURONIUM****AUTHORS:** B. Kim, E. Choi, S. Do**AFFILIATION:** Anesthesiology and Pain medicine, Seoul National Univ. Bundang Hospital, Gyeonggi-do, Korea, Republic of**INTRODUCTION:** Magnesium sulfate has been used as an anti-arrhythmic agent, and for the prevention and treatment of epileptic seizures in parturients with pre-eclampsia. Magnesium sulfate also enhances the effect of non-depolarizing muscle relaxant. The aim of this study was to evaluate the effect of magnesium sulfate on the onset time, duration of low-dose of rocuronium and the operating conditions of the surgical patients.**METHODS:** Seventy-one adult patients aged between 20 and 70 years who were scheduled for elective laryngeal microsurgery were enrolled. Patients were randomly allocated into three groups, Group A was given rocuronium 0.6 mg/kg; Group B was given rocuronium 0.45 mg/kg; and Group C was given rocuronium 0.45 mg/kg with magnesium sulfate pre-treatment. Patients in each group received either the magnesium sulfate 30 mg/kg for 2 min (group C) in 0.9% normal saline (total volume 100 ml) or 0.9% normal saline (group A and B, total volume 100 ml) alone intravenously for 5 min before induction of anesthesia. Total intravenous anesthesia with propofol and remifentanyl was used for the induction and maintenance of anesthesia and muscle relaxant was administered differently to each group as described above. Then we measured the onset time, maximal suppression, and duration of each group by using TOF-Watch® SX (Organon Ltd., Dublin, Ireland). In addition, we evaluated intubating condition, rigid-laryngoscopy inserting condition, operator's satisfaction score about operating condition using 7-point Likert scale and postoperative pain and sore throat of patients.**RESULTS:** Group B showed significantly delayed onset time than the other groups (87.1 ± 21.7 sec vs. 126.7 ± 46.7 sec vs. 88.9 ± 31.6 sec, $p < 0.001$). Durations were significantly prolonged in group A than in group B and C (2263.0 ± 414.9 sec vs. 1668.8 ± 382.1 sec vs. 1979.9 ± 606.0 , $p = 0.001$). Intubating condition (3.8 ± 0.6 vs. 3.4 ± 0.8 vs. 4.0 ± 0.2 , $p = 0.033$), rigid-laryngoscopy inserting condition (3.6 ± 0.6 vs. 3.0 ± 0.8 vs. 3.9 ± 0.4 , $p = 0.001$) and operator's satisfaction about operating condition (6.2 ± 1.4 vs. 4.8 ± 1.7 vs. 6.0 ± 0.9 , $p = 0.022$, $p = 0.005$) were significantly lower in Group B. Postoperative pain (2.8 ± 1.7 vs. 3.7 ± 2.0 vs. 2.0 ± 1.5 , $p = 0.026$) and sore throat (1.0 ± 1.1 vs. 1.8 ± 1.0 vs. 0.9 ± 1.0 , $p = 0.005$) were significantly higher in group B than in group A and C.**CONCLUSIONS:** This study showed that magnesium sulfate 30 mg/kg accelerated the onset of low-dose rocuronium without prolongation of the duration. In addition, this regimen may be helpful in the anesthetic management of an operation which requires enough muscle relaxation for endotracheal intubation but takes a short time such as laryngeal microsurgery.

S-25.

WITHDRAWN.

S-26.**ANESTHETIC MANAGEMENT OF PATIENTS WITH HEREDITARY HEMORRHAGIC TELANGIECTASIA: A RETROSPECTIVE ANALYSIS FROM AN ACADEMIC REFERRAL CENTER**

AUTHORS: V. Kumar, S. Dwarakanath, S. Bahadur, M. R. Castresana

AFFILIATION: Anesthesiology, Georgia Regents University, Augusta, GA

INTRODUCTION: Hereditary hemorrhagic telangiectasia (HHT) is a rare genetic autosomal dominant disorder of blood vessels causing arterial blood flow directly into the vein lacking capillaries in between. This leads to formation of arteriovenous malformations (AVM) at multiple locations including nose. Telangiectases in the nose present with multiple episodes of epistaxis by the time they reach middle age. Most frequently performed procedures in patients with HHT are nasal endoscopies for control of bleeding. Our institution is a referral center for management of HHT and we present results of a retrospective review of records involving perioperative anesthesia management in these patient population.

METHODS: After institutional IRB approval, we retrospectively reviewed records of patients with diagnosis of HHT based on Curacao diagnostic criteria from January 2012 to August 2014. All patients underwent nasal endoscopy procedures, cauterization or laser therapies for control of epistaxis. Patients' history, anesthetic management and complications were abstracted from electronic medical records.

RESULTS: We reviewed 88 patients with HHT who underwent 146 intraoperative nasal endoscopy and related treatment for control of epistaxis under general anesthesia. 46 % had Laryngeal Mask Airway (LMA) and 54 % had Endotracheal Tube (ET) placed. All patients were successfully extubated after procedure. Mean anesthesia time was 87.5 minutes and mean surgical time was 47.8 minutes. 37 out of 146 (25.6%) procedures received Packed Red Blood Cell (PRBC) transfusion. The mean Estimated Blood Loss (EBL) in the group that received transfusion was 324 ml with a range from 25 ml to 900 ml. Other reported complications included bronchospasm (0.02%), conversion from LMA to ET for airway protection, severe coughing after extubation. None of these patients required Intensive Care Unit admission.

DISCUSSION: HHT is autosomal dominant disorder, characterized by mucocutaneous and visceral vascular dysplasia and frequent episodes of epistaxis and gastrointestinal bleeding. Larger AVMs can occur in brain, lung, liver and spine although mild to moderate nosebleeds are the most common symptoms. Thorough pre-anesthetic evaluation is essential including echocardiogram with bubble study and location of AVMs. Surgical treatment involves cauterization, laser ablation of telangiectasis and dermoplasty or skin graft for severe transfusion dependent patients.

Anesthesia considerations

- Consider LMA to minimize airway trauma
- Blood type and screen
- Large bore intravenous access to allow transfusion if needed
- Placement of air filter in intravenous tubing to prevent paradoxical air embolism
- Use lubricated suction catheters, avoid unnecessary GI tract instrumentation
- Use of LASER warrants appropriate precautions to avoid fire and eye protection
- Consider deep extubation if no airway concerns

Airway can be managed with both ET tube and LMA. No complications related to aspiration were seen in our review of patients managed with LMA. The incidence of PRBC transfusion in our review was 25.6%. We recommend type and screen for patients presenting for nasal endoscopy and possibly cross-match for patients with history of previous transfusion.

In our study, most common complication during nasal endoscopy was bleeding from AVMs and telangiectases and blood products administration.

CONCLUSIONS: Anesthetic management of HHT patients require thorough preoperative evaluation and careful planning and expertise at multiple levels to prevent life threatening complications.

S-27.

WITHDRAWN.

S-28.

WITHDRAWN.

Subspecialty Abstracts

Anesthetic Pharmacology

S-29.

WITHDRAWN.

S-30.**PENTAZOCINE INCREASES BISPECTRAL INDEX AND SPECTRAL EDGE FREQUENCIES 95% WITHOUT SURGICAL STIMULATION DURING NITROUS OXIDE-SEVOFLURANE ANESTHESIA AFTER INDUCTION WITH PROPOFOL**

AUTHORS: H. Nagasaka¹, T. Mieda², T. Nakamura¹, Y. Horikoshi¹, S. Nishizawa¹, Y. Ide¹, Y. Yamanishi³

AFFILIATION: ¹Department of Anesthesiology, Saitama Medical University Hospital, Irumagun, Japan, ²Dept. of Anesthesiology, Saitama Medical University International Medical Center, Saitama, Japan, ³Division of Anesthesiology, Meikai University Hospital, Sakado, Japan

INTRODUCTION: Propofol and thiopental are used as intravenous (IV) induction agents. In general, both drugs have similar effects on brain electrical activity. However, the drug interactions between pentazocine and propofol might be different from those between pentazocine and thiopental. Although many investigators have reported that opioids produce minimal changes in bispectral index (BIS) values in the absence of painful stimulation, it has been reported that pentazocine increases BIS values under nitrous oxide-sevoflurane anesthesia after induction of IV thiopental. Therefore, we have examined the effects of pentazocine on BIS values and spectral edge frequencies 95% (SEF95) under nitrous oxide-sevoflurane anesthesia after induction of IV propofol.

METHODS: ASA physical status I patients (n=30) scheduled for elective oral surgery were enrolled in the trials. Patients were randomly assigned to one of 2 groups: pentazocine group (n = 15), or saline group (n = 15). Anesthesia was induced with propofol (2mg/kg) and vecuronium bromide and maintained with nitrous oxide (64-67%)-sevoflurane (1%). Either pentazocine (0.6mg/kg) or saline was administered intravenously 15min after the intubation. Fifteen min after the intubation, BIS values, SEF95%, mean arterial blood pressure (MAP), and heart rate (HR) was recorded as baseline values. BIS values, SEF95, MAP, and HR were measured every 5 min after the intubation up to 30 min. All data were expressed as the mean ± SD. Differences in BIS values, SEF95, MAP, and HR between the 2 groups throughout the experiment were analyzed by using two-way repeated-measures analysis of variance and other results, such as age, weight, height, body mass index, expired CO₂ tension, and body temperature, between the 2 groups were analyzed by using Unpaired Student's t-test. Post hoc comparisons were done by performing Fisher's protected least significant difference test. A P value of less than 0.05 was considered statistically significant.

RESULTS: The patients were not significantly different in terms of age, weight, height, body temperature, expired CO₂ tension, expired sevoflurane concentration, and expired nitrous oxide concentration were not significantly different between the 2 groups. MAP and HR showed no significant differences between the 2 groups during the study. In the saline group BIS values were approximately 40 from 5 min to 30 min after the intubation. BIS values and SEF95 were significantly increased at from 5 to 15 min from the baseline values in pentazocine group (P<0.01).

CONCLUSIONS: We found that pentazocine under nitrous oxide - sevoflurane anesthesia caused a statistically significant increase in BIS and SEF95 after induction of IV propofol. The depth of sedation during nitrous oxide-sevoflurane anesthesia with either thiopental or propofol induction should be assessed carefully by using a BIS monitor when pentazocine is also administered.

S-31.

COMPARISON OF RECOVERY TIME OF DESFLURANE ANESTHESIA WITH SEVOFLURANE ANESTHESIA DURING CONTINUOUS INFUSION OF REMIFENTANIL

AUTHORS: S. Kobayashi, Y. Ishiyama, K. Tsuruno, S. Osato, N. Ishii, N. Maruyama, M. Morimoto

AFFILIATION: Department of Anesthesiology, Rinku General Medical Center, Izumisano, Osaka, Japan

INTRODUCTION: Desflurane (DES) anesthesia is associated with a faster recovery, such as “time to open eyes,” than sevoflurane (SEV) anesthesia¹. However, the frequency of coughing at emergence is higher with DES^{2,3}. Remifentanil can attenuate this coughing⁴; therefore, anesthesiologists can administer a continuous infusion of remifentanil (CIR) while waking up the patients. In previous studies, faster recovery of DES was investigated with extremely low plasma concentration of opioids¹. However, a study reported that an increase in the plasma concentration of fentanyl marginally lowered MAC-awake of SEV⁵ (Fig.1). However, it remains unclear if a similar relationship exists between plasma remifentanil concentration and MAC-awake of DES, and, consequently, whether CIR affects faster recovery of DES anesthesia. To investigate this, we compared the recovery time of DES anesthesia with SEV anesthesia using CIR.

METHODS: After IRB approval, 80 patients (ASA I-II) who underwent otorhinological surgery were randomly allocated to either DES group (n=40) or SEV group (n=40). We excluded patients who were under anesthesia for ≤ 40 min, had a BMI ≥30, or had severe hearing loss. Anesthesia was induced with propofol, remifentanil, and rocuronium. Tracheal intubation was performed. Anesthesia was maintained with remifentanil and 0.6 MAC DES or SEV. Mapleson’s formula⁶ was used for the correction of MAC as per patient age. Toward the end of the surgery, remifentanil infusion rate was fixed at 0.02 µg/kg/min. After a 20-min equilibration period, DES or SEV was discontinued. Fresh gas flow was fixed at 6L/min and lungs were ventilated to normocapnia. Sugammadex and flurbiprofen were administered. The patients were not disturbed. Every 20 s, the patient name was called loudly. If patients opened their eyes, they were considered awake and the time (s) after discontinuing DES or SEV was defined as T1. Then, if a patient could obey commands, the tracheal tube was extubated and remifentanil infusion was stopped; this time (s) was defined as T2. At 2 min after extubation, respiratory rate (RR) was monitored, and at 5 and 15 min after extubation, pain grade was recorded with a numeric rating scale (NRS; 0-10).

Patients’ ASA and sex were compared by χ^2 tests, and other nonparametric data by Mann-Whitney’s U test. All other numerical data were analyzed using F-test and Student’s or Welch’s t-test. $P < 0.05$ was considered significant.

RESULTS: The demographic data did not differ between the study groups (Table). T1 and T2 were significantly shorter in the DES group than in the SEV group (Figs. 2, 3). RR in the DES and SEV groups were 10.3 ± 4.7 and 10.5 ± 4.5 times/min, respectively (mean \pm SD). No significant intergroup differences were found in 5- and 15-min post-extubation NRS.

CONCLUSIONS: Even during CIR, DES anesthesia had a faster recovery time than SEV anesthesia, including “time to open eyes” and “time to obey commands.”

REFERENCES:

1. Anesth Analg 2004;98:632-41
2. Anesth Analg 2009;109:387-93
3. Anesthesiology 2005;103:495-9
4. Anesth Analg 2009;108:1157-60
5. Anesthesiology 1999;90:398-405
6. Br J Anaesth 1996;76:179-85

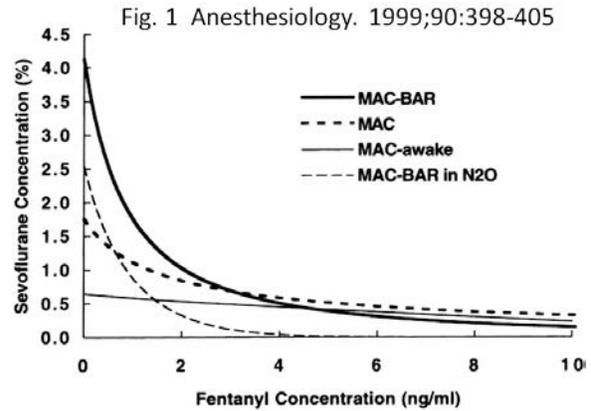
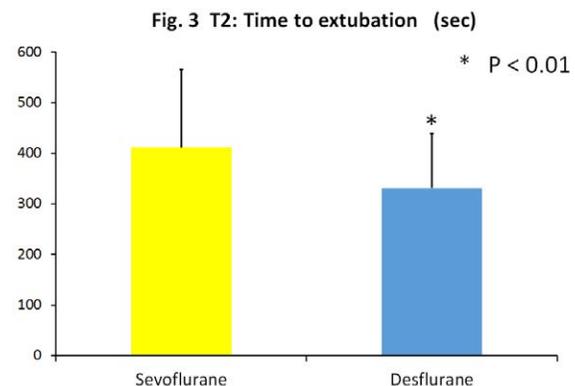
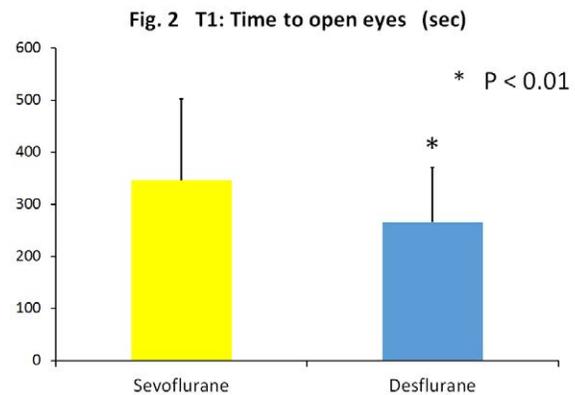


Table Demographic data (M \pm SD)

	Desflurane	Sevoflurane
<i>n</i>	40	40
Sex (M/F)	23/17	26/14
ASA PS (I/II)	23/17	20/20
Age (yr)	53.3 \pm 16.5	53.5 \pm 19.4
Height (cm)	161.4 \pm 8.9	163.4 \pm 9.6
Weight (kg)	59.6 \pm 9.2	62.1 \pm 11.9
Exposure time of anesthetic agent (min)	127.8 \pm 63.4	127.3 \pm 57.3



S-32.

WITHDRAWN.

S-33.**THE INFLUENCE OF AGE ON SENSITIVITY TO DEXMEDETOMIDINE SEDATION DURING SPINAL ANESTHESIA IN LOWER LIMB ORTHOPEDIC SURGERY****AUTHORS:** Z. Li, B. Xu, W. Tu**AFFILIATION:** Department of Anesthesiology, Guangzhou General Hospital of Guangzhou Military Command, Guangzhou, Guangdong province, China**INTRODUCTION:** Dexmedetomidine produces dose-dependent sedation with respiratory-sparing and plays an important role during spinal anesthesia. Recent animal researches suggested that dexmedetomidine pharmacodynamic sensitivity in sedation increased with age. Our prime goal was to investigate the influence of age on sensitivity to dexmedetomidine sedation in adult patients. Secondly it was to determine the optimum bolus dose of dexmedetomidine for producing adequate sedation during spinal anesthesia in lower limb orthopedic surgery.**METHODS:** 75 patients scheduled for lower limb orthopedic surgery under spinal anesthesia were assigned into one of three groups depended on age: Group 1 (aged 18~39 yr), Group 2 (aged 40~64 yr) and Group 3 (aged 65~79 yr). After the performance of spinal anesthesia, a bolus dose of dexmedetomidine was administered via an Agilia syringe pump for 15 min. The dose for each sequent patient was predetermined using a modified up-and-down method of Dixon (starting at 1.0 µg/kg in Group 1 and 2, or 0.7 µg/kg in Group 3; step size of 0.05µg/kg in all groups). The sedative state would be assessed at 26 min. The positive reaction or called suppression of consciousness was defined as OAA/S ≤ 2, or OAA/S ≤ 3 but BIS ≤ 46.**RESULTS:** The ED50 of dexmedetomidine for providing adequate sedation of suppressing consciousness was 1.21±0.06 µg/kg in Group 1, 1.16±0.08 µg/kg in Group 2 and 0.88±0.07 µg/kg in Group 3, respectively. The ED50 in elderly group was statistically significant lower than other two groups (Group 3 versus 1, P=0.000; Group 3 versus 2, P=0.000). No significant difference was noted between Group 1 and 2 in ED50 (P=0.069). The ED95 and its 95% confidence intervals (CI) calculated with a probit analysis was 1.44 µg/kg (95%CI: 1.32~1.85 µg/kg) in Group 1, 1.38 µg/kg (95%CI: 1.27~1.76 µg/kg) in Group 2, 1.06 µg/kg (95%CI: 0.97~1.35 µg/kg) in Group 3, respectively. The estimates of relative median potency between Group 1 and 3 was 1.36 (95%CI: 1.09~2.77), didn't included 1, the same between Group 2 and 3 [1.30 (95%CI: 1.07~2.42)].**CONCLUSIONS:** We conclude that elderly patients (≥65 year) appear more sensitive to dexmedetomidine, suggesting that the initial dose of dexmedetomidine should be concerned clinically when used as a sedative in old men, for it tends to be overdose.

S-34.**CAPTOPRIL PRE-TREATMENT PRODUCES ADDITIVE CARDIOPROTECTIVE EFFECTS TO ISOFLURANE PRECONDITIONING IN ATTENUATING MYOCARDIAL ISCHEMIA REPERFUSION INJURY IN RABBITS AND IN HUMANS**

AUTHORS: H. Li¹, Y. Tian², P. Liu³, J. Xu⁴, M. Irwin¹, G. Tian², Z. Xia¹

AFFILIATION: ¹Department of Anaesthesiology, The University of Hong Kong, Hong Kong, Hong Kong, ²Department of Anaesthesiology, Haikou Municipal Hospital, Affiliated Haikou Hospital Xiangya School of Medicine Central South University, Haikou, China, ³Department of Anaesthesiology, Hainan Municipal Corps Hospital, Chinese People's Armed Police Force, Haikou, China, ⁴Department of Anaesthesiology, The Second XiangYa Hospital, Central South University, Changsha, China

INTRODUCTION: Pre-treatment with the angiotensin-converting inhibitor captopril or volatile anesthetic isoflurane has, respectively, been shown to attenuate myocardial ischemia reperfusion (MI/R) injury in rodents¹ or in patients² undergoing coronary artery bypass graft (CABG) surgery using cardiopulmonary bypass (CPB). It is unknown whether or not captopril pre-treatment and isoflurane preconditioning may additively or synergistically attenuate MI/R injury.

METHODS: Patients (n=100) selected for CABG surgery were randomly assigned to five groups (n=20 per group): untreated control (Control), captopril pre-treatment for 3 days group (group Cap3d, captopril 12.5 mg, p.o., 3 times a day) before surgery or single dose captopril group (group Cap1hr, captopril 12.5 mg, p.o., 1 h before surgery) in the absence or presence of inhalational isoflurane at 1.1% end tidal concentration administered for 30 min before CPB (in group Cap3d+Iso and Cap1hr+Iso). Rabbit in vivo MI/R injury model was induced by occluding the left descending coronary artery for 30 min followed by 2 hours reperfusion. Rabbits (8 per groups) were randomized to receive sham operation (group Sham), MI/R (group I/R), captopril (group Cap, 25 mg/kg given intravenously 24 h prior to inducing MI/R), isoflurane preconditioning (group Iso, 15 min 1.1% end tidal isoflurane followed by a 15 min washout period before inducing MI/R), or the combination of captopril and isoflurane (group Iso+Cap).

RESULTS: In patients, 3 days captopril treatment combined with isoflurane (Cap3d+Iso), but not 1 hour captopril treatment combined with isoflurane, additively reduced myocardial injury [reduced plasma cardiac troponin I and creatine kinase MB, P<0.05 vs. all other groups], and attenuated myocardial inflammation (reduced plasma TNF α , IL-6, and ICAM-1), which were associated with reduced the usage of vasoactive drugs after surgery. In rabbits, post-ischemic myocardial infarct size in group Cap or group Iso was significantly lower than that in group I/R (P<0.05). Captopril and isoflurane (Iso+Cap) additively reduced IS (P<0.05 vs. Cap or Iso) and cellular injury that were associated with improved post-ischemic myocardial functional recovery and reduced myocardial apoptosis and attenuated oxidative stress (all P<0.05 vs. Cap or Iso).

CONCLUSIONS: A joint use of 3-day captopril treatment and isoflurane preconditioning additively attenuated MI/R by reducing oxidative stress and inflammation.

REFERENCES:

1. Circulation, 1993, 87:1093-9
2. Circulation, 1999, 100:340-4

S-35.

HEMODYNAMIC EFFECTS OF REMIFENTANIL DURING GENERAL ANESTHESIA IN NON-CARDIAC SURGERY PATIENTS.

AUTHORS: T. Ogura¹, S. Ishigaki², S. Itakura², T. Morohashi², Y. Takaenoki², S. Yufune²

AFFILIATION: ¹Anesthesiology, Japan Self Defense Force hospital Yokosuka, Yokosuka, Kanagawa, Japan, ²Anesthesiology, National Defense Medical College, Tokorozawa, Saitama, Japan.

INTRODUCTION: Remifentanil is known to cause bradycardia, hypotension, and low cardiac output. It has been reported that remifentanil reduced the contractile in dog study. But there is a report that fentanyl and sufentanil keep the cardiac contractile function. Also dehydrate and sympathetic dominant patients are prone to hypotension and low cardiac output by administration of opioid

Thus, we hypothesize that¹ cardiac output decreasing due to remifentanil depends on heart rate rather than cardiac contractile function² The degree of cardiac output decreasing during induction due to remifentanil is correlated with stroke volume variation that is an indicator of fluid responsiveness. The aim of this study was to characterize the hemodynamic profile of remifentanil using pulmonary artery catheter during sevoflurane anesthesia to confirm hypotheses in human.

METHODS: Forty-two patients scheduled for elective abdominal surgery, whose ASA physical status was one or two, were included in the prospective randomized study. Patients were randomly assigned to remifentanil administered group or normal saline infusion group.

After induction of anesthesia, patients were anesthetized 1% sevoflurane. And then, in the remifentanil group, the effect-site concentration of remifentanil was gradually increased 2 to 6 ng•ml⁻¹ at the step of 2 ng•ml⁻¹ every 10 minutes.(Figure1)

Hemodynamic variables including heart rate (HR), radial and pulmonary artery pressure, central venous pressure, pulmonary capillary wedge pressure, stroke volume variation (SVV), intermittent cardiac output (ICO), and right ventricular ejection fraction (RVEF) were recorded at the end of 10 minutes interval in both groups. All data are collected before surgery.

RESULTS: In remifentanil group, HR and mean arterial pressure (meanAP) were significantly decreased at the concentration of 2 ng•ml⁻¹ or more compared with baseline. To similar, ICO was significantly decreased at the concentration of 4 ng•ml⁻¹ or more. However, no significant change was found in RVEF. (Figure 2) The relationship between baseline SVV and HR change ratio and ICO change ratio at the concentration of 2 ng•ml⁻¹ remifentanil are shown in Figure 3. When SVV were higher , the decrease both in HR and ICO were larger.

CONCLUSIONS: Remifentanil decreased HR, meanAP, and ICO, but did not change RVEF. Remifentanil induced low cardiac output depends on heart rate change.

To provide enough preoperative rehydration for keeping low SVV possibly prevent ICO decreasing induced by reifentanil.

REFERENCES:

1. Anaesth 60(5): 530-5. 1988
2. Pharmacol Exp Ther 263(1): 84-91. 1992

Figure 1

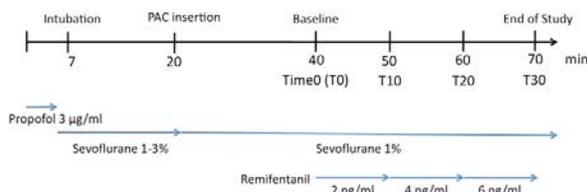


Figure 2

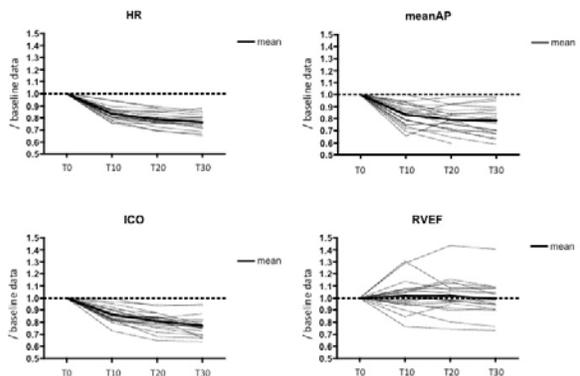
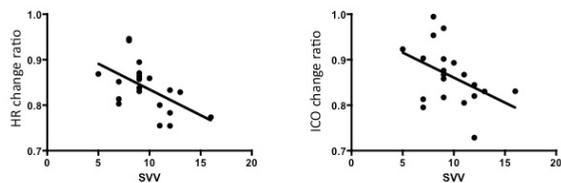


Figure 3



S-36.**GOOD MODEL PREDICTIONS OF SEDATION LEVEL, PAIN, AND RESPIRATORY DEPRESSION IN PATIENTS DURING AWAKE CRANIOTOMY USING TCI PROPOFOL AND ALFENTANIL****AUTHORS:** M. Tsou, C. Ting, S. Wang**AFFILIATION:** Department of Anesthesiology, Taipei Veterans General Hospital, Taipei, Taiwan**INTRODUCTION:** Previously developed pharmacological interaction models have been used to predict anesthetic drug effects such as analgesia, respiratory depression, and loss of responsiveness.^{1,2} The aim of this study was to validate these models in patients received awake craniotomy to see if the model could make a good prediction of responsiveness, respiratory depression and adequate analgesia.**METHODS:** Fifteen ASA class I-II, aged 30-80, adult patients received moderate sedation for awake craniotomy were enrolled. Total intravenous anesthesia with target-controlled infusion (TCI) of different concentrations of alfentanil and propofol were conducted under the monitoring of BIS (40~70), OAA/S Scale³, and vital signs. Response surface pharmacodynamic models were applied to predict patients' responsiveness, respiratory depression and adequate analgesia.**RESULTS:** The BIS, heart rate, respiratory rate and effect site concentration of propofol and alfentanil were recorded in the 13 special events. The BIS is correlated well with the the loss of responsiveness model. Most of patients' effect concentration pairs in the time point of wake-up for speech mapping were between 50% and 95% isobols. The heart rate of the patients were correlated well with the loss of response to pressure algometry model predictions in the 10 events which the patients may suffer more pain and need adequate analgesia to prevent patients move. All of them were above 50% prediction line. The respiratory rate of the patients was also correlated well with the intolerable depression model predictions throughout the procedure. Most of effect concentration pairs in 151 of all 195 events were all under 50% prediction line. Another 44 were between 50% and 95% line which were compatible with the clinical condition and these patients didn't have any intolerable respiratory depression episode during the procedure.**CONCLUSIONS:** This study provides evidence that TCI propofol and alfentanil based anesthesia can fit well to the three pre-developed response surface pharmacodynamic models during awake craniotomy.**REFERENCES:**

1. Lapiere, C.D., et al., An Exploration of Remifentanil-Propofol Combinations That Lead to a Loss of Response to Esophageal Instrumentation, a Loss of Responsiveness, and/or Onset of Intolerable Ventilatory Depression. *Anesthesia and analgesia*, 2011. 113(3): p. 490-9.
2. Johnson, K.B., et al., An evaluation of remifentanil propofol response surfaces for loss of responsiveness, loss of response to surrogates of painful stimuli and laryngoscopy in patients undergoing elective surgery. *Anesthesia and analgesia*, 2008. 106(2): p. 471-9, table of contents.
3. Chernik, D.A., et al., Validity and reliability of the Observer's Assessment of Alertness/Sedation Scale: study with intravenous midazolam. *Journal of clinical psychopharmacology*, 1990. 10(4): p. 244-51.

S-37.**INFLUENCE OF GENDER ON GENERAL ANESTHESIA AND FENTANYL-INDUCED BISPECTRAL INDEX (BIS) CHANGES****AUTHORS:** T. Mieda¹, A. Kitamura¹, T. Nakamura², Y. Horikoshi², H. Nagasaka², K. Onuki³, S. Hagihira;**AFFILIATION:** ¹Anesthesiology, Saitama Medical University International Medical Center, Saitama, Japan, ²Anesthesiology, Saitama Medical University, Saitama, Japan, ³Comprehensive Medical Science, Meikai University Hospital, Sakado, Japan, ⁴Anesthesiology, OsakaUniversityGraduateSchool of Medicine, Osaka, Japan**INTRODUCTION:** Higher bispectral index (BIS) values during maintenance of general anesthesia in female have been reported, despite similar amounts of anesthetic drug administration. Moreover, it is widely reported that opioid analgesics acting display quantitative and qualitative differences in effect in male and female. These sex-related differences are not restricted to the analgesic properties of opioids. In addition, it has been reported that opioids increases BIS values as well as 95% spectral edge frequency (SEF95%) under sevoflurane-nitrous oxide (N2O) anesthesia. Therefore, we examined the effects of gender on general anesthesia and fentanyl-induced BIS and SEF95% changes under sevoflurane-N2O anesthesia.**METHODS:** ASA physical status I patients (n=25, aged 16-45 yr, male and female were 10 and 15, respectively), scheduled for elective oral surgery were enrolled in the trials. Anesthesia was induced with thiopental and vecuronium bromide and maintained with N2O (64-67%)-sevoflurane (1%). Fentanyl (2 µg/kg) was administered intravenously 15min after the intubation. Fifteen min after the intubation, BIS values, SEF95%, mean arterial blood pressure (MAP), and heart rate (HR) was recorded as baseline values. BIS values, SEF95%, MAP, and HR were measured every 5 min after the intubation up to 30 min. All data were expressed as the mean ±SD. Unpaired Student's t-tests were applied to compare normally distributed variables between genders. A P value of less than 0.05 was considered statistically significant.**RESULTS:** The patients were similar in terms of age, body temperature, expired CO2 tension, expired sevoflurane concentration, and expired nitrous oxide concentration except of weight and height. All patients were confirmed to be 100% SpO2 in our present study. As results, there were no differences between genders for BIS values, SEF95%, MAP, and HR under N2O-sevoflurane anesthesia at baseline. Moreover, there were no differences between genders for MAP and HR after fentanyl administration. However, fentanyl-induced BIS and SEF95% increases in female were significantly higher than those in male at 15 minutes after fentanyl administration (P = 0.01 and 0.001, respectively), despite similar amounts of anesthetic drug administration. Similar BIS values and SEF95% between genders at baseline suggest that sensitivity to the hypnotic effect of anesthetic drugs is same between genders in contrast to previous reports.**CONCLUSIONS:** We found that gender was an important factor influencing fentanyl-induced BIS and SEF95% increases in patients undergoing general anesthesia.

S-38.**THE IMPACT OF CYP3A5 GENE POLYMORPHISMS ON THE PHARMACOKINETICS OF FENTANYL AND NORFENTANYL IN THE PERIOPERATIVE PERIOD**

AUTHORS: H. Kato¹, T. Kato¹, K. Hirano², T. Yagi², N. Tanaka², J. Kawakami², S. Sato¹

AFFILIATION: ¹Anesthesiology and Intensive Care, Hamamatsu University School of Medicine, Hamamatsu, Japan, ²Hospital Pharmacy, Hamamatsu University School of Medicine, Hamamatsu, Japan

INTRODUCTION: The impact of CYP3A5 gene polymorphisms on the metabolism of fentanyl is a widely discussed topic. CYP3A5*3 is known to affect the pharmacokinetics of fentanyl during transdermal administration in cancer patients¹ and intravenous continuous infusion in intensive care patients². The aim of this study was to evaluate the influence of CYP3A5 gene polymorphisms on the pharmacokinetics of fentanyl in patients who underwent surgery.

METHODS: We enrolled 40 patients who were scheduled for elective surgery under general anesthesia and continuous fentanyl infusion for postoperative analgesia. The study protocol was approved by the IRB. Written informed consent was obtained from each patient. According to the fentanyl administration protocol, a loading dose of fentanyl (200 µg) was administered before the skin incision, and continuous fentanyl infusion was commenced (50 µg/h) and was maintained for the 24 hours postoperatively. Blood samples were obtained at the following times: once before the operation, every 30 minutes during the operation, and the next morning. The plasma concentrations of fentanyl and its metabolite norfentanyl were measured by liquid chromatography/tandem mass spectrometry. The CYP3A5 genotype was determined using a modified polymerase chain reaction and restriction fragment length polymorphism amplification techniques, previously described³. In this study, the timing of blood sampling in the morning of first postoperative day was not standardized because it was performed in the wards by nurses as a routine procedure. As a result, there was a large time gap from the duration of intraoperative administration of fentanyl to the time of blood sampling. The plasma concentrations of fentanyl/norfentanyl are affected not only by the metabolism of fentanyl but also the duration of fentanyl administration. Therefore, we arranged the plasma concentration of fentanyl/norfentanyl in their time series and compared between the *1 carrier group (*1/*1 + *1/*3) and the *3/*3 group.

RESULTS: The relationships between the plasma concentrations of fentanyl/norfentanyl and CYP3A5 gene polymorphisms was evaluated using analysis of covariance on SPSS statistical software; the covariate used was the duration of fentanyl administration. CYP3A5 polymorphisms showed significant effect on plasma concentrations of fentanyl/norfentanyl (P = 0.006 and 0.005, respectively).

CONCLUSIONS: CYP3A5 gene polymorphisms affect the plasma concentrations of fentanyl/norfentanyl in the perioperative period.

REFERENCES:

1. Drug Metab. Pharmacokinet. 27(4): 414-21 (2012)
2. Therapeutic Drug Monitoring 36(3): 345-52 (2014)
3. Pharmacogenetics 12(4): 331-34 (2002)

S-39.**LIPID-FREE PROPOFOL USING NOVEL SEMIFLUORINATED SURFACTANTS IN RATS**

AUTHORS: C. L. Parks¹, W. B. Tucker², C. A. Amlong¹, M. Perouansky¹, S. Mecozzi³, R. A. Pearce¹

AFFILIATION: ¹Department of Anesthesiology, University of Wisconsin-Madison, Madison, WI, ²Department of Chemistry, University of Wisconsin-Madison, Madison, WI, ³School of Pharmacy, University of Wisconsin-Madison, Madison, WI

INTRODUCTION: Propofol is the most common agent for induction of general anesthesia in the United States. It is routinely used for maintenance of anesthesia and for sedation in the operating room and intensive care unit. The formulation available clinically (Diprivan) is a lipid emulsion of 1% propofol with 10% soybean oil, 1.2% egg yolk lecithin, and 2.25% glycerol. Diprivan is clinically effective and generally well tolerated. However, it has several drawbacks: support of microbial growth, hyperlipidemia (elevated triglycerides and propofol infusion syndrome), and pain on injection. Anaphylaxis in patients with egg allergies has also been of concern. These issues have led to attempts to reformulate the drug, including the addition of preservatives and antimicrobials, variations of oil and lecithin content, changes in size of triglycerides, and alternative solvents.^{1,2} In the present experiments, we studied two novel surfactant-based propofol nanoemulsions, and compared their anesthetic effects to Diprivan in rats.

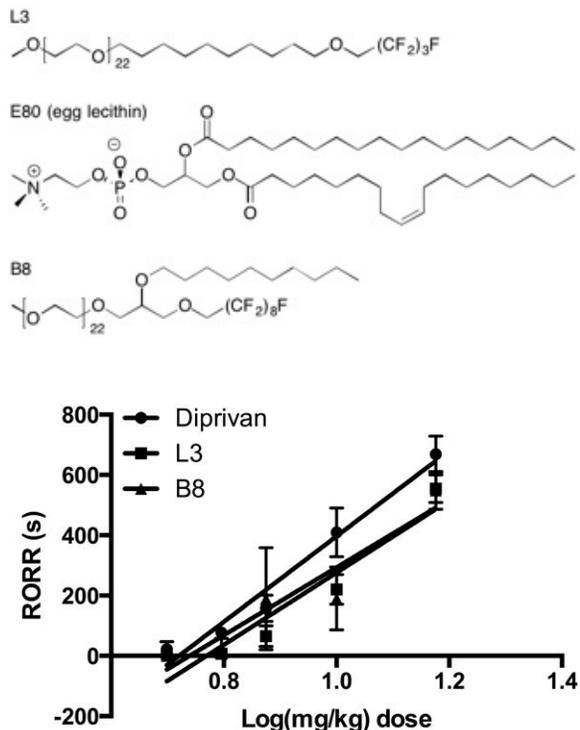
METHODS: Studies were approved by the Institutional Animal Care and Use Committee. Experiments to measure loss and recovery of the righting reflex were conducted in six male Sprague-Dawley rats. Rats were received from the supplier with an implanted jugular catheter. Three propofol formulations were tested: Diprivan; lipid-free formulation incorporating semifluorinated surfactant L3 with egg lecithin (E80); and lipid-free formulation using only semifluorinated surfactant B8 (Figure). For each, five different bolus doses ranging from 5-15 mg kg⁻¹ were administered over 20 s using a syringe pump.^{3,4} Rats received one dose per day. Observers were blinded to dose. To measure potency, time to recovery of righting reflex was plotted vs. log dose for each data set; the x-intercept of the linear regression line was considered the threshold dose for causing loss of righting reflex.⁵

RESULTS: All three formulations showed efficacy in causing loss of righting reflex. No ill effects were evident during or after the anesthetic period. For Diprivan, B8, and L3, the threshold doses causing loss of righting reflex were 5.3 ± 0.3, 5.4 ± 0.4, and 5.8 ± 0.1 mg kg⁻¹ respectively (Graph). For all doses tested, mean time to return of righting reflex for the lipid-free formulations was similar to or slightly shorter than for Diprivan. The lipid-free emulsions were stable for 1 year. Particle size profiles were (B8: 212 ± 66 nm; L3: 74 ± 88 nm; mean ± SD) within the tolerance range for Diprivan (150 - 300 nm).

CONCLUSIONS: The three formulations of propofol were similar in efficacy, potency, and duration of action. The lipid-free formulations showed long-term stability, with particle sizes similar to Diprivan. Avoiding complications related to microbial growth and hyperlipidemia may provide an advantage over currently available lipid-based formulations. Further studies are indicated to test toxicity and side-effect profiles.

REFERENCES:

1. Anesthesiology 103:860, 2005;
2. Curr. Opin. Anaesthesiol. 20:311, 2007;
3. Br. J. Anaesth. 52: 743, 1980;
4. Laboratory Animals. 27:250, 1993;
5. Anesth. Analg. 101:131, 2005.



S-40.**THE EFFECTS OF INTRAVENOUS ANESTHETICS ON CELL MIGRATION USING CULTURED HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS**

AUTHORS: K. Takaishi¹, S. Kawahito², N. Mita², T. Aoyama¹, R. Otsuka¹, H. Kitahata³

AFFILIATION: ¹Dental Anesthesiology, Tokushima University Hospital, Tokushima, Japan, ²Anesthesiology, Tokushima University Hospital, Tokushima, Japan, ³Dental Anesthesiology, Tokushima University, Tokushima, Japan

INTRODUCTION: Cell migration is one of the important processes of angiogenesis. Anesthetics can affect angiogenesis¹. We previously reported that high-dose midazolam inhibited in vitro capillary tube formation by suppressing proliferation of endothelial cells. However, the detailed effects of intravenous anesthetics on angiogenesis have not yet been clarified. The aim of this study was to determine the effects of intravenous anesthetics on endothelial cell migration.

METHODS: Human umbilical vein endothelial cells (HUVEC, BD Biosciences Bedford, MA) were cultured in the media 200 (Gibco by Life technologies, MD, US) supplemented with LSGS kit (Gibco by Life technologies, MD, US). Quantitation of endothelial cell migration was achieved by measuring the fluorescence of migrating cells using BD BioCoat angiogenesis system (BD Biosciences Bedford, MA, US) after labeling with calcein AM. The effects of midazolam (1, 10, 50 μ M), diazepam (1, 10, 50 μ M), propofol (50 μ M) and ketamine (50 μ M) on endothelial cell migration were investigated using HUVEC with mediums contained each anesthetic with or without 2% fetal bovine serum (FBS). Results were expressed as mean \pm SD. Data were compared by means of one-way repeated ANOVA followed by the Scheffe test.

RESULTS: Endothelial cell migration was significantly stimulated with FBS (Figure). Fifty μ M of midazolam significantly impaired endothelial cell migration stimulated with FBS (the fluorescent of positive control stimulated with FBS: $364.0\pm 42.4\times 10^3$, 50 μ M midazolam: $248.5\pm 23.7\times 10^3$, $p < 0.01$). Low dose of midazolam, diazepam, propofol, and ketamine did not show any significant enhancing or suppressive effects on endothelial cell migration.

CONCLUSIONS: High-dose midazolam had suppressive effect on endothelial cell migration.

REFERENCES:

1. Anesth Analg; 107 (2): 686-692, 2008.

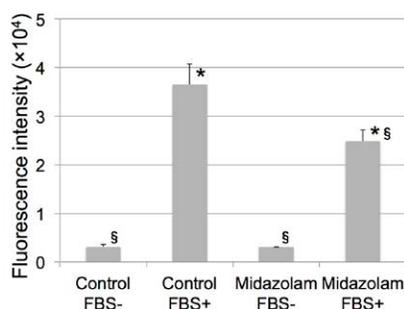


Figure The effects of midazolam on cell migration
Midazolam: 50 μ M midazolam. *: $p < 0.05$ compared with the migration of human umbilical endothelial cells (HUVEC) in fetal bovine serum free medium (FBS-), \$: $p < 0.05$ compared with the migration of HUVEC in medium contained 2% FBS (FBS+).

S-41.**NOVEL LOCAL ANESTHETICS DEMONSTRATE ISOMER-DEPENDENT ANALGESIA IN MICE**

AUTHORS: G. Kracke¹, M. VanGordon², Y. Sevryugina², P. Kueffer², K. Kabytaev², S. Jalisatgi², M. Hawthorne²

AFFILIATION: ¹Anesthesiology, University of Missouri, Columbia, MO, ²International Institute of Nano and Molecular Medicine, University of Missouri, Columbia, MO

INTRODUCTION: Clinically there is a need for local anesthetics with a greater specificity of action and longer duration. We have synthesized a series of local anesthetic derivatives called boronicaines in which the aromatic, phenyl ring of lidocaine was replaced with an isomeric, polyhedral carborane cluster. This carborane cluster is an icosahedral cage comprised of ten boron and two carbon atoms (C₂B₁₀H₁₂), and is more hydrophobic than a benzene ring. The boronicaine derivatives were tested for their analgesic activity and compared to lidocaine using a standard hot plate test in mice following a plantar injection. The use of mice in these studies was approved by the University of Missouri Animal Care and Use Committee. Results showed that the compounds differed in their analgesic activity in the following order: ortho-carborane = C, C'-dimethyl meta-carborane > para-carborane > lidocaine > meta-carborane derivative. Both ortho-boronicaine and C, C'-dimethyl meta-boronicaine had longer durations of analgesia than lidocaine. Differences in analgesic activity are rationalized by variations in chemical structure and protein binding characteristics.

S-42.**ISOFLURANE EXTERNALIZES PHOSPHATIDYLSERINE IN HUMAN KIDNEY PROXIMAL TUBULE CELLS VIA REACTIVE OXYGEN SPECIES-MEDIATED INHIBITION OF AMINOPHOSPHOLIPID TRANSLOCASE ACTIVITY**

AUTHORS: H. Lee, M. Kim

AFFILIATION: Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Volatile inhalational anesthetics including isoflurane protect against renal ischemia and reperfusion injury by reducing renal tubular necrosis and inflammation¹. Isoflurane causes externalization of phosphatidylserine in the plasma membrane leading to transforming growth factor- β 1 release with subsequent induction of anti-inflammatory and cytoprotective sphingosine kinase-1². In this study, we aimed to determine the cellular mechanisms of isoflurane-mediated phosphatidylserine externalization.

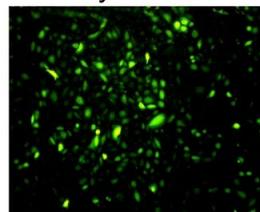
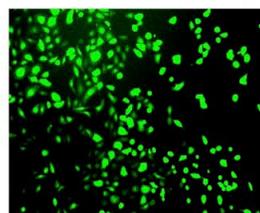
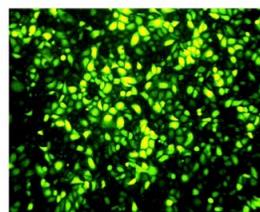
METHODS: We treated cultured human proximal tubule (HK-2) cells with 2.5% isoflurane or with carrier gas (room air with 5% CO₂) for 0-16 hours. Aminophospholipid translocase activity (also called flippase - transporters that move lipids to inner leaflet of plasma membrane) was measured utilizing NBD labeled phosphatidylserine (1,2-dioleoyl-sn-glycero-3-phospho-L-serine-N-(7-nitro-2-1,3-benzoxadiazol-4-yl ammonium salt) with methods described previously³. The intracellular reactive oxygen species with isoflurane exposure was detected utilizing 5-(and-6)-carboxy-2',7'-dichlorodihydrofluorescein diacetate (carboxy-H2DCFDA) (Molecular Probes, Eugene, OR) fluorescence (4). HK-2 cells were pre-incubated for 30 min with carboxy-H2DCFDA and treated with either carrier gas or with 2.5% isoflurane for 0-16 hours. Fluorescence was examined with an Olympus IX81 epifluorescence microscope with an excitation wavelength of 485 nm and an emission wavelength of 538 nm and quantified with the Slidebook software (Intelligent Imaging Innovations, Inc., Denver, CO).

RESULTS: In cultured human proximal tubule (HK-2) cells, 2.5% isoflurane treatment for 6-16 hours caused an inhibition of aminophospholipid translocase activity by ~50% (N=5). In addition, 2.5% isoflurane treatment for 6 or 16 hours increased the reactive oxygen species generation in HK-2 cells by >200% and >500%, respectively (N=5, Figure). Inhibition of reactive oxygen species generation with 2-mercaptopyrionyl glycine abolished the isoflurane-mediated inhibition of aminophospholipid translocase.

CONCLUSIONS: Our studies suggest that isoflurane-mediated phosphatidylserine externalization is mediated by reactive oxygen species-mediated inhibition of aminophospholipid translocase activity. Our findings add to the complex cellular signaling pathways of volatile anesthetic-mediated renal protection that may lead to new therapeutic applications of inhalational anesthetics during the perioperative period for organ protection in high risk surgical patients.

REFERENCES:

1. Am J Physiol Renal Physiol 293: F713-F722, 2007.
2. Am J Physiol Renal Physiol 298: F1041-F1050, 2010.
3. J Biol Chem 282: 8498-8509, 2007
4. Antioxid Redox Signal 3: 3-10, 2001.

**Isoflurane induced ROS generation
Carboxy-H2DCFDA Fluorescence**Carrier Gas
16 hrsIsoflurane
2.5% 6 hrsIsoflurane
2.5% 16 hrs

S-43.

RESPONSE SURFACE MODEL FOR PREDICTING WAKE-UP TIME DURING SEDATED GASTROINTESTINAL ENDOSCOPY USING MIDAZOLAM AND ALFENTANIL

AUTHORS: C. Ting, J. Liou, M. Tsou

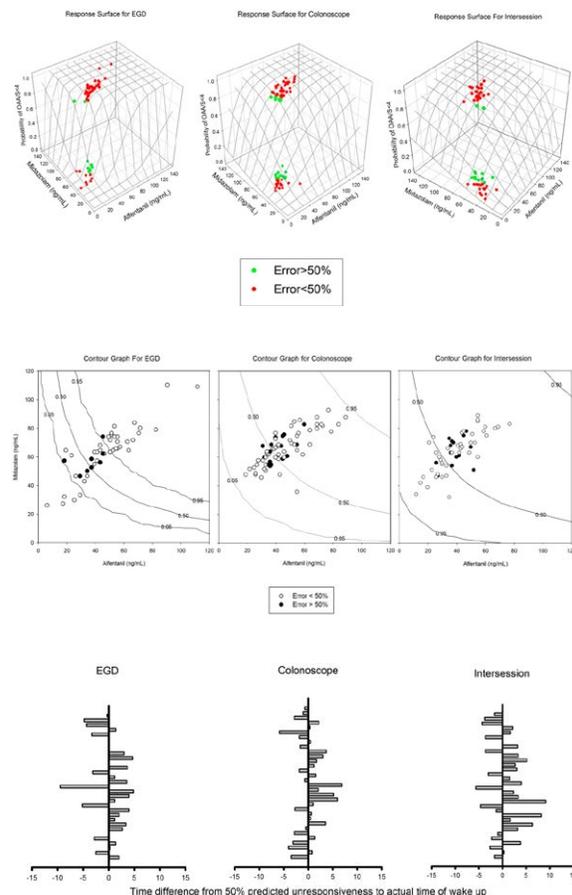
AFFILIATION: Department of Anesthesiology, Taipei Veterans General Hospital, Taipei, Taiwan

INTRODUCTION: Response surface model was developed to predict multiple drug interactions in a wider range of sedation levels. It serves as a useful tool in predicting the wake-up time during sedation. Response surface model for gastrointestinal endoscopy has not been published for midazolam-alfentanil interaction. Here we develop a set of models and validate its accuracy for esophagogastroduodenoscopy (EGD) and colonoscopy by using patient data.

METHODS: Thirty-three adults scheduled for combined EGD and colonoscopy were enrolled. Adequate sedation with intravenous midazolam and alfentanil were performed and monitored with auditory evoked potential. Sedation Observer's Assessment of Alertness/Sedation (OAA/S) score were recorded by an independent observer every two minutes. A score greater or equal to 4 is considered awake. Pharmacokinetic profiles were calculated using simulation software. A total of 216 concentration sets were obtained for analysis and model construction. Model parameters for EGD, colonoscopy and intersession (time period between procedures where no stimuli were present) were calculated using logistic regression and validated with Spearman's correlation against patient data.

RESULTS: Response surface parameters were developed for the 3 models. Estimated wake up time deviation from true arousal are 0.31 ± 3.68 , 0.28 ± 2.94 , and 0.82 ± 3.86 minutes for models EGD, colonoscopy and intersession respectively. ρ for Spearman's correlation were 0.655, 0.550 and 0.631 and all p-values < 0.001. Correlation was moderate to strong. The model successfully predicted wake up time in 74.55%, 73.24% and 83.3% respectively.

CONCLUSIONS: Prediction of wake-up time during sedated gastrointestinal endoscopy using intravenous midazolam and alfentanil by response surface model is a potential tool. Hypnosis with alfentanil alone is unlikely in clinically practiced doses. Our models showed good prediction of wake up time, with the EGD group giving best results. All 3 models showed significant synergy between the two drugs.



S-44.**DEXMETETOMIDINE, A SEDATIVE-ANALGESIC
ADJUNCT IN ANESTHESIA, ACTS ON LIPID
MEMBRANES: ONE OF POSSIBLE MECHANISMS****AUTHORS:** M. Mizogami¹, Y. Matsuki¹, K. Shigemi¹, H. Tsuchiya²**AFFILIATION:** ¹Department of Anesthesiology and Reanimatology, University of Fukui Faculty of Medical Sciences, Yoshidagun, Fukui, Japan, ²Department of Dental Basic Education, Asahi University School of Dentistry, Mizuho, Gifu, Japan**INTRODUCTION:** Dexmedetomidine (an S-enantiomer of medetomidine), a highly selective α_2 agonist with sympatholytic, sedative and analgesic properties, has been used as an adjunct in regional and general anesthesia¹. We studied whether it could mechanistically act on lipid membranes as a novel target besides α_2 adrenergic and imidazoline receptors. We also characterized its membrane activity by comparing with reference drugs including its antipode, lower selective α_2 agonist and anesthetics.**METHODS:** Fluorescent probe-labelled lipid bilayer membranes were prepared with 1,2-dipalmitoylphosphatidylcholine to be typical DPPC model membranes and with phospholipids and cholesterol to mimic the membrane lipid compositions of peripheral nerves, central nerves and cardiomyocytes². The membrane preparations were subjected to the reaction with dexmedetomidine, levomedetomidine (R-enantiomeric medetomidine), clonidine, lidocaine, bupivacaine and propofol at 0.01-1 mmol l⁻¹. Their potencies to act on lipid membranes were evaluated by drug-induced membrane fluidity changes that were determined by measuring fluorescence polarization³.**RESULTS:** Dexmedetomidine acted on DPPC model membranes and increased their fluidity as well as reference membrane-acting drugs at 0.01-1 mmol l⁻¹, although its membrane effects were more potent than clonidine, lidocaine and bupivacaine. The comparisons of different fluorescent probes to selectively locate at a graded series of levels in lipid bilayers indicated that dexmedetomidine was more effective at the deeper regions of membranes rather than at the superficial regions. In peripheral nerve-mimetic membranes, the relative potency to increase membrane fluidity was dexmedetomidine > bupivacaine > clonidine > lidocaine at 0.2 mmol l⁻¹ for each ($P < 0.05$ vs. control for all). In central nerve-mimetic membranes and cardiomyocyte-mimetic membranes, however, dexmedetomidine was less active than propofol at 0.05 mmol l⁻¹. Dexmedetomidine enantio-selectively acted on peripheral nerve-mimetic membranes containing chiral cholesterol much more potently than levomedetomidine at 0.01-0.1 mmol l⁻¹ to induce a 1.6-4 fold increase in membrane fluidity.**CONCLUSIONS:** Dexmedetomidine is able to not only bind to α_2 adrenergic and imidazoline receptors but also interact with membrane lipids. Its membrane action is considered to modify the physicochemical property of lipid membranes, thereby directly affecting the functions of biomembranes and indirectly modulating the activities of receptors through the conformational alteration of transmembrane proteins.**REFERENCES:**

1. Rev Bras Anesthesiol 2012; 62: 118-133.
2. Front Pharmacol 2013; doi: 10.3389/fphar.2013.00150.
3. Eur J Anaesthesiol 2010; 27: 829-834.

S-45.

XENON ANESTHESIA: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

AUTHORS: L. Law¹, E. A. Lo², T. Gan³

AFFILIATION: ¹Anesthesiology, Duke University, Durham, NC, ²Pharmaceutical Sciences, UBC, Vancouver, BC, Canada, ³Anesthesiology, Stony Brook University, Stony Brook, NY

INTRODUCTION: Xenon anesthesia has been studied for decades. However, no meta-analysis of randomized controlled trials (RCTs) on xenon anesthesia has been conducted. The primary aim of this study was to systematically review all available evidence from RCTs comparing xenon and other inhalational and intravenous anesthetics on anesthetic outcomes.

METHODS: We found 43 RCTs from PubMed, MEDLINE, CENTRAL, EMBASE and CINAHL (until July 2014). A total of 31 studies comparing xenon (841 patients) with other inhalational agents (836 patients) and 12 studies comparing xenon (373 patients) with propofol (360 patients) were found. Outcomes such as intraoperative hemodynamics, emergence, postoperative nausea and vomiting (PONV), other adverse events and opioid consumption were evaluated.

RESULTS: Patients undergoing xenon anesthesia had a higher mean arterial pressure (MAP) and lower heart rate (HR) intraoperatively than volatile anesthesia (mean difference [MD] = 9mmHg [95% confidence interval (CI) 4.5,13.0], -6min⁻¹ [95%CI -9.1,-3.3]) and propofol anesthesia (MD = 7mmHg [95%CI 2.3,11.7], -10min⁻¹ [95%CI -12.3,-7.3]). (Table 1) Comparing with baseline, intraoperative MAP remained stable (change 0.30) under xenon anesthesia but MAP dropped by > 15% under volatile (MD = -17mmHg [95%CI -26.6,-7.9], change = -17.5%) and propofol (MD = -14mmHg [95%CI -23.3,-5.4], change = -15.0%) anesthesia. (Table 2) Patients had a faster emergence from xenon anesthesia than volatile anesthesia: eyes opening (MD = -4min [95%CI -4.7,2.5]), extubation (MD = -4min [95%CI -4.6,-3.4]), orientation (vs sevoflurane: MD = -4min [95%CI -5.6,-3.2]; vs isoflurane: MD = -7min [95%CI -8.8,-4.5]), count-down (vs sevoflurane: MD = -4min [95%CI -5.1,-3.2]; vs isoflurane: MD = -8min [95%CI -10.0,-6.7]), and reaction on demand (vs sevoflurane: MD = -5min [95%CI -6.0,-3.2]). (Table 1) However, xenon anesthesia increased the risks of PONV (RR = 1.72 [95%CI 1.23,2.41]) and hypertension (RR = 1.72 [95%CI 1.14,2.59]). Perioperative opioid consumptions were not significantly different between xenon and other anesthetics. (Table 1)

CONCLUSIONS: Xenon anesthesia provides more stable intraoperative blood pressure, lower heart rate and faster emergence from anesthesia than volatile and propofol anesthesia. However, xenon is associated with a higher incidence of PONV. We suggest xenon anesthesia to be considered for high risk patients who may benefit from stable intraoperative blood pressure, low heart rate and rapid emergence from anesthesia e.g. those with aortic stenosis.

Table 2: Comparing intraoperative hemodynamics with baseline

Outcome Variables	Intraoperative – baseline Mean Difference (MD) [95% confidence interval]	MD/baseline % change
Xenon vs volatile agents		
Xenon: HR (min ⁻¹)	MD = -16.54 [-20.24, -12.84]	-22.3%
Volatile: HR (min ⁻¹)	MD = -8.31 [-13.45,-3.18]	-11.2%
Xenon: MAP (mmHg)	MD = -4.02 [-14.13, 6.08]	-4.1%
Volatile: MAP (mmHg)	MD = -17.22 [-26.57, -7.87]	-17.5%
Xenon vs Propofol		
Xenon: HR (min ⁻¹)	MD = -10.26 [-15.58, -4.94]	-16.2%
Propofol: HR (min ⁻¹)	MD = -4.08 [-9.33, 1.16]	-6.1%
Xenon: MAP (mmHg)	MD = -5.23 [-15.19, 4.73]	-5.5%
Propofol: MAP (mmHg)	MD = -14.31 [-23.28, -5.35]	-15.0%

Abbreviations, HR: heart rate, MAP: mean arterial pressure.

Table 1: Summary of result from meta-analysis

Outcome variables	Xenon vs other Inhalational agents	Xenon vs Sevoflurane	Xenon vs Isoflurane	Xenon vs Desflurane	Xenon vs Propofol
Intraoperative HR (min ⁻¹)	MD = -6.17 [-9.09,-3.26]	MD = -7.46 [-11.09,-3.82]	MD = -3.60 [-13.76,6.57]	-	MD = -9.77 [-12.25,-7.28]
Intraoperative MAP (mmHg)	MD = 8.77 [4.49,13.04]	MD = 12.32 [4.26,20.39]	MD = 11.03 [4.51,17.55]	-	MD = 7.00 [2.32,11.68]
Time to open eyes (min)	MD = -3.99 [-4.66,-3.32]	MD = -3.98 [-5.01,-2.95]	MD = -3.74 [-4.31,-3.17]	MD = -4.17 [-5.86,-2.48]	-
Time to extubation (min)	MD = -4.09 [-4.58,-3.60]	MD = -4.30 [-5.30,-3.29]	MD = -4.28 [-4.87,-3.68]	MD = -3.85 [-4.26,-3.43]	-
Time to spatial orientation (min)	-	MD = -4.36 [-5.58,-3.15]	MD = -6.69 [-8.83,-4.54]	-	-
Time to countdown (min)	-	MD = -4.15 [-5.10,-3.19]	MD = -8.37 [-10.02,-6.71]	-	-
Time to react on demand (min)	-	MD = -4.59 [-5.99,-3.20]	MD = -3.60 [-13.76,6.57]	-	-
Aldrete score at 5min	MD = 0.68 [0.08,1.28]	-	-	-	-
Aldrete score at 15min	MD = 0.46 [0.16,0.76]	-	-	-	-
Aldrete score at 30min	MD = 0.57 [0.27,0.86]	-	-	-	-
PONV	RR = 1.72 [1.29,2.29]	-	-	-	RR = 2.33 [0.75,7.22]
Intraoperative opioid consumption (mg [®])	MD = -14.93 [-69.04,39.19]	-	-	-	-

MD = mean difference, RR = risk ratio

S-46.**NEUROPROTECTIVE EFFECTS OF DEXMEDETOMIDINE AGAINST THAPSIGARGIN –INDUCED ER STRESS MEDIATED APOPTOSIS INVOLVE IN $\alpha 2$ – ADRENOCEPTOR AND IMIDAZOLINE RECEPTOR****AUTHORS:** M. Inagaki, M. Somei, M. Tsuji, K. Oguchi**AFFILIATION:** Pharmacology, Showa University, Tokyo, Japan

INTRODUCTION: Dexmedetomidine is a potent and highly selective $\alpha 2$ -adrenoceptor agonist with sedative, analgesic and sympatholytic properties. Besides its action at $\alpha 2$ -adrenergic receptors, dexmedetomidine also exhibits some affinity for imidazoline binding sites. Besides dexmedetomidine's sedative effects, dexmedetomidine also exerts a cell-protective effect on nervous tissue under ischemic conditions. Invasive incidents such as ischemia or hypoxia induce not only changes in respiratory, circulatory, and nervous systems in the whole body but also various damages in individual cells. Hypoxia causes dysfunction in energy production, or depletion of ATP, accumulation and aggregation of abnormal proteins in the endoplasmic reticulum (ER), which induce ER stress response. In the present study, we examined whether dexmedetomidine has protective effects on the apoptosis mediated by thapsigargin-induced ER stress in SH-SY5Y cells, and proposed the possible mechanism of its neuronal protection.

METHODS: In this study, we used thapsigargin (1 μ M) to generate ER stress in SH-SY5Y cells. For studies of the role of dexmedetomidine, SH-SY5Y cells were pretreated with various concentrations of dexmedetomidine (1-100 nM) for 1 hour before co-treatment with 1 μ M thapsigargin for 20 hours. To detect apoptosis, caspase-3 activity was determined fluorometrically using a respective synthetic peptide substrate. To examine effects of dexmedetomidine on expression of ER stress markers (Chop, Ire-1 and Xbp-1), caspase activities and eIF2 α phosphorylation in thapsigargin-induced ER stress cells, we incubated SH-SY5Y cells with or without pretreatment with respective inhibitor of either $\alpha 2$ -adrenoceptor or imidazoline receptor for 1 hour, followed by thapsigargin plus dexmedetomidine treatment for 20 hours.

RESULTS: Thapsigargin-induced increases in activities of caspase-4 and -3, phosphorylation of eIF2 α and expressions of ER stress biomarkers were suppressed by co-incubation with dexmedetomidine. In the presence of atipamezol which blocks the $\alpha 2$ -adrenoceptor, or idazoxan which binds to imidazoline2 receptor and $\alpha 2$ -adrenoceptor, inhibition of caspase-4 activity by treatment with dexmedetomidine in thapsigargin-induced ER stress cells was not significantly difference. However, pretreatment with efaroxan, imidazoline1 receptor ligand and $\alpha 2$ -adrenoceptor antagonist, prevented the inhibition of caspase-4 activity by treatment with dexmedetomidine in ER stress cells.

CONCLUSIONS: These results demonstrated that dexmedetomidine at clinically relevant concentrations suppressed the ER stress-induced apoptosis in this cell system. It may be possible that some of the neuroprotective potencies by dexmedetomidine are mediated by imidazoline receptors.

S-47.**SEVOFLURANE UPTAKE AND ELIMINATION IN PIGS****AUTHORS:** S. Ho¹, C. Hou²**AFFILIATION:** ¹Anesthesiology, Taipei Veterans General Hospital, Taipei, Taiwan, ²Institute of Medical Sciences, National Defense Medical Center, Taipei, Taiwan

INTRODUCTION: As pharmacokinetic studies of volatile anesthetics measuring blood concentrations were scarce, incomplete and inconsistent. This study was designed to explore and compare the uptake and elimination kinetics of sevoflurane among inspired gas, end-tidal gas, arterial blood, mixed venous blood and cerebrospinal fluid.

METHODS: 2.6% sevoflurane was administered to eight young pigs for two hours, followed by two hours' elimination. Sevoflurane concentrations in inspired gas (CIsev), end-tidal gas (CEsev), arterial blood (Asev), mixed venous blood (PAsev) and cerebrospinal fluid (CSFsev) were determined by Infrared analyzer and gas chromatography, respectively. Respiratory and hemodynamic parameters including cardiac output were measured concurrently.

RESULTS: Significant differences were observed among CIsev, CEsev, Asev, PAsev and CSFsev at every sampling time upon reaching equilibration. Asev/ PAsev ratios during the elimination phase were reasonably similar (0.53 to 0.58). Sevoflurane concentration-time curves for CEsev, Asev and PAsev were best described by tri-exponential model and CSFsev was best described by bi-exponential model with zero-order input and first order elimination kinetic. The rates of sevoflurane blood uptake (mean \pm SD, ml of vapor/min) were relatively constant, peaked at 11.07 ± 5.34 in the fifth minute and declined to 7.50 ± 3.01 in the 120th minute. About 83% of sevoflurane was retained in the body after two hours' elimination.

CONCLUSIONS: Uptake of sevoflurane is very similar to constant infusion instead of a square root time of function. Pharmacokinetic properties of sevoflurane in CEsev, Asev and PAsev were similar but not identical. End-tidal concentrations also do not suitably represent arterial concentrations of sevoflurane. Finally, Residual subanesthetic concentrations of sevoflurane in association with postoperative impairment in psychomotor and physiologic functions should be considered.

S-48.**COMBINED NEUROPROTECTIVE EFFECT OF PROPOFOL AND DEXMEDETOMIDINE ON ER STRESS-MEDITATED APOPTOSIS IN NEUROBLASTOMA SH-SY5Y CELLS****AUTHORS:** M. Somei, M. Inagaki, M. Tsuji, K. Oguchi**AFFILIATION:** Pharmacology, Showa University, Tokyo, Japan

INTRODUCTION: Rabbits are widely used in experimental research. Rabbit endotracheal intubation is difficult because of the rabbits' narrow pharyngeal inlet and small larynx. Researchers usually perform tracheostomy in rabbits under general anesthesia; however, in some studies, such as serial imaging studies, tracheostomy is not preferable. Spontaneous breathing via a face mask may not preserve the airway, and controlled ventilation is difficult when the face mask is applied. In rabbits, repeated intubation attempts might cause laryngeal trauma, which could then result in airway obstruction following extubation. Some researchers have reported the benefit of the laryngeal mask airway (LMA) for airway management in rabbits. Recently, a novel supraglottic airway device, v-gel® (Docsinnovent, UK), designed for rabbits became available. We compared v-gel with LMA for airway management in rabbits under general anesthesia.

METHODS: Hamamatsu University School of Medicine Institutional Review Board approved this prospective trial. Male Japanese white rabbits weighing 2.6 ± 0.1 kg ($n = 3$) were used. For general anesthesia in rabbits, an anesthesia machine (Apollo, Dräger, Germany) was used. General anesthesia was induced by 5% isoflurane in 100% oxygen in a small anesthetic chamber. When the animal became unresponsive to a mouth opening, the rabbit was placed in the left lateral position. General anesthesia was maintained using a small face mask with 2% isoflurane without muscle relaxant. Standard monitoring (ECG, SPO_2 , and left femoral arterial blood pressure) was applied.

LMA size 1 (Disposable Laryngeal Mask Straight, Ambu, Denmark) or v-gel size R3 (for rabbit body weight from 1.8 kg to 3.5 kg) (Fig. 1, right: LMA size 1, left: v-gel size R3) was inserted alternately in a randomized order. All devices were inserted by an anesthesiologist with 15 years of experience (HM). The time from insertion to adequate placement was recorded. Insertion success and adequate placement was determined by auscultation (smooth spontaneous breathing sound) and capnography attached to the Apollo machine. After 10 min of spontaneous breathing, animals were mechanically ventilated for 10 min. The conditions of spontaneous breathing and mechanical ventilation, such as airway pressure, air leak, air leak sound from the stethoscope placed on the neck, and gastric insufflation (gastric insufflation sound and the presence of abdominal distension), were evaluated and compared.

RESULTS: V-gel tends to have a shorter insertion time (v-gel: 15.3 ± 8.7 s vs LMA: 23.6 ± 5.1 s). Airway conditions during spontaneous breathing of both groups were almost the same and appropriate. In the v-gel group, adequate mechanical ventilation was performed. However in the LMA group, gastric insufflation and abdominal distension due to device misplacement was observed (v-gel: 0/3 vs LMA: 3/3).

CONCLUSIONS: A shorter insertion time and less gastric insufflation due to misplacement during mechanical ventilation might make v-gel a more favorable option than LMA for airway management in rabbits under general anesthesia.

S-49.

PREOPERATIVE ORAL REHYDRATION AFFECTS PHARMACOKINETICS OF ROCURONIUM

AUTHORS: S. Ishigaki¹, K. Masui¹, Y. Miyake², A. Kanaya², T. Ogura²

AFFILIATION: ¹Anesthesiology, National Defense Medical College, Tokorozawa, Saitama, Japan, ²Anesthesiology, Japan Self Defense Force hospital Yokosuka, Yokosuka, Kanagawa, Japan

INTRODUCTION: Preoperative enough oral rehydration solution (ORS) intakes prevent hypovolemia. Our previous study revealed that patients taking preoperative ORS showed lower stroke volume variation (SVV) at the time just after the induction of anesthesia. This result indicates that ORS increases circulatory blood volume.

Rocuronium, like other muscle relaxants, distributes only in the plasma and interstitial fluid volume. We hypothesized that preoperative ORS would decrease plasma concentration of rocuronium.

METHODS: Following IRB approval, and obtaining informed consent, twenty-four male patients, ASA 1, aged 20-50 years old scheduled for elective surgery were enrolled in this randomized-controlled study. They were randomly assigned to two groups: drinking 1500 ml ORS 6 to 2 hours before anesthesia (ORS group) and nothing by mouth from 6 hours before anesthesia (Control group). Bicarbonate Ringer’s solution was infused at 80 ml/h from 2 hours before anesthesia in both groups. Anesthesia was induced and maintained with propofol and remifentanyl. Then, bolus dose of 0.6 mg/kg rocuronium were administered over 5 seconds). Blood samples for measuring rocuronium concentration were obtained from radial artery at 60, 90, 120 seconds and 30 minutes after administration of rocuronium. Analysis of rocuronium was carried out using high performance liquid chromatography. Noncompartmental analysis was used to fit the plasma time-concentration data and obtain the estimation for the area under the curve from time 0 to infinity (AUC:0-inf) and area under the curve from time 0 to the last sample time (AUC:0-30). Student’s t-test was used to compare the rocuronium plasma concentration, AUC, patient characteristics, heart rate and blood pressure.

RESULTS: Age, weight, height and BMI showed no statistical differences between the groups (Table 1). The heart rate and blood pressure immediately before rocuronium administration were similar between the groups. The time course of the plasma concentration is demonstrated in figure 1. The plasma concentration at 60, 90, 120 seconds were significantly lower in ORS group. The estimated AUC:0-inf and AUC:0-30 from noncompartmental analysis are shown in Table 2. Both AUC:0-inf and AUC:0-30 demonstrated a significant reduction in ORS group.

CONCLUSIONS: Preoperative oral rehydration significantly affects rocuronium pharmacokinetics. Our findings indicate if the patient takes preoperative rehydration, we would better to consider that patients need higher dose rocuronium for intubation and earlier additional administration of rocuronium to maintain anesthesia.

Table 1. Patient characteristics

	Control, n=12	ORS, n=12
Age, yr.	39 (11)	37 (12)
Weight, kg	71 (11)	71 (5)
Height, cm	173 (6)	173 (6)
BMI, kg/m ²	23.8 (2.5)	23.9 (2.3)

Data presented as mean (S.D.)

Figure 1. Mean plasma concentration vs. time-curve

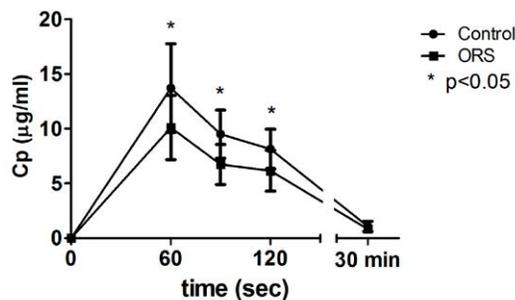


Table 2. Area under the curve

	Control	ORS	p
AUC:0-30	113.5 (29.8)	85.6 (27.4)	0.026
AUC:0-inf	128.9 (36.4)	97.5 (32.2)	0.036

Data presented as mean (S.D.)

S-50.

NITROUS OXIDE FOR TREATMENT-RESISTANT MAJOR DEPRESSION: A PROOF-OF-CONCEPT TRIAL

AUTHORS: P. Nagele¹, A. Duma¹, M. Kopec¹, C. F. Zorumski², C. Conway²

AFFILIATION: ¹Anesthesiology, Washington University, St. Louis, MO, ²Psychiatry, Washington University, St. Louis, MO

INTRODUCTION: Recently, NMDA receptor antagonists, such as ketamine, have been shown to provide rapid antidepressant effects in patients with treatment-resistant depression (TRD). Because nitrous oxide, an inhalational general anesthetic, is also an NMDA receptor antagonist, we hypothesized that nitrous oxide may be a rapidly acting treatment for TRD.

METHODS: In this proof-of-principle, blinded, randomized placebo-controlled crossover trial 20 TRD patients received a 1-hour inhalation of up to 50% nitrous oxide/50% oxygen or 50% nitrogen/50% oxygen (placebo control) in random order. Primary endpoint was the change on the 21-point Hamilton Depression Rating Scale (HRDS-21) 24 hours after treatment.

RESULTS: Mean duration of nitrous oxide treatment was 55.6 ± 2.5 (SD) minutes at a median inspiratory nitrous oxide concentration of 44% (37 - 45%, median, IQR). In two patients nitrous oxide treatment was briefly interrupted and in three discontinued. Depressive symptoms improved significantly at 2 hours and 24 hours after receiving nitrous oxide compared to placebo (mean difference in HDRS-21 score at 2 hours: -4.8 points, 95% CI -1.8 to -7.8 points, p= 0.002; at 24 hours: -5.5 points, 95% CI -2.5 to -8.5 points, p<0.001; comparison between nitrous oxide and placebo: p<0.001). Four patients (20%) had treatment response (reduction ≥50% on HRDS) and three patients (15%) a full remission (HRDS ≤ 7 points) after nitrous oxide compared to one patient (5%) and none after placebo (odds ratio [OR] for response 4.0, 95% CI 0.45 - 35.79; OR for remission 3.0, 95% CI 0.31 - 28.8, respectively). No serious adverse events occurred and all adverse events were brief and of mild to moderate severity.

CONCLUSIONS: This proof-of-concept trial demonstrated that nitrous oxide has rapid and marked antidepressant effects in patients with treatment-resistant depression.

Figure 1A.

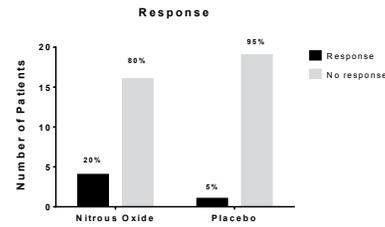


Figure 1B.

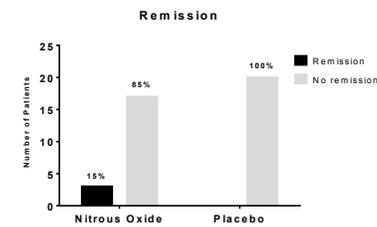


Figure 1: Clinical outcomes after nitrous oxide and placebo treatment. Rates of response (A) (defined as a reduction in HRDS-21 score ≥50%) and remission (B) (defined as complete remission).

S-51.

PROSPECTIVE SINGLE BLINDED RANDOMIZED CONTROLLED STUDY COMPARING THE EFFICACY OF EPSILON-AMINOCAPROIC ACID AND TRANEXAMIC ACID IN PEDIATRIC PATIENTS UNDERGOING ELECTIVE IDIOPATHIC SCOLIOSIS CORRECTIVE SURGERY.

AUTHORS: K. Vivek, A. Appelstein, S. Nair, C. Balikai, M. Moguilevitch

AFFILIATION: Anesthesiology, Albert Einstein College of Medicine/Montefiore Med, New York, NY

INTRODUCTION: Epsilon-aminocaproic acid (EACA) and tranexamic acid (TXA) are routinely used to prevent significant blood loss during multilevel pediatric scoliosis surgeries. Efficacy of these anti-fibrinolytic drugs was demonstrated in cardiac, total joint arthroplasty and in adult spine surgeries^{1,2}. To date very few studies have compared the efficacy of these drugs in multilevel pediatric scoliosis surgeries. Purpose of this study was to compare the efficacy of EACA and TXA in reducing intraoperative blood loss, post operative drain output and blood transfusion requirements.

METHODS: This is a single center, prospective, single blinded, randomized controlled pilot study comparing the efficacy of TXA and EACA used intraoperatively in pediatric patients undergoing multilevel idiopathic scoliosis corrective surgery. After obtaining IRB approval, idiopathic scoliosis patients undergoing corrective surgery were randomly assigned to one of the two groups - TXA or EACA. The following parameters were analyzed: Intraoperative estimated blood loss (EBL), perioperative blood transfusion requirements, surgical drain output on post operative day (POD)-1, POD-2, POD-3 and total 72 hr drain output).

RESULTS:Forty six patients were randomly assigned to receive TXA (n=23) and EACA (n=23). Groups were similar at baseline with regards to weight, starting hematocrit level and gender distribution (Table 1). Age and number of spinal fusion levels were different in the two groups. The median (25th and 75th percentile) EBL in TXA and EACA group were 600 (400-800) and 600 (450-800) respectively, p 0.580. The median 72 hour drain output in the TXA and EACA group were 303.5 (186.5-553) and 330 (165-513) respectively, p 0.991. Additionally there were no differences in the blood transfusion requirements between the two groups.

CONCLUSIONS: TXA and EACA showed no difference in EBL, 72 hour drain output and blood transfusion requirements in pediatric patients undergoing idiopathic scoliosis repair. The endpoints analyzed did not demonstrate superiority of one drug over the other. Additionally no adverse events were reported in both groups. Even though study was not powered to demonstrate equivalency, as there were no differences in any of the endpoints measured, cost of the drugs can be an important factor in deciding the choice of treatment. The acquisition cost of these drugs is comparably low: \$1 to \$2 for a 5-g vial of EACA, and \$20 to \$25 for a 1 g vial of TXA³. Limitations of the study are single center, small sample size; anesthesiologist was not blinded to the treatment and occurrence of baseline differences in the two groups. A double blinded randomized controlled study incorporating cost effective analysis is needed to attain a definite conclusion.

REFERENCES:

1. Henry DA et al: Antifibrinolytic use for minimizing perioperative allogeneic blood transfusion. Cochrane Database Syst. Review.2007
2. Eubanks JD. Antifibrinolytics use in major orthopaedic surgery. J. Am. Acad. Orthop. Surg. 2010, Mar; 18(3): 132-8.
3. Eaton MP. Antifibrinolytic therapy in surgery for congenital heart disease. Anesth Analg. 2008 Apr;106(4):1087-100.

1. Study Population Characteristics

	Tranexamic Acid (n=23)	Epsilon-Aminocaproic Acid (n=23)	Test of significance result (p value)
Age (years)	13 (12-15)	15 (14-16)	0.009*
Gender	Male/Female 5/18 (21.7%/78.3%)	Male/Female 7/16 (26.1%/73.9%)	0.451
Weight (Kgs)	55	54	54
Starting Hematocrit (%)	36.5 (36-40)	40 (36-42.6)	0.163
Number of Spinal levels fused	12 (10-12)	10 (9-12)	0.005*

2. Analysis of Results

	Tranexamic Acid (n=23)	Epsilon-Aminocaproic Acid (n=23)	Test of significance result (p value)
Intraoperative estimated blood loss (cc)	600 (400-800)	600 (450-800)	0.581
Salvaged volume from cell saver (cc)	134 (33-205)	122 (80-149)	0.758
Intraoperative crystalloids administered (cc)	2600 (2000-3500)	2350 (2000-3000)	0.348
Intraoperative colloids administered (cc)	500 (250-500)	500 (250-750)	1.0
Drain output Day1 (cc)	91 (53.75 - 203.75)	90 (28-280)	0.856
Drain output Day2 (cc)	88.5 (58.25 - 241.75)	138 (40-220)	0.937
Drain output Day3 (cc)	25 (15-71.25)	39 (5-130)	0.793
Total Drain output over 72 hrs (cc)	303.5 (186.5 - 553)	330 (165 - 513)	0.991
Received blood transfusion (yes or no)	5 (21.7%)	3 (13%)	0.605

S-52.

AN IN VITRO STUDY OF DEXMEDETOMIDINE DISPOSITION IN NEONATAL/INFANT CARDIOPULMONARY BYPASS CIRCUITS

AUTHORS: N. S. Wilder¹, D. B. Andropoulos², G. S. Moorthy³, T. A. Paugh⁴, K. K. Kibler², D. Wagner¹, A. F. Zuppa⁵

AFFILIATION: ¹Anesthesiology, University of Michigan Health System, Ann Arbor, MI, ²Anesthesiology, Baylor College of Medicine, Houston, TX, ³Center for Clinical Pharmacology, The Children’s Hospital of Philadelphia, Philadelphia, PA, ⁴Perfusion, University of Michigan Health System, Ann Arbor, MI, ⁵Anesthesiology and Critical Care Medicine, The Children’s Hospital of Philadelphia, Philadelphia, PA

INTRODUCTION: Dexmedetomidine (DEX), a highly selective α-2 adrenergic agonist has gained widespread use in children for sedation and as an adjunct to general anesthesia.¹ DEX has the potential for significant benefit in the infant congenital heart surgery population because it provides analgesia and anxiolysis with minimal respiratory depression and has potential neuroprotective properties.² The pharmacokinetics of DEX has only been examined in the postoperative infant cardiac surgical population.³ The purpose of this study is to describe DEX disposition in infant cardiopulmonary bypass (CPB) circuits during simulated CPB.

METHODS: Separate studies were performed at two major Congenital Cardiac Centers utilizing their respective CPB circuits, protocols, prime compositions, and ultrafiltration techniques (Table 1). Circuits flowed at 600 ml/minute and the blood prime was managed to ensure normal physiological parameters. A bolus dose of DEX was administered to each CPB circuit at time = 0. At center 1, five uncoated (UC) circuits were administered 4 mcg of DEX and blood was collected 5, 10, 15, then every 15 until 240 minutes. At center 2, seven X-Coated (XC) circuits were dosed with 5 mcg (n=2), 2.67 mcg (n=3) 1.72 mcg (n=1), or 0.28 mcg (n=1) of DEX and blood was collected 5, 10, 30, 60, 120, 180, 230, 240 min. DEX

Assay: In vitro samples were diluted 50 fold using blank human plasma and analyzed by a validated DEX human plasma assay.⁴ Dilution integrity was tested by independent analysis of 2 duplicate sets of circuit XC-1 samples (accuracy: 81 - 110%). The expected DEX concentration ([DEX]) = dose administered to CPB (mcg) / circuit volume (mL), converted to pg/mL. Percent expected = (actual/expected)*100. The percent expected concentrations for the UC circuits were compared to the XC circuits using the Wilcoxon rank sum-test.

RESULTS: [DEX] in the UC circuits is illustrated in Figure 1. [DEX] was ~50% of expected at 5 minutes, then decreased another 26% over the next 235 minutes. In contrast, the XC circuits shown in Figure 2 show ~100% of expected [DEX] initially, followed by a 22% decrease over the next 175 minutes. The difference in DEX uptake between the UC and XC circuits is delineated in Table 2. The UC circuits underwent only CUF with negligible change in [DEX]. Conversely, CUF in the XC circuits lead to a 51% (p=0.01) decrease in [DEX], and MUF redoubled the [DEX] (p=0.05).

CONCLUSIONS: This is the first study to examine DEX behavior in the CPB circuit. Uncoated circuits bind DEX immediately, while X-coated circuits minimally bind DEX, thus making more drug available to the patient. In coated circuits, the DEX concentration decreases dramatically during CUF but is reconcentrated during MUF. Findings from this study have allowed the authors to design a safe and effective DEX dosing strategy for a Phase I Safety and Pharmacokinetics Study in Corrective Infant Cardiac Surgery, currently underway through the Pediatric Heart Network.

REFERENCES:

1. Anesth Analg. 2011;113:1129-42.
2. Anesthesiology. 2009;110:1077-85.
3. Pediatr Crit Care Med. 2013 Jun;14(5):499-507.
4. J Chromatogr B Analyt Technol Biomed Life Sci. 2007;852:195-201.

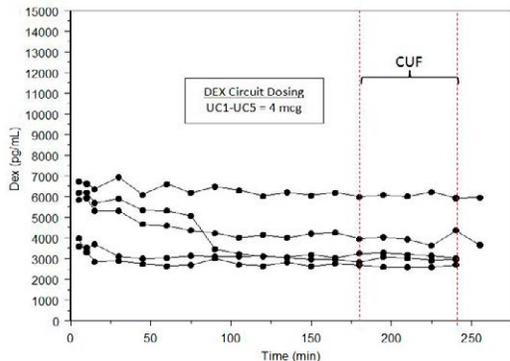


Fig 1. Dexmedetomidine concentration over time in uncoated CPB circuits. CPB, cardiopulmonary bypass; CUF, continuous ultrafiltration; DEX, dexmedetomidine; mcg = microgram; pg/mL, pictogram/milliliter; UC, uncoated circuit.

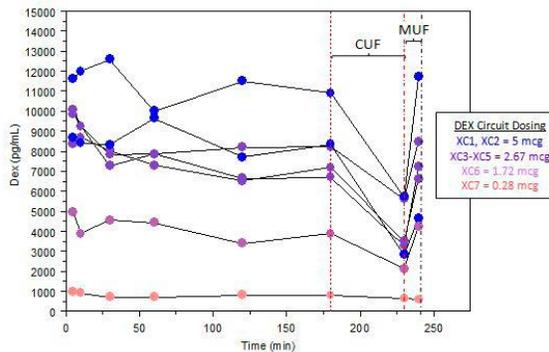


Fig 2. Dexmedetomidine concentration over time in X-coated CPB circuits. CPB, cardiopulmonary bypass; CUF, continuous ultrafiltration; DEX, dexmedetomidine; mcg, microgram; pg/mL, picogram/milliliter; MUF, modified ultrafiltration; XC, X-coated circuit.

	Center 1	Center 2
CPB circuit	Neonatal 1/4" x 1/4" PVC tubing	Mixture of 3/16" and 1/4" PVC tubing
Oxygenator	Terumo Capiox RX-05 BABY-RX	Terumo Capiox RX-05 BABY-RX
Circuit surface	Uncoated	Poly(2-Methoxyethylacrylate)-coated ⁵ (Terumo X-coating™)
Pump prime	Fresh (<7 days) pRBC / FFP / heparin / NaHCO ₃ / CaCl ₂	Expired pRBC / 25% albumin / Plasmaslyte / heparin / NaHCO ₃ / CaCl ₂
Ultrafiltration	Continuous: 180min - 240 min	Continuous: 180min - 230 min Modified: 230 min - 240 min
Temperature	37°C	36°C
Circuit Volume	360 ml	350 ml

⁵An amphiphilic organic polymer shown to reduce protein and platelet adsorption in *in vitro* and *ex vivo* studies. CaCl₂, calcium chloride; CPB, cardiopulmonary bypass; FFP, fresh frozen plasma; NaHCO₃, sodium bicarbonate; pRBC, packed red blood cells; PVC, polyvinylchloride.

Time (min)	Uncoated Circuits			X-coated Circuits	p Value [§]
	Expected [DEX] (ng/ml)	Actual [DEX] (pg/ml)	% of Expected [DEX]		
5	11111	5850	53 (34-58)	110 (81-129)	p < 0.003
30	11111	5310	48 (27-58)	93 (88-103)	p < 0.006
60	11111	4600	41 (26-54)	90 (70-103)	p < 0.006
120	11111	3120	28 (26-46)	85 (69-100)	p < 0.008
180	11111	3250	29 (25-45)	88 (79-99)	p < 0.003
230	11111	3140	28 (25-45)	43 (40-73)	NS
240	11111	3020	27 (26-46)	86 (74-95)	p < 0.015

Data are presented as median (25th percentile – 75th percentile).
[§] P-value from Wilcoxon rank sum test comparing percent of expected [DEX] in Uncoated vs. X-coated circuits.
 CPB, cardiopulmonary bypass; [DEX], dexmedetomidine concentration; NS, not significant; %, percent; pg/mL, picogram/milliliter.

S-53.**THE EFFECTS OF INTRAOPERATIVE
DEXMEDETOMIDINE INFUSION ON POSTOPERATIVE
BOWEL MOVEMENT IN PATIENTS UNDERGOING
LAPAROSCOPIC GASTRECTOMY****AUTHORS:** J. Cho, Y. Yoo, W.J. Choi**AFFILIATION:** Department of Anesthesiology and Pain Medicine, Yonsei University College of Medicine, Seoul, Korea, Republic of**INTRODUCTION:** Pneumoperitoneum during laparoscopic surgery causes sympathetic hyper-activation, catecholamine release and hemodynamic instability, resulting in postoperative ileus and prolonged hospital stay. Dexmedetomidine has sympatholytic effects and maintains hemodynamic stability by reducing norepinephrine release. We hypothesized that the sympatholytic effect of dexmedetomidine would attenuate sympathetic hyperactivation caused by pneumoperitoneum and fasten recovery of bowel function. The aim of this randomized and controlled trial was to investigate the effects of intraoperative dexmedetomidine treatment on the postoperative bowel movement in patients undergoing laparoscopic gastrectomy.**METHODS:** Eighty-one patients undergoing laparoscopic gastrectomy were randomized to placebo (n = 42) or to dexmedetomidine infusion (n = 39) at a rate of 0.4 µg/kg/h after loading dose of 0.5 µg/kg for 10 min. The infusion was started after insufflation of pneumoperitoneum and continued until end of surgery. The primary endpoint was the postoperative bowel movement, assessed by the time to first flatus and time to first diet intake. The secondary outcomes studies were the duration of postoperative hospital stay, the postoperative pain scores, hemodynamics variables, and the balance of autonomic nervous system assessed by the ratio of low-frequency/high-frequency (LF/HF) power of heart rate variability.**RESULTS:** The time to first flatus was earlier in the dexmedetomidine group than in the control group (79.4 ± 15.5 h vs. 66.0 ± 16.9 h, $P < 0.001$). There was no significant difference in the time to first diet intake between groups. The duration of postoperative hospital stay was significantly shorter in the dexmedetomidine group compared with the control group (6.2 ± 2.0 vs. 5.4 ± 0.7 , $P = 0.018$). Pain scores during postoperative 6 h were lower in the dexmedetomidine group, compared with the control group, while there were no significant differences thereafter. Mean blood pressure and heart rate were lower in the dexmedetomidine group compared with the control group during pneumoperitoneum, while they were maintained between $\pm 20\%$ of baseline values. LF/HF ratios during pneumoperitoneum were significantly increased in the control group compared to the baseline value, which suggested sympathetic hyperactivation, while it was not changed in the dexmedetomidine group.**CONCLUSIONS:** Dexmedetomidine administration was associated with faster recovery of bowel movement and reduced postoperative hospital stay. It also reduced pain and analgesic requirement in the immediate postoperative period. It might be attributed that dexmedetomidine attenuated sympathetic hyperactivation and provided analgesic effect during pneumoperitoneum in laparoscopic gastrectomy.

S-54.**BEHAVIOR OF ENDOTHELIAL GLYCOCALYX LAYER DURING SEPSIS IN MICE AS OBSERVED USING FLUORESCENCE IN VIVO MICROSCOPY**

AUTHORS: H. Kataoka¹, A. Ushiyama², H. Kawakami³, Y. Akimoto³, S. Matsubara³, H. Miyao⁴, T. Iijima¹

AFFILIATION: ¹Department of Perioperative Medicine, Division of Anesthesiology, Showa University, School of Dentistry, Tokyo, Japan, ²Department of Environmental Health, National Institute of Public Health, Saitama, Japan, ³Department of Anatomy, Division of Microscopic Anatomy, Kyorin University, School of Medicine, Tokyo, Japan, ⁴Department of Anesthesiology, Saitama Medical Center, Saitama Medical University, Saitama, Japan

INTRODUCTION: The endothelial glycocalyx (GCX) is located on the apical surface of the vascular endothelium and is composed of a negatively charged network of proteoglycans and glycoproteins; it is less than 500 nm thick¹. Clinically, GCX disorders are reportedly induced under some pathophysiological statuses, such as severe sepsis², but the crucial role of the GCX is not well understood. Therefore, we aimed to develop a real-time and in vivo imaging method of the GCX using fluorescence microscopy to observe the time-dependent behavior of the GCX in the presence of severe sepsis in mice.

METHODS: We used male BALB/c mice with a dorsal skinfold chamber to observe the subcutaneous microcirculation³. For GCX visualization, we used fluorescein isothiocyanate (FITC)-labeled lectins. In general, each lectin exhibits specific carbohydrate binding; therefore, we compared the binding ability of a variety of lectins (including Wheat Germ Agglutinin; WGA). FITC-lectin was injected intravenously prior to the observation of the vasculature images using microscopy. To observe the behavior of the GCX, the animals were allocated into three groups: control, LPS-treated, and glycosidase-treated groups. LPS was intraperitoneally injected at a dose of 2 mg/kg at 0 and 18 hours, and images were obtained at 24 hours after the initial injection. Glycosidase (a mixture of hyaluronidase and heparinase III) was intravenously injected 2 hours before observation. In all the groups, GCX imaging was performed using the intravenous injection of FITC-WGA. This study was approved by the Animal Care and Use Committee of the National Institute of Public Health.

RESULTS: To identify an appropriate lectin for GCX visualization, we examined 8 different lectins. The results showed that wheat germ agglutinin (FITC-WGA) stained the GCX well in the control group. In the LPS group, however, both the brightness and the thickness of the FITC-WGA were clearly attenuated. The staining was also attenuated in the glycosidase group. These results suggest the collapse of the GCX under severe septic and glycosaminoglycan-digested conditions. Similar results were observed using electron microscopy. Both the fluorescence and the electromicroscopic observations suggested that an LPS-induced septic condition elicited the collapse of the GCX and that this collapse might have exacerbated the pathophysiological status.

CONCLUSIONS: This study showed that FITC-WGA is a useful tool for visualizing endothelial GCX in the subcutaneous vasculature of mice. Both the brightness and the thickness of the FITC-WGA-positive layer were attenuated under septic and glycosaminoglycan-digested conditions. These findings suggest the collapse of the GCX under these conditions. Moreover, the behavior of the FITC-WGA-positive layer was in accordance with that of the GCX layer identified using electron microscopy. GCX imaging using FITC-WGA and in vivo microscopy provides the advantage of enabling a detailed analysis of both GCX and its physiological function.

REFERENCES:

1. Ann Rev of Biomed Eng. 2007; 9: 121-1672.
2. Microvas Res. 2013;90:86-9
3. Microvas Res. 2004;68:147-52.

Subspecialty Abstracts

Cardiovascular Anesthesiology

S-55.**A RETROSPECTIVE CHART ANALYSIS OF PATIENTS UNDERGOING TRANSMYOCARDIAL LASER REVASCLARIZATION - A GEORGIA REGENTS UNIVERSITY EXPERIENCE****AUTHORS:** S. Agarwal, S. Bahadur, M. R. Castresana**AFFILIATION:** Anesthesiology and Perioperative Medicine, Georgia Regents University, Augusta, GA**INTRODUCTION:** Transmyocardial laser revascularization (TMR) is an approved surgical procedure for diffuse, end-stage coronary artery disease (CAD) in conjunction with CABG in patients who would be incompletely revascularized by CABG alone.¹ We sought to conduct a retrospective chart review of the TMR cases that have been performed in the Georgia Regents University, Augusta, GA recently, in order to assess the safety of this procedure.**METHODS:** After IRB approval, electronic charts of 10 patients who underwent TMR recently were reviewed. Data was analyzed using MS excel 2013. All continuous variables are reported as mean \pm SD (standard deviation)**RESULTS:** In our cohort, the mean age was 60.8 ± 9.4 years and mean body mass index (BMI) was 31.1 ± 4.1 . All patients were hypertensive, most had hyperlipidemia, and more than 50% had diabetes, while only one patient had chronic kidney disease. All patients had multivessel CAD, as diagnosed by angiography. Only two patient had a recent MI, rest presented with unstable angina.Intraoperatively, all underwent TMR in the postero-inferior wall of the left ventricle, 9 patients received 20 channels, while one patient received 16 laser channels. All patients received antifibrinolytics either aminocaproic acid (70%) or tranexemic acid (30%). Mean cardiopulmonary bypass (CPB) and aortic cross clamp (ACC) times were 80.3 ± 26.1 mins and 43.5 ± 19.9 mins respectively. Cell saver use was documented in 8 patients, with mean processed blood of 326.1 ± 177.1 mL.TEE was used in all patients to guide TMR. Live 2D and 3D TEE was also performed while the laser channels were created, which showed a characteristic, “fireworks” or “blast of steam” appearance due to transmural penetration of the laser. This helped identify the exact site of channel to warn the surgical team if they were too close to the vital structures, namely mitral and aortic valves.²None of the patients had any TMR-related complications like, bleeding, tamponade, malignant arrhythmias, new regional wall motion abnormalities or any new valvular dysfunctions. Average length of ICU and hospital stay was 2.3 ± 0.5 days and 8.1 ± 3.5 days respectively.**DISCUSSION:** In our institution, TMR is done only in conjunction with CABG in patients who are not candidates for complete surgical revascularization. While both, Ho:YAG and carbon dioxide (CO₂) lasers are FDA approved for this purpose, in our institution only Ho:YAG laser is routinely used. Retrospective studies done in the past have shown TMR to be surgically feasible and safe, with excellent short term results.³

The main limitations of the study were that it was a retrospective study with a very limited number of patients. Also we did not do a long-term follow-up of these patients to assess the efficacy of the procedure.

CONCLUSIONS: In the small cohort of patients undergoing TMR at our institution, the procedure was well tolerated with no intraoperative morbidity or mortality.**REFERENCES:**

1. Hillis LD, et al. *Circulation* 2011;124:e652-735.
2. Agarwal S, et al. *Anesth Analg.* 2014 Mar;118(3):512-5.
3. Trehan N, et al. *Eur J Cardiothorac Surg* 1997; 12:276-284.

S-56.**A SUCCESSFUL CASE OF CONVENTIONAL TREATMENT FOR SYSTOLIC ANTERIOR MOTION WITHOUT LEFT VENTRICULAR OUTFLOW TRACT OBSTRUCTION FOLLOWING MITRAL VALVE PLASTY****AUTHORS:** J. Ichikawa, M. Kodaka, K. OKAMURA, M. Komori**AFFILIATION:** Anesthesiology, Tokyo Women's Medical University Medical Center East, Tokyo, Japan**INTRODUCTION:** The incidence of systolic anterior motion (SAM) of anterior mitral leaflets is 2-14% following mitral valve repair surgery. SAM occurs when a slack anterior leaflet is forced into the left ventricular outflow tract (LVOT) by the flow of ejected blood. The decision for further surgical treatment is complicated but occurs when conservative management is ineffective. One factor that can contribute to dynamic left ventricular outflow tract

obstruction (LVOTO) is the bloodstream causing drag forces and a Venturi effect on the anterior mitral leaflet. This can lead to SAM and the anterior mitral leaflet contacting the septum during the systole period, causing progressive LVOTO. We report a case of SAM after mitral valve plasty that did not cause severe LVOTO, and was managed by conservative medical therapies resulting in a favorable prognosis.

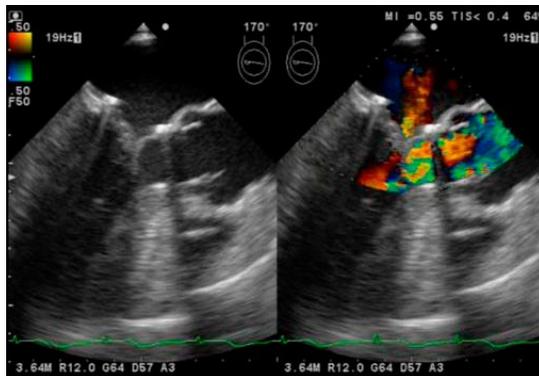
METHODS: A 74-year-old woman (weight, 65 kg; height, 159 cm) with hypertension developed mild mitral regurgitation (MR) because the lateral scallop of the posterior leaflet (P3) billowed. Preoperative transthoracic echocardiogram identified the ejection fraction to be 78.5% and revealed the absence of ventricular septum thickening. Quadrangular resection of P3, in addition to an annuloplasty with a 30-mm ring (Physio II) were performed. At the

weaning from cardiopulmonary bypass, dopamine was infused at 5 µg/kg/min. Transesophageal echocardiography monitoring revealed SAM, moderate MR and peak systolic pressure gradients in the LVOT to be 21.9 mmHg. Despite volume loading, limited dopamine administration and 30 mg of Esmolol, the MR was not successfully corrected. However, further surgical intervention was deemed unnecessary because of the absence of severe LVOTO and circulatory collapse. Transthoracic echocardiogram, performed at postoperative day 5, identified that SAM had sufficiently ameliorated and the remaining MR was trivial. The patient was discharged on postoperative day 10.

CONCLUSIONS: Although the precise mechanism of SAM was not determined, it was revealed that the coaptation point of the elongated posterior leaflet shifted anteriorly, resulting in it being positioned in the LVOT. The management of SAM intraoperatively remains controversial; some groups advocate conservative therapy, while others propose surgical repair. Brown et al., suggested that SAM treated with β-blockade without afterload-reducing medication usually improves with time because of late ventricular remodeling, subsequently surgical intervention is rarely necessary.¹ In this case, although conventional treatment failed to eliminate SAM, further surgical manipulation was not necessary because severe LVOTO and circulatory collapse were not present. The degree and duration of SAM determines the severity of the dynamic LVOT gradients.² LVOTO and hemodynamic evaluation may be important to decide whether surgical intervention is required.**REFERENCES:**

1. J Thorac Cardiovasc Surg; 133:136-43, 2007
2. Circulation;116:e110-e113,2007

Fig 1: Transesophageal echocardiography showing systolic anterior motion of anterior mitral leaflets and mild mitral regurgitation.



S-57.

THE IMPLICATIONS OF PREOPERATIVE BETA BLOCKERS IN CARDIAC SURGERY PATIENTS WITH INTRAOPERATIVE BLOOD TRANSFUSION

AUTHORS: V. J. Orhurhu¹, K. Owais², E. Akintoye¹, J. D. Mitchell¹, F. Mahmood², R. Matyal²

AFFILIATION: ¹Epidemiology and Biostatistics, Quantitative Methods, Harvard School of Public Health, Boston, MA, ²Anesthesia Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA

INTRODUCTION: Beta blockers are usually used in the prevention of stroke recurrence in the outpatient setting. However, its applications in cardiac surgery patients who receive blood transfusion still remain unclear. In this study we investigated the association of preoperative beta blocker administration and postoperative outcomes in cardiac surgery patients who received intraoperative blood transfusion.

METHODS: A retrospective study was conducted on 3379 patients who had undergone cardiac surgery between the periods of January 2002 through December 2013. Of these patients, 1176 were excluded from the study for not meeting inclusion criteria. Patients were divided into those taking (n=1666) and not taking (n=537) beta blockers preoperatively. Eight perioperative variables significantly associated with preoperative beta blocker were included in a logistic regression model and propensity scores were calculated. Hosmer-Lemeshow goodness-of-fit test and C-statistics were used to calibrate and evaluate the model. Preoperative beta blocker exposure and the propensity score covariate were included in an additional logistic regression model to evaluate the association with mortality and four additional postoperative outcomes.

RESULTS: The operative mortality for the study cohort occurred in 93 of 1666 patients (5.58%) in the beta blocker group and 55 of 537 patients (10.24%) in the group without beta blocker (OR = 0.51; 95% confidence interval [CI], 0.36-0.73; P=0.000). After multivariate adjustment, the odd of mortality in the non-beta blocker group was 2.5 times higher than the beta blocker group. The odd of permanent stroke in the non-beta blocker group was 2.1 times higher than the beta blocker group. There were no significant association between preoperative beta blockers and postoperative arrhythmia, readmission (<30 days), and perioperative myocardial infarction (MI). The Hosmer-Lemeshow goodness of fit test chi square value was 0.6705 and the area under the receiver operating curve was 0.5812.

CONCLUSIONS: Higher mortality was seen amongst the group without preoperative beta blocker administration. We also observed a higher association of permanent stroke in groups without preoperative beta blocker administration. This result suggests some protective effect of preoperative beta blockers in cardiac surgery patients who receive blood transfusion.

Table 1: Univariate, Multivariate logistic regression-adjusted, and Propensity adjusted associations between preoperative beta blocker and five postoperative outcomes.

	Univariate Analysis		Multivariate Logistic Regression		Propensity Score Adjusted	
	OR (95% CI)	P value	OR (95% CI)	p-value	OR (95% CI)	p-value
Operative Mortality	0.51 (0.37-0.73)	0.000	0.40 (0.25-0.65)	0.000	0.42 (0.26-0.68)	0.000
Permanent Stroke	0.59 (0.37-0.97)	0.038	0.47 (0.25-0.85)	0.013	0.47 (0.26-0.85)	0.012
Arrhythmia	1.25 (0.97-1.60)	30.08	0.99 (0.72-1.36)	0.961	0.86 (0.63-1.17)	0.333
Readmission (<30days)	1.12 (0.87-1.44)	0.389	0.95 (0.67-1.35)	0.775	1.06 (0.74-1.50)	0.762
Perioperative MI	0.89 (0.28-2.82)	0.844	0.42 (0.11-1.54)	0.192	0.85 (0.23-3.17)	0.811

S-58.**THE ASSOCIATION BETWEEN MILD ANEMIA AND POSTOPERATIVE OUTCOMES IN CARDIAC SURGERY PATIENTS WITHOUT BLOOD TRANSFUSION**

AUTHORS: V. J. Orhurhu¹, K. Owais², E. Akintoye¹, J. Mitchell², F. Mahmood², R. Matyal²

AFFILIATION: ¹Epidemiology and Biostatistics, Quantitative Methods, Harvard School of Public Health, Boston, MA, ²Anesthesia Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA

INTRODUCTION: Indication for blood transfusion still remains controversial in cardiac surgery patients. In this study, we sought to determine the relationship between mild anemia, defined as hematocrit <36%, and postoperative mortality in cardiac surgery patients without blood transfusion.

METHODS: A total of 3526 consecutive patients underwent cardiac surgery between the periods of January 2002 through December 2013. Of these patients, 1497 were excluded for not meeting the inclusion criteria for this study. A step wise logistic regression was used to adjust fifteen preoperative characteristics that could potentially act as confounders in our study. The following preoperative characteristics included in our multivariable regression model were: gender, weight, height, weight, age, last creatinine level, perfusion time, hypertension, surgery status, use of angiotensin converting enzyme inhibitor, ejection fraction, congestive heart failure, coronary artery bypass graft, and use of intra-aortic balloon pump. The adjusted association between mild anemia and postoperative mortality was reported in the form of odds ratio and a 95% confidence interval. Three additional postoperative outcomes were also evaluated.

RESULTS: Postoperative mortality for the study cohort of 2382 patients was 2.98% overall. 55% for the patients had mild anemia. Compared to the group without anemia, the adjusted odds of postoperative mortality was 0.91 (0.48-1.71, p= 0.761). Of the three additional postoperative outcomes (Table 1), acute kidney injury had a 5% higher odd amongst patients who were mildly anemic. Interestingly, mild anemia was not significantly associated with bleeding and readmissions after 30 days.

CONCLUSIONS: Mild anemia was not significantly associated with increased risk for postoperative mortality in patients who underwent cardiac surgery without blood transfusion in our study. However, mild anemia was significantly associated with higher risk for acute kidney injury. Blood transfusion may be beneficial in reducing acute kidney injury in mild anemic patients.

Table 1: Univariate, stepwise logistic regression-adjusted associations between anemia and four postoperative outcomes.

	Univariate Analysis		Stepwise Logistic Regression	
	OR (95% CI)	P value	OR (95% CI)	p-value
Operative Mortality	2.33 (1.42-3.82)	0.001	0.91 (0.48-1.71)	0.761
Acute Kidney Injury	2.05 (1.70-2.48)	0.000	1.64 (1.30-2.07)	0.001
Bleeding	0.91 (0.51-1.61)	0.736	0.88 (0.44-1.76)	0.727
Readmission > 30 days	1.55 (1.26-1.92)	0.000	1.14 (0.88-1.48)	0.313

S-59.

PROFILING OF CELL STRESS PROTEIN EXPRESSION IN CARDIAC TISSUE OF CARDIOSURGICAL PATIENTS UNDERGOING REMOTE ISCHEMIC PRECONDITIONING: INDICATIONS FOR THIOREDOXIN IN CARDIOPROTECTION

AUTHORS: K. S. Zitta¹, P. Meybohm², M. Gruenewald³, M. Steinfath⁴, M. Albrecht⁵

AFFILIATION: ¹Department of Anaesthesiology and Intensive Care Medicine, UKSH, Kiel, Germany, ²Department of Anaesthesiology, Intensive Care Medicine and Pain Therapy, University Hospital Frankfurt, Frankfurt, Germany, ³Department of Anaesthesiology and Intensive Care Medicine, University Hospital SH, Kiel, Kiel, Germany, ⁴Department of Anaesthesiology and Intensive Care Medicine, University Hospital Kiel, Kiel, Germany, ⁵Department of Anaesthesiology and Intensive Care Medicine, University Hospital Schleswig-Holstein, Kiel, Germany

INTRODUCTION: Transient episodes of ischemia in a remote organ (remote ischemic preconditioning, RIPC) can attenuate myocardial injury but the underlying mechanisms of RIPC in the target organ are still poorly understood^{1, 2}. Some recent studies suggest that the small redox protein thioredoxin may be a potential candidate for preconditioning-induced organprotection³. Here we employed a human proteome profiler array to investigate the RIPC regulated expression of cell stress proteins in heart tissue of cardiosurgical patients with cardiopulmonary bypass (CPB) and focused on the potential role of thioredoxin in RIPC-mediated cardioprotection.

METHODS: RIPC was induced by four 5 minute cycles of transient upper limb ischemia/reperfusion using a blood pressure cuff. Right atrial tissue was obtained from patients receiving RIPC (N=19) and control patients (N=19) before and after CPB (Figure 1). Cell stress proteome profiler arrays as well as Westernblotting and ELISA experiments for thioredoxin were performed employing the respective tissue samples.

RESULTS: Protein arrays revealed an upregulation of 26.9% (7/26; CA IX, Cyt C, HSP-60, HSP-70, pJNK, SOD2, Thio-1) of cell stress associated proteins in RIPC tissue obtained before CPB, while 3.8% (1/26; SIRT2) of the proteins were downregulated (Figure 2). Array results were verified for thioredoxin by semiquantitative Westernblotting studies which showed a significant upregulation of thioredoxin protein levels in cardiac tissue samples of RIPC patients taken before CPB (RIPC: 5.36±0.85 a.u.; control: 3.23±0.39 a.u.; P<0.05; Figure 3). Quantification of thioredoxin levels in tissue of RIPC and control patients by ELISA experiments further confirmed the Westernblotting results (RIPC: 0.30±0.02 ng/mg protein; control: 0.24±0.02 ng/mg protein; P<0.05; Figure 4).

CONCLUSIONS:RIPC leads to an early upregulation of several cell stress proteins in heart tissue of cardiosurgical patients and thioredoxin may be a factor involved in RIPC-mediated cardioprotection.

REFERENCES:

1. Hausenloy et al. (2007). *Lancet* 370:575-579
2. Hausenloy, Yellon (2009). *Atherosclerosis* 204:334-341
3. Nicholson et al. (2013). *Arteriosclerosis, thrombosis, and vascular biology* 33:744-751

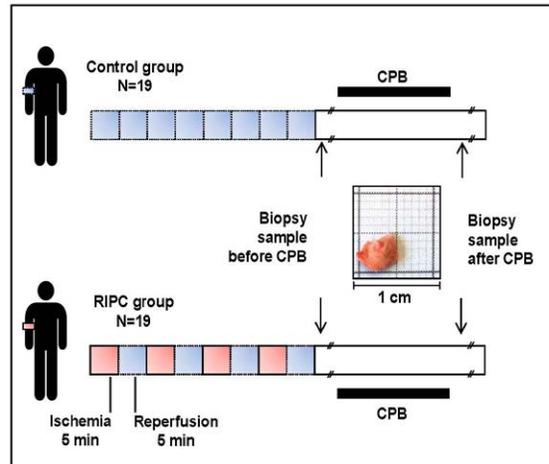


Figure 1: Experimental setting. RIPC was performed by 4 cycles of 5 minutes of upper arm ischemia induced with a blood pressure cuff. Each cycle of ischemia was followed by 5 minutes of reperfusion. Cardiac biopsies were obtained before and after CPB. CPB, cardiopulmonary bypass; RIPC, remote ischemic preconditioning.

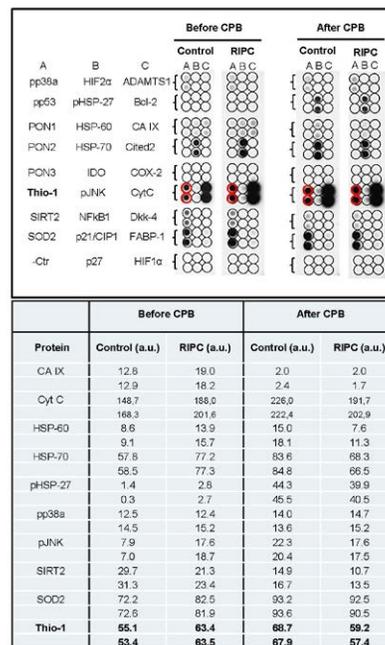


Figure 2: Proteome profiling of cell stress proteins. Equal amounts of protein from control (N=18) and RIPC patients (N=18) were pooled and employed in the array. Only proteins with signal intensities ≥10% of the internal reference control protein spot (not shown) were quantified. Numbers in the table represent the densitometric intensities of duplicate sample spots. pp38a, phospho-p38 alpha (T181/Y185); HIF2a, hypoxia inducible factor 2 alpha; ADAMTS1, a disintegrin and metalloproteinase with thrombospondin motifs 1; pp53, phospho-p53 (S46); pHSP-27, phospho-heat shock protein-27; Bcl-2, B cell lymphoma-2; PON1, paraoxonase 1; HSP-60, heat shock protein-60; CA IX, carbonic anhydrase IX; PON2, paraoxonase 2; HSP-70, heat shock protein-70; Cited2, Cbp/p300-interacting transactivator; PON3, paraoxonase 3; IDO, indoleamine 2,3-dioxygenase; COX-2, cyclooxygenase-2; Thio-1, thioredoxin-1; pJNK, phospho JNK Pan (T183/Y185); CytC, cytochrome C; SIRT2, sirtuin 2; NFkB1, nuclear factor kappa B1; Dkk-4, dickkopf-4; SOD2, superoxide dismutase 2; p21/CIP1, cyclin-dependent kinase inhibitor 1A; FABP-1, fatty acid binding protein-1; - Ctr, negative control; p27, cyclin-dependent kinase inhibitor 1B; HIF1a, hypoxia inducible factor 1 alpha. a.u., arbitrary units.

S-59 • continued

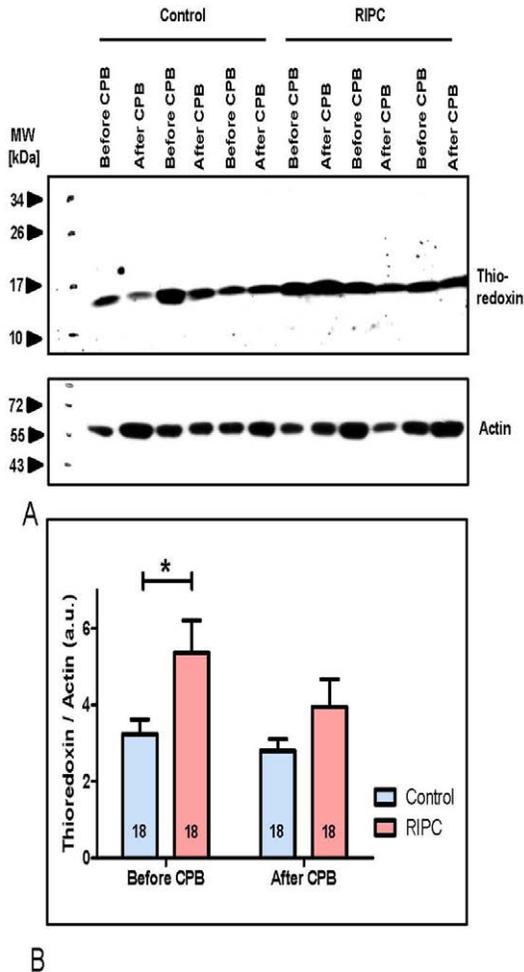


Figure 3: Semiquantitative evaluation of thio-redoxin protein expression. A: Representative Western blotting experiment performed with cardiac tissue samples of 3 control and 3 RIPC patients. B: Evaluation of the relative protein expression levels of thio-redoxin in control and RIPC patients. Numbers in the columns display the numbers of patients employed in the respective experiment. MW, molecular weight; kDa, kiloDalton; a.u., arbitrary units; columns display the mean; bars denote SEM; *, P<0.05.

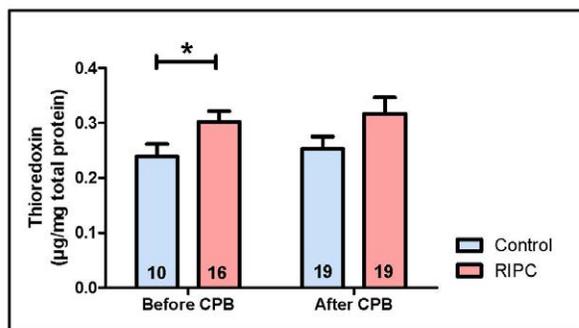


Figure 4: Quantification of thio-redoxin protein expression by ELISA. The amount of thio-redoxin protein is increased in tissue from RIPC patients that was obtained before CPB. Numbers in the columns display the numbers of patients employed in the respective experiment. Columns display the mean; bars denote SEM; *, P<0.05.

S-60.

HEMODYNAMIC CHANGES INDUCED BY CONTINUOUS CUIRASS NEGATIVE PRESSURE IN PATIENTS WITH FONTAN CIRCULATION

AUTHORS: N. Katori, Y. Kakinuma, H. Morisaki

AFFILIATION: Anesthesiology, Keio University, Tokyo, Japan

INTRODUCTION: Early extubation in patients with Fontan circulation is generally advocated because spontaneous respiration increases systemic venous return and cardiac output^{1,2}. However there are patients who need positive pressure ventilation because of delayed recovery from anesthesia due to residual opioids or sedatives, hypothermia, etc. after the Fontan procedure. Continuous cuirass negative pressure (CNPV) has been shown to attenuate the negative effects of positive pressure ventilation on circulation in adult cardiac patients³. Thus we hypothesized CNPV would augment cardiac output in patients with Fontan circulation as shown in normal circulation. We hereby examined the effect of CNPV in combination with positive pressure ventilation on hemodynamics after the Fontan procedure.

METHODS: With approval of institutional review board and adherence to the Declaration of Helsinki, adult patients who underwent the Fontan operation between Dec 2009 and Dec 2013 were included in the study. All patients were transferred to the ICU with their trachea intubated and received positive pressure support (PS; 5 cmH₂O) with positive end-expiratory pressure (3-5 cmH₂O) under spontaneous breathing postoperatively. Synchronized intermittent mandatory ventilation was provided to avoid hypercapnia if necessary (3-8 /min). Continuous cuirass negative pressure ventilation (-10-15 cmH₂O) was started three hours after the admission to the ICU. CNPV was continued for 12-24 hours after the extubation. Cardiac index (CI) and central venous oxygen saturation (ScvO₂) were monitored by FloTrac sensor and PreSep oximetry catheter (Edwards Lifesciences, CA, USA) continuously through the surgery and postoperative period. CI and ScvO₂ were compared between pre- and post-CNPV periods. Data were analyzed with Kruskal-Wallis H-test followed by Mann-Whitney U-test with Bonferroni correction where applicable. P value less than 0.05 was considered significant.

RESULTS: Five patients were included in the study. Mean CI before and after CNPV were 1.9 ± 0.3 and 2.5 ± 0.2 (L/min/m²), respectively. Accordingly, ScvO₂ increased after the initiation of CNPV significantly (52 ± 2 vs. 65 ± 4 %). These hemodynamic changes may indicate CNPV augments cardiac output and improves oxygen delivery.

CONCLUSIONS: CNPV augmented cardiac output even in combination with positive pressure ventilation and improved oxygen delivery. Continuous cuirass negative pressure ventilation is effective to increase cardiac output and to improve oxygen delivery in patients with the Fontan circulation.

REFERENCES:

1. Ann Thorac Surg 2008; 86: 576-82.
2. Eur J Cardio-thorac Surg 2001; 20: 114-9.
3. Ann Thorac Surg 2008; 85: 1355-60.

S-61.**THE INFLUENCE OF BRACHIAL-ANKLE PULSE WAVE VELOCITY ON ACUTE KIDNEY INJURY AFTER CARDIAC SURGERY**

AUTHORS: K. Sato, Y. Seino, S. SAKUMA, S. Yokokawa, S. Kurokawa, M. Ozaki

AFFILIATION: Department of Anesthesiology, Tokyo Women's Medical University, Tokyo, Japan

INTRODUCTION: Brachial-ankle pulse wave velocity (baPWV), which is calculated as the ratio of the distance between the brachial and the tibial artery divided by the transit time between these two arteries by noninvasive techniques, has been proposed as a biomarker of arteriosclerosis and cardiovascular risk. We hypothesized that arteriosclerosis represented by baPWV was an independent risk factor for acute kidney injury (AKI) after cardiac surgery, and investigated the influence of baPWV on AKI after cardiac surgery that was associated with increased postoperative mortality and morbidity.

METHODS: All adult patients who underwent cardiac surgery in our institution over one year were investigated retrospectively. Exclusion criteria included surgeries without cardiopulmonary bypass, emergency surgeries, surgeries with deep hypothermic circulatory arrest, patients who were not measured baPWV preoperatively, and patients with end-stage renal failure requiring hemodialysis. Medical charts were reviewed to recognize postoperative AKI defined by RIFLE criteria and related risk factors. Multivariate logistic regression analysis was conducted to identify risk factors for AKI after cardiac surgery.

RESULTS: Among 345 patients undergoing cardiovascular surgery, 102 patients met the inclusion criteria. Patients with AKI were more likely to be male (75% vs. 48%, $p = 0.02$), have diabetes mellitus (32% vs. 12%, $p = 0.04$), re-exploration (16% vs. 3%, $p = 0.04$), higher serum creatinine (0.99 mg/dl vs. 0.79 mg/dl, $p = 0.04$), lower hemoglobin (10.4 mg/dl vs. 12.0 mg/dl, $p = 0.04$), and calcium channel blocker medication (55% vs. 27%, $p = 0.02$) compared with patients without AKI. baPWV was not associated with AKI defined by RIFLE criteria. Multivariate logistic regression analysis revealed that diabetes mellitus (odds ratio: 5.9, 1.2-34.2), re-exploration (odds ratio: 18.4, 1.1-602.5) and preoperative hemoglobin of less than 12 mg/dl (odds ratio: 5.5, 1.1-35.2) were independent risk factors for AKI.

CONCLUSIONS: In this retrospective study, baPWV was not associated with AKI after cardiac surgery. Diabetes mellitus, re-exploration and lower hemoglobin were identified to be independent risk factors for AKI.

REFERENCES:

1. Hypertension 2012; 60: 556-562
2. Circulation 2009; 119: 2444-2453
3. Critical Care 2004; 8: R204-R212

S-62.

NUMEROUS ARTERIAL GAS EMBOLI OCCUR DURING CLOSED-CIRCUIT EXTRACORPOREAL MEMBRANE OXYGENATION

AUTHORS: Y. Jiao¹, K. Gipson², J. Gross³, R. B. Schonberger⁴

AFFILIATION: ¹Department of Anesthesiology, University of Connecticut, Hartford, CT, ²Department of Anesthesiology, University of Connecticut, Wallingford, CT, ³Department of Anesthesiology, University of Connecticut, Farmington, CT, ⁴Department of Anesthesiology, Yale University, New Haven, CT

INTRODUCTION: Extracorporeal membrane oxygenation (ECMO) in patients with severe cardiopulmonary disease is frequently complicated by end-organ dysfunction¹. Gaseous microemboli (GME) are known to damage end-organs during cardiopulmonary bypass, yet they have not been characterized in bypass circuits during closed-circuit ECMO. To assess the GME burden during ECMO, we performed a semi-quantitative analysis of GME in venous-to-arterial ECMO with correlation to clinical events during patient care.

METHODS: Observational study of patients undergoing venous-to-arterial ECMO was approved by the Human Investigation Committee at our study institution. We used two precordial Doppler probes to detect GME non-invasively in the ECMO circuit upstream and downstream of the Maquet Cardiohelp oxygenator. Recordings were performed on 4 patients for a total of 15 hours while an investigator noted the timing and nature of clinical events during routine patient care (e.g. patient movement, IV drug delivery). The Doppler signal was processed via custom analog envelope detector then digitized and recorded electronically for offline analysis. To estimate GME counts and volumes represented by the Doppler signals recorded during patient care, we used an ECMO circuit filled with human blood and a patient simulator in the laboratory as previously described². We compared precordial Doppler signals with the more invasive gold-standard Emboli Detection and Classification (EDAC) quantifier in pre- and post-membrane locations during simulated clinical interventions. Correlations between Doppler and EDAC data were used to estimate GME counts and volumes from the clinical precordial Doppler data.

RESULTS: All three formulations showed efficacy in causing loss of righting reflex. No ill effects were evident during or after the anesthetic period. For Diprivan, B8, and L3, the threshold doses causing loss of righting reflex were 5.3 ± 0.3 , 5.4 ± 0.4 , and 5.8 ± 0.1 mg kg⁻¹ respectively (Graph). For all doses tested, mean time to return of righting reflex for the lipid-free formulations was similar to or slightly shorter than for Diprivan. The lipid-free emulsions were stable for 1 year. Particle size profiles were (B8: 212 ± 66 nm; L3: 74 ± 88 nm; mean \pm SD) within the tolerance range for Diprivan (150 - 300 nm).

CONCLUSIONS: Large numbers of embolic signals are observed in unfiltered ECMO circuits during adult venous-to-arterial ECMO. A smaller number of larger emboli in the premembrane location yield larger numbers of smaller emboli in the postmembrane location, suggesting fragmentation of the emboli as they traverse the pump and oxygenator. Increased embolic rates during patient movement and IV administration suggest mechanical dislodgement of venous air and iatrogenic introduction of venous air as sources of gaseous emboli in the ECMO circuit. The embolic rates observed suggest a role for arterial filtration or other GME removal methodology to reduce end-organ complications during ECMO.

REFERENCES:

1. Ann Thorac Surg 97:610-6 (2014)
2. Ann Thorac Surg 97:879-86 (2014)

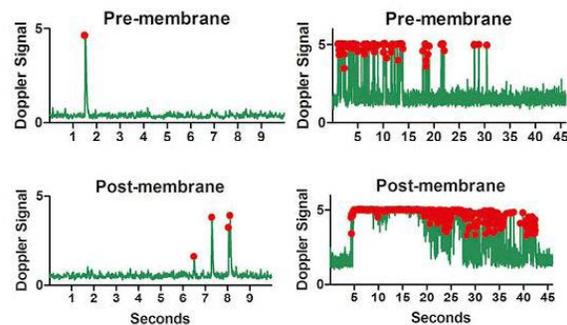


Figure 1: Doppler recordings of GME during ECMO in adult patients. Numerous GME were recorded in all 4 ECMO patients. (A) Quiet periods of ICU care were characterized by small showers of emboli (peaks highlighted with red dots), while (B) during intravenous therapy multiple and repeated showers with hundreds or thousands of emboli were observed.

Table 1: Estimates of (post-membrane) GME burden in adult ECMO patients

	Time (min)	Total Est. Emboli	Total Est. Volume (µL)	Est. Embolic Rate (per min)
Quiet	674	11951	0.9	17.7
Movement	64	18985	1.5	296.5
Intravenous	162	346344	62.3	2135.1
Total	900	377280	64.7	419.2

S-63.**INTRAOPERATIVE RIGHT VENTRICULAR FRACTIONAL AREA CHANGE IS A GOOD INDICATOR OF RIGHT VENTRICULAR CONTRACTILITY: A RETROSPECTIVE COMPARISON USING TWO- AND THREE-DIMENSIONAL ECHOCARDIOGRAPHY**

AUTHORS: T. Imada, S. C. Shibata, Y. Matsumoto, A. Maeda, T. Kamibayashi, Y. Fujino

AFFILIATION: Department of Anesthesiology and Intensive Care Medicine, Osaka University Graduate School of Medicine, Suita, Osaka, Japan

INTRODUCTION: Transesophageal echocardiography (TEE) is an essential diagnostic tool in evaluating ventricular function in cardiac dysfunction patients during surgery. Although two-dimensional echocardiographic (2DE) assessment is useful as an evaluation of the right ventricular (RV) function, intraoperative 2DE assessment of RV function is underutilized due to complex structural geometry of RV and difficulty in the measurement technique. RV fractional area change (RVFAC) is a relatively easy method to evaluate RV function and is recommended as one of the quantitative methods of estimating RV function.¹ A newly developed software which can reconstruct two 2DE images into three-dimension (3D) has been reported to be clinically feasible tool for quantitative RV analysis.^{2,3} We designed the following study to determine the strength of the correlation between intraoperative measurement of RVFAC and RV ejection fraction (RVEF) by 3DE.

METHODS: The authors obtained approval from the ethics committee of our institution for this retrospective record based study. The patients who received TEE during surgery at our institution between March 2014 and June 2014 were enrolled in this study. All 2D and 3D images were simultaneously acquired in the midesophageal four-chamber view. Analysis for RVFAC and 3D volumetric data was performed by separate anesthesiologist both blind to the other's results. RVFAC, defined as (end-diastolic area-end-systolic area) / end-diastolic area × 100, was calculated during surgery. The full-volume data sets acquired over 2 beats were exported from the ultrasound system to an off-line personal computer installed with "Image Arena" software package (TomTec GmbH, Munich, Germany) and were analyzed by a dedicated software "4D RV-FUNCTION" (TomTec GmbH, Munich, Germany) postoperatively.

RESULTS: A total of 62 patients were enrolled in this study, eight RVEF by 3DE data sets were excluded (6 patients with poor quality of 3D full-volume data set due to stitch artifact and 2 patients due to arrhythmia). As a result, 54 patients were analyzed. The mean RVFAC was 38.8 ± 8.7 % and the mean RVEF by 3DE was 41.4 ± 8.3 %. The RVFAC had good correlation with RVEF by 3DE ($r = 0.638$; $p < 0.001$).

CONCLUSIONS: RVFAC correlated well with RVEF derived by 3DE and this result suggests that even anesthesiologists who are inexperienced in assessment of RV function by TEE can estimate accurate right ventricular function and conduct more high-quality intraoperative hemodynamic management.

REFERENCES:

1. J Am Soc Echocardiogr 2010, 23, 685-713
2. J Cardiothorac Vasc Anesth 2013, 27, 367-375
3. J Am Coll Cardiol 2007, 50, 1668-1676

S-64.**MILRINONE AUGMENTS ENDOTHELIAL CELL SURVIVAL IN NORMOXIA AND HYPOXIA**

AUTHORS: J. H. Rim¹, J. Montoya-Gacharna¹, P. Butala², S. Warren²

AFFILIATION: ¹Anesthesiology, University of Missouri, Columbia, MO, ²International Institute of Nano and Molecular Medicine, University of Missouri, Columbia, MO

INTRODUCTION: Phosphodiesterase inhibitors protect the myocardium against ischemia-reperfusion stress (Huang MH et al., 2011), and milrinone is used during perioperative care of cardiac patients (Poh KK, et. Al., 2014, Mebazaa A et al., 2010, Troitzsch D et al., 2001, Lobato EB, 1998). Its efficacy and mechanisms in relation to cardioprotection against ischemic stress have not been identified. Interestingly PDE inhibitors have cytoprotective effects in the heart (Rao YJ and Lei X, 2009). We assess the hypothesis that milrinone confers protective effects against hypoxic stress in human umbilical vein endothelial cells (HUVECs) and demonstrate that it improves survival in normoxia and hypoxia.

METHODS: HUVECs were cultured with and without hypoxia and harvested at 24 and 48 hours. Cells were incubated with 0.1mM, 0.01mM milrinone, or endothelial growth medium as control. Harvested cells were assessed for viability and differential gene expression for apoptosis using MTT assay and quantitative reverse-transcriptase polymerase chain reaction (RT-PCR).

RESULTS: HUVECs demonstrated a survival benefit when cultured with milrinone in normoxia as well as hypoxia. With normoxia, at 48 hours, HUVECs were more viable with milrinone; cells cultured with 0.01mM milrinone had a viability 1.55 fold greater than controls, and cells cultured with 0.1mM milrinone had a viability 1.39 fold greater than controls. In hypoxia, cells cultured with milrinone had a viability an average 1.13 fold greater than controls. RT-PCR for apoptotic factors PUMA, BAX, p53, caspase-3, caspase-9, and cytochrome C all demonstrated significant decreases in normoxia and hypoxia, with cells receiving 0.01mM in hypoxia demonstrating the greatest decreases in apoptotic factor expression (average fold change 0.25 +/- 0.02, $p < 0.05$). In comparison, BCL-2, an anti-apoptotic factor, was found to have increased expression in cells cultured with milrinone compared to controls (fold change 1.96 +/- 0.38, $p < 0.05$).

CONCLUSIONS: We demonstrate that milrinone appears to have a protective effect on endothelial cells in normoxic and hypoxic environments leading to increased viability and decreased apoptosis, with an inverse dosing effect. We believe this lends further evidence to support the positive effects of milrinone in cardiovascular protection.

REFERENCES:

1. Huang MH, Nguyen V, Rastogi S, McConnell BK, Wijaya C, Urestsky BF, Poh KK, Tan HC, Fujise K. 2011. Cardiovasc Drugs Ther Jun; 25(3):223-32.
2. Lobato EB, Florete JR and Bingham HL. 1998. British J of Anesthesia. 81:782-784.
3. Mebazaa A, Pitsis AA, Rudiger A, Toller W, Longrois D, Ricksten SE, Bobek I, De Hert S, Wieselthaler G, Schirmer U, VonSegesser LK, Sander M, Poldermans D, Ranucci M, Karpati PC, Wouters P, Seeberger M, Schmid ER, Weder W, Follath F. 2010. Crit care; 14(2):201.
4. Poh KK, Xu X, Chan MY, Lee CH, Tay EL, Low AF, Chan KH, Sia W, Tang LQ, Tan HC, Lui CY, Nguyen, Fujise K, Huang MH. 2014. Eur J Clin Pharmacol. May;70 (5):527-30.
5. Rao YJ and Lei X. 2009. Acta Pharmacologica Sinica. 30:1-24.
6. Troitzsch D, Abdul-Khaliq H, Vogt S, Lange PE and Moosdorf R. 2001. Critical Care. 5 (Suppl B):6.

S-65.

SEVOFLURANE AS OPPOSED TO PROPOFOL ANESTHESIA ALLEVIATES MYOCARDIAL ISCHEMIA AND REPERFUSION INJURY IN RABBITS VIA MITOCHONDRIAL MECHANISMS OF DISEASE

AUTHORS: C. Lotz, T. Tischer-Zeitz, J. Stumpner, C. Blomeyer, A. Frank, N. Roewer, T. M. Smul

AFFILIATION: Anesthesia and Intensive Care, University of Wuerzburg, Wuerzburg, Germany

INTRODUCTION: Pharmacological interventions reducing myocardial ischemia and reperfusion (I/R) injury include the short-term administration of anesthetics. Both sevoflurane as well as propofol elicit cardiac protection via specific conditioning protocols^{1,2}. We investigated the hypothesis that sevoflurane in comparison to propofol anesthesia per se elicits cardiac protection against I/R-injury via mitochondrial mechanisms of disease.

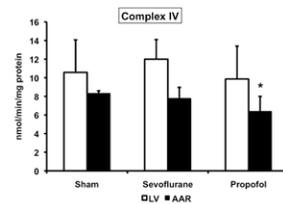
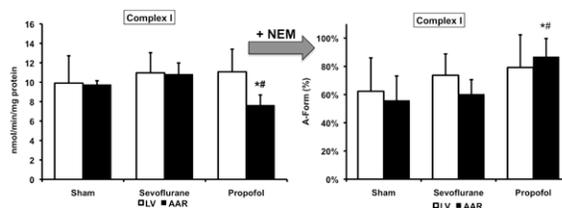
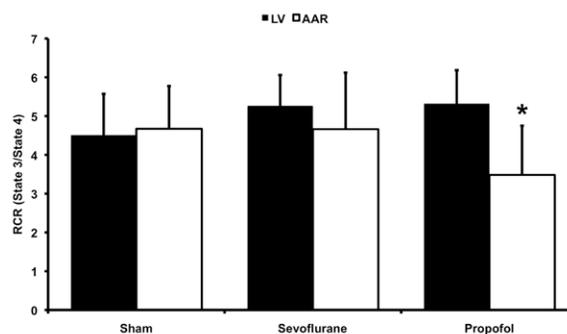
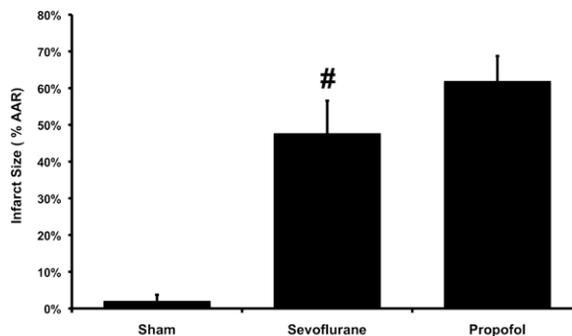
METHODS: The Institutional Animal Care and Use Committee approved the study. Male New Zealand white rabbits (n = 36) were subjected to a 30-min coronary artery occlusion followed by 3hrs of reperfusion. After induction with pentobarbital, the animals either received sevoflurane or propofol for maintenance of general anesthesia. Infarct size was determined as a percentage of the area at risk (AAR) after triphenyltetrazolium chlorid-staining. Cardiac mitochondria were isolated from the non-ischemic left ventricle (LV) and the AAR. Mitochondrial oxygen consumption was measured using a Clark electrode. Mitochondrial respiratory chain complex activities (I-IV) were analyzed utilizing specific assays. Data are mean±SD.

RESULTS: The Institutional Animal Care and Use Committee approved the study. Male New Zealand white rabbits (n = 36) were subjected to a 30-min coronary artery occlusion followed by 3hrs of reperfusion. After induction with pentobarbital, the animals either received sevoflurane or propofol for maintenance of general anesthesia. Infarct size was determined as a percentage of the area at risk (AAR) after triphenyltetrazolium chlorid-staining. Cardiac mitochondria were isolated from the non-ischemic left ventricle (LV) and the AAR. Mitochondrial oxygen consumption was measured using a Clark electrode. Mitochondrial respiratory chain complex activities (I-IV) were analyzed utilizing specific assays. Data are mean±SD.

CONCLUSIONS: Sevoflurane as opposed to propofol anesthesia preserved mitochondrial respiration and elicited cardiac protection against I/R-injury.

REFERENCES:

1. Kokita N, Hara A, Abiko Y, Arakawa J, Hashizume H, Namiki A: Propofol improves functional and metabolic recovery in ischemic reperfused isolated rat hearts. *Anesth Analg* 1998; 86: 252-8
2. Toller WG, Kersten JR, Pagel PS, Hettrick DA, Wartier DC: Sevoflurane reduces myocardial infarct size and decreases the time threshold for ischemic preconditioning in dogs. *Anesthesiology* 1999; 91: 1437-46



S-66.**EVALUATION OF RELEVANCE FOR PERIOPERATIVE RISK OR BENEFITS AND TEMPERATURE MANAGEMENT DURING CARDIOPULMONARY BYPASS****AUTHORS:** Y. Taniguchi**AFFILIATION:** Department of Anesthesiology, The Jikei University School of Medicine, Tokyo, Japan

INTRODUCTION: The controversy over the benefits between normothermic and hypothermic cardiopulmonary bypass (CPB) is still uncertain. We therefore retrospectively analyzed the intraoperative and intensive care management for cardiac surgery in two centers, and evaluated the relevance for outcome and hypothermia, mild-hypothermia and normothermia CPB. Material and Methods Following IRB approval, from April 2013 to March 2014, a total 452 patients underwent cardiac surgery, 168 patients excluded the emergency, re-operation and off pump were identified. They were assigned three group; core temperature below 31° during CPB were assigned as hypothermia group (H group n=43), 31~35° as mild-hypothermia group (MH group n=63), over 35° as normothermia group (N group n=62). A retrospective database and medical record review was performed to evaluate the operation time (OT), intraoperative blood loss (BL), blood transfusion volume (BT), intubation periods (IP), ICU stay and incidence of surgical site infection (SSI). These variables were compared between the three groups using the chi-square, Fisher's exact test. P<0.05 was considered as statistically significant.

RESULTS: The demographics of the patients in each group are similar. General anesthesia was the predominant type of anesthesia in three groups. OT (min) was 432±166, 379±135, 254±81 in the H, MH, N group respectively, and significantly longer in the H group (p<0.001). There was no significant difference between three groups in BL, however, BT, SSI were significantly higher and IP and ICU stay were significantly longer in H group (p<0.001). (table 1)

CONCLUSIONS: Hypothermia during CPB maintained core temperature below 31° was eventually affected coagulation function, caused to much blood transfusion and longer intubation period, finally increased SSI perioperatively.

Normothermic CPB might be one of the strategies as less blood transfusion, shortening intubation and ICU stay, lead to improvement of outcome in cardiac surgery undergoing CPB.

REFERENCES:

1. Zhonghua Wai Ke Za Zhi. :Analysis of factors related to acute renal failure post deep hypothermia circulatory arrest surgery of type a aorta dissection surgery 2013 Dec; 51(12):1094-8. PMID:24499719

Table 1

	H-group(n=43)	MH-group(n=63)	N-group(n=62)	P-value
operation time (min)	432± 167	379±136	254± 81	<0.001
Blood loss(ml)	594 [420-768]	550 [385-714]	423 [368-488]	0.21
Blood transfusion(ml)	2622 [1852-3392]	1878 [1322-2434]	426 [248-604]	<0.001
Intubation period (day)	4.3 [1.6-7.0]	2.7 [1.7-3.7]	1.3 [1.0-1.7]	<0.001
ICU Stay (day)	7.3 [4.5-10.1]	6.7 [5.0-8.3]	3.7 [2.5-5.0]	<0.001
SSI (%)	9/43 (21)	5/63 (8)	0/62 (0)	<0.001

S-67.

REMOTE ISCHEMIC PRECONDITIONING ATTENUATES SHORT-TERM POSTOPERATIVE COGNITIVE IMPAIRMENT AFTER CARDIAC SURGERY

AUTHORS: D. J. De Vry, J. A. Hudetz, K. M. Patterson, Z. Iqbal, S. D. Gandhi, P. S. Pagel

AFFILIATION: Anesthesia, Clement J Zablocki VA Medical Center, Milwaukee, WI

INTRODUCTION: Remote ischemic preconditioning (RIPC) exerts neuroprotective effects in models of cerebral ischemia-reperfusion injury. We tested the hypothesis that RIPC attenuates short-term postoperative cognitive impairment in patients undergoing cardiac surgery using cardiopulmonary bypass (CPB).

METHODS: After IRB approval and written informed consent, age- and education-matched men (n=30; age greater than 55) undergoing elective coronary artery or valve surgery using CPB were enrolled. RIPC was produced after induction of anesthesia using 4 cycles of brief (5 min) upper extremity ischemia (tourniquet inflation to 200 mmHg) interspersed with 5 min periods of reperfusion (deflation). Recent verbal and nonverbal memory and executive functions were assessed before and 1 week after surgery using a standard neuropsychometric test battery or at 1-week intervals in nonsurgical controls (n=15). The Geriatric Depression Inventory and the Hachinski Ischemia scales were used to identify clinical depression and vascular dementia, respectively.

RESULTS: Baseline neurocognitive scores were similar in patients with versus without RIPC in all three cognitive domains. Significant declines in performance on two nonverbal memory tests (Figure Reconstruction and Delayed Figure Reproduction; P=0.001 and P=0.003, respectively) and one verbal memory test (Delayed Story Recall; P=0.004) were observed 1 week after surgery in patients who were not treated with RIPC. There were no changes in performances on measures of executive function in this group. In contrast, performance on all cognitive tests was unchanged after compared with before surgery in patients receiving RIPC. At least a 1 standard deviation decline from baseline in cognitive performance was detected in Figure Reconstruction, Delayed Figure Reproduction, Immediate Story Recall, and Delayed Story Recall in patients who were not exposed to RIPC. The incidence of at least a 1 standard deviation decline in neuropsychometric tests was observed in significantly fewer (1 versus 9; P<0.0001) patients with versus without RIPC treatment based on composite Z-scores. Overall cognitive performance after surgery was (P=0.002) better in patients treated with versus without RIPC. Neither clinical depression nor vascular dementia was detected in either group.

CONCLUSIONS: The current results indicate that RIPC attenuates short-term postoperative cognitive impairment in patients undergoing cardiac surgery using CPB.

S-68.

DIET INDUCED HYPERCHOLESTEROLEMIA AND METABOLIC SYNDROME LEAD TO INCREASED APOPTOSIS IN THE AORTA IN A SWINE MODEL

AUTHORS: R. Saraf¹, T. Huang¹, J. B. Hubbard¹, K. Owais², F. Mahmood², R. Matyal²

AFFILIATION: ¹Department of Anesthesia and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA, ²Anesthesia, Beth Israel Deaconess Medical Center, Boston, MA.

INTRODUCTION: The physiologic and biochemical changes in hypercholesterolemia and metabolic syndrome (MetS) often precede cardiovascular disease and type II diabetes. An increased burden of oxidative stress and apoptosis has been noted in the myocardium in the initial stages of these disorders. However, the initial effect of MetS on vascular tissue has not been completely established. We hypothesize that a MetS inducing high cholesterol diet (HCD) induces cellular and biochemical changes in large and medium arteries.

METHODS: Two groups of adult Yorkshire miniswine were fed a normal diet (n=7) and a high cholesterol diet (n=7), respectively, for 13 weeks. At the end of the experiment, tissues from the aorta and right coronary artery were harvested before the animals were euthanized. Western blots and immunohistochemistry were performed on the aorta and right coronary artery (RCA).

RESULTS: The final BMI for the HCD group was 51.3 ± 5.0 while the control was 17.6 ± 5.0. The blood sugar thirty minutes after dextrose challenge was 157.1 ± 7.7 in the HCD group and 113.3 ± 5.9 in the control group at the end of the experiment. There was an increase in the expression of pro-apoptotic marker Apaf-1 (p=0.01) and oxidative stress marker p38 MAPK (p=0.3) in the HCD group aorta. Apoptotic markers cleaved caspase3/caspase3 (p=0.017) were also increased in this group compared to the control aorta while anti-apoptotic marker p-Akt (p=0.002) was lower in the HCD group aorta compared to the control aorta. The aorta of the HCD group also displayed increased pro-fibrotic markers MMP-9 (p=0.001) and TGF-β (p<0.001) compared to the control aorta. For the HCD group RCA, the pro-apoptotic marker Apaf-1 trended higher compared to the control group but this difference was not statistically significant (p > 0.3). However, the oxidative stress marker p38MAPK was noted to be significantly higher in the HCD group RCA.

CONCLUSIONS: A high cholesterol diet leads to dysregulation of apoptotic markers in the early stage of metabolic syndrome. Interestingly, a brief exposure to HCD does not lead to similar activation of the intrinsic apoptotic pathway in the RCA. Further analysis of RCA, LAD, aortic, and myocardial tissue is needed to determine if other apoptotic, fibrotic, and oxidative stress markers are expressed after exposure to a high cholesterol diet.

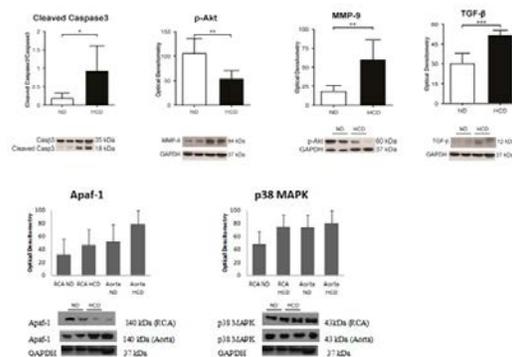


Figure 1. Immunoblotting of Right Coronary Artery (RCA) and Aorta in both Normal Diet (ND) and High Cholesterol Diet (HCD) pigs. (A) Immunoblotting for apoptotic marker cleaved caspase-3 demonstrated increased apoptosis in the ascending aorta of the HCD group (p=0.017) (*p<0.05). (B) Anti-apoptotic marker protein kinase B (p-Akt) (p=0.002) was decreased in the aortic HCD group compared to the ND group (**p<0.01). (C) Elevated fibrosis is seen through immunoblotting of pro-fibrotic marker matrix metalloproteinase-9 (MMP-9) (p<0.001) (**p<0.01) and (D) transforming growth factor-β (TGF-β) (p=0.005) (**p<0.01) in aortic tissue. (E) Oxidative stress marker p38 MAPK significantly increased in RCA and aortic tissue of HCD group. (F) Elevated levels of apoptotic marker Apaf-1 also seen in RCA and aortic tissue of HCD pigs.

S-69.

CA2+/CALMODULIN-DEPENDENT PROTEIN KINASE IIδ IS ESSENTIAL FOR CARDIOPROTECTION BY DESFLURANE-INDUCED PRECONDITIONING: RESULTS OF A MURINE KNOCKOUT-STUDY

AUTHORS: T. Tischer-Zeitz¹, J. Stumpner², C. Lotz², T. M. Smul³, N. Roewer²

AFFILIATION: ¹Department of Anaesthesia and Critical Care, University Hospital of Wuerzburg, Wuerzburg, Germany, ²Department of Anaesthesia and Critical Care, University Hospital of Wuerzburg, Wuerzburg, Germany, ³Department of Anesthesia, UCSF, San Francisco, CA

INTRODUCTION: The Ca²⁺/calmodulin-dependent protein kinase (CaMKII) is responsible for Ca²⁺ homeostasis and stress adaptation in cardiomyocytes under physiological conditions¹. Pharmacological inhibition of CaMKII or the upstream beta1-adrenergic receptor (ADRB1) prevents cardioprotection by anesthetic-induced preconditioning (APC)². The effect of a genetic knockout of CaMKII on APC and the interactions of subsequent adaptional mechanisms are unknown to date.

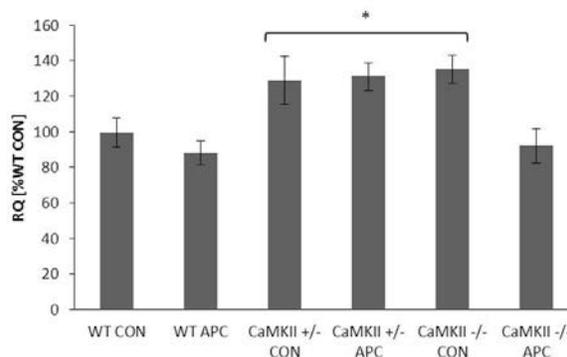
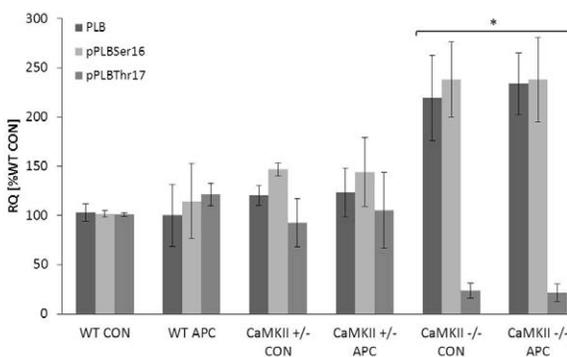
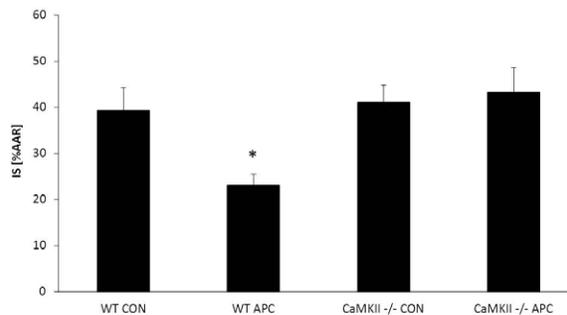
METHODS: After institutional approval by the local IRB, male BL6 mice were bred either as wild type or heterozygote (+/-) resp. homozygote (-/-) with knockout of CaMKIIδ, the prevalent isoform of CaMKII in cardiomyocytes. Animals aged between 8 to 16 weeks underwent an ischemia/reperfusion protocol of 45 minutes of coronary artery occlusion (CAO) succeeded by 3 hours of reperfusion. In the respective group 1.0 MAC desflurane was administered for 15min followed by 15min of washout prior to the onset of CAO. Myocardial infarct size (IS) was determined by gravitoplanimetry and expressed as a percentage of the area at risk (AAR). Changes in the expression of ADRB1, phospholamban (PLB) and its protein kinase A specific phosphorylated form (serine 16; pPLBSer16) resp. CaMKIIδ specific phosphorylated form (threonine 17; pPLBThr17) were determined by western immunoblotting. Data are mean±SEM.

RESULTS: APC reduced IS in WT (23±2%, n=7; *p<0.05) compared to the control group (CON; 39±5%, n=8). IS was neither reduced in CaMKII -/- CON (41±4%, n=8) nor in CaMKII -/- APC (43±5%, n=9) (Fig. 1). In the CaMKII -/- group PLB and pPLBSer16 were elevated, whereas pPLBThr17 was reduced (Fig.2). The elevation of ADRB1 in CaMKII +/- and CaMKII -/- mice was abolished by APC in CaMKII -/- (Fig. 3).

CONCLUSIONS: The homozygous knockout of CaMKIIδ prevented desflurane mediated cardioprotection. The increase of ADRB1 expression in hetero- and homozygous CaMKIIδ knockout mice was abrogated by desflurane application in CaMKII-/-.

REFERENCES:

1. Xu L, Lai D, Cheng J, et al., Circ Res 2010; 107:398-407.
2. Lange M, Smul TM, Redel A, et al., Anesthesiology 2008; 109:72-80.



S-70.**THE RATIO AND RISK FACTORS OF POST-ANESTHETIC SHIVERING WITH REMIFENTANIL IN PATIENTS UNDERGONE CARDIAC SURGERY: A RETROSPECTIVE STUDY**

AUTHORS: K. Ueta¹, T. Tamura², Y. Hayashi³, A. Uchiyama¹, Y. Fujino¹

AFFILIATION: ¹Department of anesthesiology, Osaka University graduate school of medicine, Suita, Osaka, Japan, ²Department of Anesthesia, Saiseikai Nakatsu Hospital, Osaka, Japan, ³Department of Anesthesia, Sakurabashi-Watanabe Hospital, Osaka, Japan

INTRODUCTION: Remifentanil is the ultra-short-acting opioid and large dose administration attenuates hemodynamic response at cardiac surgery. On the other hand, remifentanil could induce post-anesthetic shivering (PAS) which attributes to instability of hemodynamics because of the increase of oxygen consumption and peripheral artery resistance. The mechanism of PAS may be due to the activation of N-methyl-d-aspartate (NMDA) receptor by remifentanil¹ and opioid withdrawal caused by acute tolerance². However, the relationship of PAS and remifentanil has not been elucidated at cardiac surgery. We investigated the proportion of PAS with and without remifentanil and the risk factors of PAS with remifentanil at cardiac surgery in a retrospective manner.

METHODS: This study was approved by the Institutional Review Board of Osaka University Medical School. We recruited 162 patients over 15 years old who underwent cardiac surgery including off-pump-CABG between April 2009 and March 2011. Anesthesia and intensive care unit (ICU) records were reviewed for demographic data, temperature, drug including opioid, and operative procedure. T-test, chi-square, Mann-Whitney tests and multivariate analysis were performed and P<0.05 was significant.

RESULTS: PAS occurred 15 of 99 (15%) patients with remifentanil, which was significantly more than 3 of 66 (4%) without remifentanil. Multivariate analysis revealed that the significant risk factors of PAS with remifentanil of cardiac surgery were not only male but also the decrease of fentanyl administration amount (micro g/kg/hr) after cardiopulmonary bypass.

CONCLUSIONS: PAS is associated with remifentanil at cardiac surgery, which may be diminished by the usage of fentanyl after cardiopulmonary bypass.

REFERENCES:

1. Anesth Analg, 113, p484-7, 2011.
2. Anaesthesia, 62, p1266-80, 2007.

S-71.**POSTCONDITIONING EFFECTS OF HYPERCAPNIA AGAINST MYOCARDIAL STUNNING IN SWINE**

AUTHORS: T. Hara, D. Akiyama, I. Shibata, O. Yoshitomi

AFFILIATION: Anesthesiology, Nagasaki University, Nagasaki, Japan

INTRODUCTION: Postconditioning is a phenomenon where rapid intermittent interruptions of blood flow in the early phase of reperfusion limit ischemia/reperfusion injury. Myocardial stunning is the mechanical dysfunction that persists after restoration of coronary or myocardial circulation. We reported the efficacy of pharmacological management of myocardial stunning¹⁻⁷. In the perioperative management as one lung ventilation or acute respiratory distress syndrome, we cannot but permit hypercapnia. It was reported that hypercapnia could protect myocardium against infarction in rabbit heart⁸, but efficacy of hypercapnia against myocardial stunning is unclear. We studied the cardioprotective effects of hypercapnia in the early phase of reperfusion in swine stunned myocardium.

METHODS: All experimental procedures used in this investigation were approved by Institutional Animal Care Committee. In anesthetized open-chest swine, the left anterior descending coronary artery (LAD) was perfused through an extracorporeal circuit from the carotid artery. The animals were instrumented for measurements of systemic and coronary hemodynamics. After hemodynamic stabilization, stunned myocardium was produced by 12-min occlusion of LAD and 90-min reperfusion in all swine. Hypercapnia group (group H: n=10) were ventilated to maintain PaCO₂ approximately 70 mmHg for 30 minutes from the start of reperfusion. Normocapnia group (group C: n=10) were ventilated normally. Regional myocardial contractility was evaluated with segment shortening (%SS) by ultrasonic transducer. All values were expressed as mean ± SD. Data between groups were analyzed with Mann-Whitney U test. p<0.05 was considered statistically significant.

RESULTS: There were no significant differences in baseline values between groups. Heart rate and coronary blood flow at 30 minutes after reperfusion in group H were significantly higher than that in group C (111±/15 vs. 93±/13 beat/min, p=0.04, 21.7±/2.8 vs. 18.5±/3.5 ml/min, p=0.03, respectively). In both groups, %SS markedly decreased and fell below 0% during ischemia, indicating bulging. %SS at 90 minutes after reperfusion showed no significance between groups (7.2±/1.8% vs. 7.5±/2.3%). Sympathetic stimulation due to hypercapnia would be involved in the mechanism of hemodynamic change during hypoventilation. Increase in coronary blood flow due to hypercapnia might exacerbate intracellular calcium overload during reperfusion.

CONCLUSIONS: Hypercapnia in the early phase of reperfusion could not enhance the functional recovery of stunned myocardium in swine. Increase in coronary blood flow due to hypercapnia might exacerbate intracellular calcium overload during reperfusion.

REFERENCES:

1. Anesth Analg 2001;92:1139-45,
2. J Anesth 2005;19:124-30,
3. Cardiovasc Drugs Ther 2006;20:327-34,
4. Cardiovasc Drugs Ther 2008;22:293-8,
5. J Anesth 2010;24:575-81,
6. Shock 2012;38:92-7,
7. Scand Cardiovasc J 2013;47:50-7,
8. J Huazhong Univ Sci Technol 28: 706-10, 2008.

S-72.**MORPHOLOGICAL EVALUATION OF THE MITRAL ANNULUS DURING DISPLACEMENT OF THE HEART DURING OFF-PUMP CORONARY ARTERY BYPASS SURGERY**

AUTHORS: Y. Toyama¹, K. Igarashi², H. Kanda¹, K. Yamamoto¹, T. Kunisawa¹, H. Iwasaki¹

AFFILIATION: ¹Anesthesiology and Critical care, Asahikawa Medical University, Asahikawa, Japan, ²Anesthesiology, Sapporo Cardio Vascular Center, Sapporo, Japan

INTRODUCTION: Displacement of the heart during off-pump coronary artery bypass (OPCAB) surgery may result in serious deterioration of circulatory dynamics, one cause of which is the exacerbation of mitral regurgitation (MR) due to morphological changes of the mitral annulus. It has been reported that the height of the mitral annulus decreases and it becomes flatter in mitral valve prolapse and ischemic MR, but there has been no detailed report of the morphological changes of the mitral annulus during displacement of the heart. In this study, three-dimensional transesophageal echocardiography (3D-TEE) was used to evaluate morphological changes of the mitral annulus during displacement of the heart.

METHODS: The subjects were 30 patients who were scheduled to undergo OPCAB of the right coronary artery (RCA) and the left circumflex artery (LCX). 3D-TEE (iE33, Philips) was used to acquire three-dimensional zoom (3D zoom) data of the mitral valves after a median sternotomy (Normal Position: NP) and during displacement of the heart to expose the RCA (RCA Position: RP) and the LCX (LCX Position: LP). The primary endpoint was the height of the mitral annulus, and secondary endpoint were the severity of MR, the distance between the commissures, anteroposterior diameter, circumference, and surface area of the mitral annulus. Mitral Valve Quantification (MVQ) software (QLAB, Philips) was used for quantitative analysis. Measured values are expressed as means \pm standard deviation, and a repeated measures analysis of variance (ANOVA) and the Tukey-Kramer test were used for statistical analysis, with $p < 0.05$ regarded as significant.

RESULTS: The height of the mitral annulus was significantly lower during both RP and LP compared with NP (NP: 6.91 ± 1.16 cm, RP: 5.89 ± 0.99 cm, LP: 5.73 ± 0.92 cm). MR became more severe during RP in 16 patients (53%) and during LP in 17 (57%). No significant differences were observed in the distance between the commissures, anteroposterior diameter, circumference, and surface area of the mitral annulus during either RP or LP.

CONCLUSIONS: The normal mitral annulus is saddle-shaped rather than flat. During displacement of the heart to expose both the RCA and LCX, the height of the mitral annulus decreased, and it became flattened and lost its saddle shape. This suggests that MR may have become more severe as a result.

S-73.**MICRORNA-21 MEDIATES ISOFLURANE-INDUCED CARDIOPROTECTION AGAINST ISCHEMIA/ REPERFUSION INJURY THROUGH AKT/NOS/MPTP PATHWAY IN THE MOUSE**

AUTHORS: Z. Ge, J. Olson, Y. Yan, Y. Liu, J. Kersten, D. C. Wartier, Z. J. Bosnjak

AFFILIATION: Anesthesiology, Medical College of Wisconsin, Milwaukee, WI

INTRODUCTION: The volatile anesthetic, isoflurane, protects the heart against ischemia/reperfusion injury in human cardiac surgery and experimental animals.^{1,2} Because emerging evidence suggests that microRNA-21 (miR-21) plays an important role in regulating ischemia/reperfusion injury,^{3,4} we examined the role of miR-21 in isoflurane-induced cardioprotection against ischemia/reperfusion and explored the underlying mechanisms.

METHODS: In vivo or Langendorff-perfused hearts of C57BL/6 and miR-21^{-/-} mice underwent 30 min of ischemia followed by 2 h of reperfusion in the presence or absence of 1.0 minimum alveolar concentration of isoflurane administered prior to ischemia. Quantitative RT-PCR was used to quantify the expression of cardiac miR-21 mRNA. The expression of Akt, neuronal endothelial nitric oxide synthase (eNOS), and endothelial nitric oxide synthase (eNOS) proteins was measured by Western blot. Opening of the mitochondrial permeability transition pore (mPTP) in cardiomyocytes isolated from mice was induced by photoexcitation-generated oxidative stress and detected by rapid dissipation of tetramethylrhodamine ethyl ester fluorescence using a laser-scanning confocal microscope. Transthoracic echocardiography was used to evaluate the dimensions and function of the left ventricle.

RESULTS: The expression of myocardial miR-21 mRNA was significantly increased by $194 \pm 64\%$, $39 \pm 8\%$, and $87 \pm 28\%$ ($P < 0.05$, $n = 5-8$ /group) 30 min, 3 h, and 6 h, respectively, in C57BL/6 mice following isoflurane treatment for 30 min. Isoflurane decreased infarct size from $54 \pm 3\%$ in the control group to $36 \pm 4\%$ ($P < 0.05$, $n = 8$ mice/group) and improved cardiac function following ischemia/reperfusion injury in C57BL/6 mice, concomitantly with increased phosphorylation of Akt, eNOS, and nNOS proteins and decreased mitochondrial NADH levels 5 min after ischemia. The mPTP opening in cardiomyocytes isolated from C57BL/6 mice was delayed by isoflurane. Hearts from miR-21^{-/-} mice displayed no marked differences in dimensions and function of the left ventricle at baseline, infarct size and cardiac function following ischemia/reperfusion injury, p-Akt, p-eNOS, p-nNOS, and the opening time of the mPTP, compared to C57BL/6 mouse hearts. However, isoflurane failed to alter infarct size and cardiac function after ischemia/reperfusion injury, mitochondrial NADH levels, p-Akt, p-nNOS, and the opening time of the mPTP in miR-21^{-/-} mice.

CONCLUSIONS: ISO protects mouse hearts from ischemia/reperfusion by a miR-21-dependent mechanism. The Akt/NOS/mPTP cascade is involved in miR-21-mediated cardioprotective effect of isoflurane.

REFERENCES:

1. Anesthesiology 1997; 87: 361-70
2. J Thorac Cardiovasc Surg 2009; 137: 1436-42, 1442 e1-2
3. J Biol Chem 2009; 284: 29514-25
4. Circ Cardiovasc Genet 2014; 7: 311-20

S-74.**ROUTINE IMMUNE-MODULATORY TREATMENT WITH HYDROCORTISONE AND PENTOXIFYLLINE INCREASES INOTROPE AND VASOPRESSOR NEEDS IN COMPARISON WITH PREDNISOLON IN PATIENTS UNDERGOING COMBINED VALVE AND CORONARY ARTERY BYPASS GRAFTING SURGERY - A RETROSPECTIVE COHORT ANALYSIS**

AUTHORS: M. Heringlake¹, H. Schroeder², H. Heinze¹, A. E. Berggreen¹, H. Paarmann¹

AFFILIATION: ¹Department of Anesthesiology and Intensive Care Medicine, University of Lübeck, Lübeck, Germany, ²Department of Anesthesiology and Intensive Care Medicine, Christian - Albrecht University Kiel, Kiel, Germany

INTRODUCTION: Perioperative treatment of cardiac surgical patients with hydrocortisone (HC)¹ and pentoxifylline (PTX)² have shown promising results in terms of less need for vasopressor and inotropic drugs, and improved short term outcomes. The present analysis aims to determine the effects of a routine combined anti-inflammatory treatment with HC and PTX in comparison with a low-dose regimen of prednisolon (PRED) in patients undergoing prolonged cardiac surgical procedures (combined valve and coronary artery bypass grafting surgery (VS-CABG).

METHODS: Following approval by the local ethical committee that waived the need for informed consent, patient charts of all patients undergoing isolated VS-CABG during 2006 and 2007 were studied retrospectively. During 2006, all patients had been treated with a bolus of 2 mg/kg PRED immediately after induction of anesthesia. During 2007 all patients were treated with 100 mg HC before induction of anesthesia, followed by a continuous infusion of HC (10mg/h intra-, and 5mg/h postoperatively up to a maximum of 300 mg within 24h). Additionally, all patients received a 300mg bolus of PTX followed by a continuous infusion of 1,5 mg/kg/h until 6h after surgery (maximum: 1200 mg). Following exclusion of emergency cases and patients that could not clearly be ascribed to a specific treatment, 149 patients treated with PRED and 132 patients treated with HC/PTX were identified and analyzed.

RESULTS: Types of valve surgery in the PRED and the HC/PTX group included the aortic valve in 77.2 and 78%, the mitral valve in 30.2 and 27.7%, and the tricuspid valve in 2.7 and 2.3% of cases, respectively. The groups were comparable with respect to demographics and additive Euroscore (PRED: 7.1 ± 2.5; HC/PTX: 7.2 ± 2.7). Duration of surgery in the HC/PTX group was slightly prolonged in comparison with the PRED group (296 ± 77min vs. 276.5 ± 69.6 min; p = 0.0411) while duration of cardiopulmonary bypass showed no significant difference (156.8 ± 56.8 min vs. 148.9 ± 44.5 min; p = 0.1895).

Intraoperatively, 65.9% vs. 48.3% of patients in the HC/PTX and PRED group, respectively were treated with dobutamine (p=0.0241). Patients in the HC/PTX group were treated with significantly higher noradrenaline doses (p = 0.0001). No differences were observed in the use of phosphodiesterase-III inhibitors. Length of hospital stay (12 ± 9.9d vs. 10.8 ± 9.5d) as well as 30 day mortality (5.3% vs. 4.7%) revealed no significant difference between the HC/PTX and the PRED groups, respectively.

CONCLUSIONS: Taking into account the limitations of the retrospective design and potentially unmeasured confounders, these findings question that a combined use of HC/PTX is associated with improved clinical outcomes in comparison with a low-dose of PRED in patients undergoing prolonged cardiac surgery and instead show that this treatment leads to an increased need for inotropic and vasopressor support. It remains to be determined, if these unwarranted effects are due to the combination of the therapeutics or a lack of efficacy of the drugs per se.

REFERENCES:

1. Crit Care Med 2003;31: 1068 - 1074
2. Applied Cardiopulm Pathophysiol 2007; 11: 17 - 24

S-75.

WITHDRAWN.

S-76.**SEVOFLURANE POSTCONDITIONING MIGHT REDUCE SEVERITY OF CARDIAC AND NON-CARDIAC COMPLICATIONS AFTER ELECTIVE CARDIAC VALVE SURGERY. RESULTS OF A 6 MONTH FOLLOW-UP**

AUTHORS: M. Schläpfer¹, J. M. Bonvini¹, S. Kuhn², T. A. Neff³, B. Beck-Schimmer¹

AFFILIATION: ¹Institute of Anesthesiology, University Hospital Zurich, Zurich, Switzerland, ²Institute of Anesthesiology, University Hospital Zurich, 8091 Zurich, Switzerland, ³Institute of Anesthesiology, Kantonsspital Muensterlingen, Muensterlingen, Switzerland

INTRODUCTION: Anesthetic conditioning with volatile anesthetics has reduced ischemia-reperfusion injuries in various settings of pre- and postconditioning, which is reflected by a significant decrease of surrogate markers such as troponin. However, it is still less clear if these findings in changes in biomarkers can be translated into a clinical benefit for the patient. In a recent randomized controlled trial from our center, including 102 patients undergoing elective cardiac surgery, we were able to show significant lower troponin levels on the first postoperative day after a 4 hour sedation with sevoflurane in comparison to propofol on the intensive care unit¹. In order to assess the clinical long-term implications of these findings, we performed a 6-month follow up, focusing on cardiac and non cardiac events.

METHODS: All patients who successfully completed the postconditioning trial were included into this follow-up study, approved by the local ethical committee (KEK-ZH 2014-0040). Primary and secondary endpoints were assessment of Cardiac events (dysrhythmias, congestive heart failure and cardiac ischemia) and non-cardiac complications (pulmonary embolism, bleeding, infection, cerebral events and chronic kidney failure) resulting in diagnostic or therapeutic interventions. Data were retrieved from the hospital database, secondary care units and family doctors. Statistical analysis was performed in R (R Foundation for Statistical Computing). Mixed linear models with propofol as reference group were chosen.

RESULTS: Ninety-four of the 102 from the primary study were evaluated in this 6-month follow-up. Sixteen out of 41(35%) patients in the sevoflurane and 17 patients out of 53 (32%) in the propofol group suffered from one or several cardiac events during the first 6 months after participating in the primary study (p=0.752). In 4 (10%) patients treated with sevoflurane vs. 7 (13%) patients treated with propofol non-cardiac events were reported (p=0.607). Therapeutic or medical intervention was required only in 12 patients in the sevoflurane compared to 20 patients in the propofol group (OR: 0.24, CI: 0.040-1.43, p=0.118). Eleven patients in the propofol arm compared to only 2 patients in the sevoflurane group were hospitalized due to complication (OR 0.233, CI: 0.042-1.293, p=0.095).

CONCLUSIONS: We document a similar number of adverse events (cardiac and non cardiac) in patients treated with sevoflurane compared to propofol. Despite not reaching statistical significance, we observed less severe complications in the sevoflurane group (less need for treatment, fewer admissions to the hospital). Statistical significance might not have been reached because the original study was powered for biochemical surrogate markers and not for clinical outcomes.

REFERENCES:

1. Steurer MP et al: Crit Care. 2012 14;16(5)
Late pharmacologic conditioning with volatile anesthetics after cardiac surgery.

S-77.

WITHDRAWN.

S-78.**DOES LOW-DOSE ONDANSETRON INCREASE THE RISK OF PERIOPERATIVE POLYMORPHIC VENTRICULAR TACHYCARDIA OR DEATH**

AUTHORS: G. A. Nuttall¹, S. C. Voogd¹, H. M. Wagner¹, M. J. Ackerman², M. S. Marienau¹, W. C. Oliver¹

AFFILIATION: ¹Anesthesiology, Mayo Clinic College of Medicine, Rochester, MN, ²Pediatric Cardiovascular Diseases, Mayo Clinic College of Medicine, Rochester, MN

INTRODUCTION: Nausea and vomiting affects as many as one-third of surgical patients and increases length of hospital stay and decreases patient satisfaction.¹ Ondansetron is one of the drugs used for prevention and treatment of nausea and vomiting. The U.S. Food and Drug Administration was considering issuing a black box warning regarding the use of ondansetron and the potential to develop polymorphic ventricular tachycardia (PVT) (Torsades de Pointes).² The primary objective of this retrospective study was to determine if ondansetron administration (4 mg) was associated with episodes of PVT during a two-year period.

METHODS: The authors identified 121,910 doses of ondansetron given to 53,522 patients in our institution during a two-year time frame. These patients were cross-matched with an electrocardiogram and adverse outcome database; this identified 4,759 patients with documentation of prolonged QTc (> 450 ms), ventricular tachycardia within 48 hours of receiving ondansetron, or death within seven days of receiving ondansetron.

RESULTS: Fourteen patients had documented monomorphic ventricular tachycardia and 32 patients died within 48 hours of ondansetron administration. No patients developed PVT or died as a direct result of ondansetron administration. All ventricular tachycardia events were precipitated by existing cardiovascular disease, acute hypoxemia, acute hemorrhage, or sepsis. Of the 32 deaths, all were a direct result of underlying disease.

CONCLUSIONS: Low-dose ondansetron does not increase the incidence of PVT or death. Our results are consistent with prior smaller publications.³⁻⁶

REFERENCES:

1. Hsu ES. A review of granisetron, 5-hydroxytryptamine₃ receptor antagonists, and other antiemetics. *Am J Ther.* 2010; 17(5): 476-486. doi: 10.1097/MJT.0b013e3181ea7821.
2. U.S. Food and Drug Administration. FDA Drug Safety Communication: New information regarding QT prolongation with ondansetron (Zofran). <http://www.fda.gov/Drugs/DrugSafety/ucm310190.htm>. Accessed January 14, 2013.
3. Charbit B, Albaladejo P, Funck-Brentano C, Legrand M, Samain E, Marty J. Prolongation of QTc interval after postoperative nausea and vomiting treatment by droperidol or ondansetron. *Anesthesiology.* 2005; 102(6): 1094-1100.
4. Charbit B, Alvarez JC, Dasque E, Abe E, Demolis JL, Funck-Brentano C. Droperidol and ondansetron-induced QT interval prolongation. *Anesthesiology.* 2008; 109(2): 206-212. doi: 10.1097/ALN.0b013e31817fd8c8.
5. Hafermann M, Namdar R, Seibold G, Page RL. Effect of intravenous ondansetron on QT interval prolongation in patients with cardiovascular disease and additional risk factors for torsades: a prospective, observational study. *Drug Healthc Patient Saf.* Oct 2011; 3: 53-58. doi: 10.2147/DHPS.S25623.
6. GSK Clinical Trials Registry. A randomized, double-blind, four-period crossover study to investigate the effect of intravenous ondansetron, a 5-HT₃ antagonist, on cardiac conduction as compared to placebo and moxifloxacin in healthy adult subjects. Clinical study ID: S3A115458.

S-79.**EFFECTS OF MODIFIED ULTRAFILTRATION ON WHOLE BLOOD COAGULATION IN PEDIATRIC CARDIAC SURGERY**

AUTHORS: Katori¹, Y. Kakinuma², H. Morisaki³

AFFILIATION: ¹Anesthesiology, Keio University, Tokyo, Japan, ²Anesthesiology, Keio University, Tokyo, Japan, ³Keio University School of Medicine, Tokyo, Japan

INTRODUCTION: Modified ultrafiltration (MUF) which is performed after separation from cardiopulmonary bypass (CPB) has become popular in pediatric cardiac surgery. MUF can remove excessive water from patient's blood and result in hemoconcentration. It has been demonstrated that MUF increased hemoglobin concentration and decreased postoperative bleeding and transfusion requirement¹, although few study examined changes in whole blood coagulation after MUF. Hence we examined the effects of MUF on whole blood coagulation after MUF using rotation thromboelastometry (ROTEM®: Tem international GmbH, Germany).

METHODS: With approval of institutional review board and adherence to the Declaration of Helsinki, twenty pediatric patients who underwent MUF during cardiac surgery between May 2013 and September 2014 were included in the study. Whole blood was collected into 3.2% citrate tube (1:9 in volume) and EDTA tube at 3 points: after anesthesia induction, after separation from CPB (before MUF) and after termination of MUF. Complete blood count including hemoglobin concentration (Hb, mg/dl), hematocrit (Hct, %) and platelet count (Plt, ×10³/μl) was examined with EDTA sample. Fibrinogen concentration (FNG, mg/dl) and antithrombin activity (AT, %) were examined with citrate sample. Whole blood coagulation was examined by EXTEM and FIBTEM tests. EXTEM is an extrinsic coagulation test which is activated by tissue factor. FIBTEM is a specific test to examine firmness of fibrin gel. And clot firmness in FIBTEM is considered to correspond to fibrinogen concentration. Following ROTEM parameters were examined in EXTEM: clotting time (CT, sec) which corresponds to the lag time before clotting; clot formation time (CFT, sec) which reflects the initial rate of clot formation; and maximum clot firmness (MCF, mm) as the maximal tensile strength of clot. MCF was examined in FIBTEM. Values are expressed as mean ± SD. Wilcoxon t-test was used to compare pre and post MUF values. P < 0.05 was considered significant.

RESULTS: Patient age was 16 ± 19 months. CPB time and MUF time were 133 ± 66 and 15 ± 2 minutes, respectively. None of the patients received plasma or platelet concentrates during CPB or MUF. Hb, Hct, FNG and AT increased significantly after MUF compared with pre-MUF values: 12.2 ± 2.8 vs. 14.4 ± 3.5 (g/dl), 35.5 ± 7.8 vs. 41.0 ± 9.3 (%), 81 ± 32 vs. 95 ± 29 (mg/dl), 42 ± 14 vs. 51 ± 16 (%), respectively (p<0.01). However, platelet count decreased from 111 ± 59 to 71 ± 47 (10³/μl) (p<0.01). There was no difference between pre- and post-MUF values in FIBTEM, although FNG increased after MUF. In EXTEM, CT and CFT were prolonged significantly after MUF, which indicated attenuated fibrin formation. MCF of EXTEM decreased significantly after MUF (p<0.01): 43 ± 12 vs. 37 ± 13 (mm).

CONCLUSIONS: Increase in Hb, Hct, FNG and AT after MUF indicated successful hemoconcentration by MUF. However results in EXTEM indicated that MUF attenuated clot formation despite the increase in fibrinogen concentration. Thus MUF does not always improve whole blood coagulation in pediatric cardiac surgery.

REFERENCES:

1. *Circulation* 1991;84(5 suppl):III422-31.

S-80.

MULTI-COLOR FLOW CYTOMETRY REVEALS SPECIES SPECIFIC AND HIBERNATION-STATE SPECIFIC DIFFERENCES IN INNATE IMMUNITY, SUSCEPTIBILITY TO INJURY, AND RESPONSE TO SURGICAL ISCHEMIA-REPERFUSION IN SPRAGUE-DAWLEY RATS COMPARED WITH ARCTIC GROUND SQUIRRELS

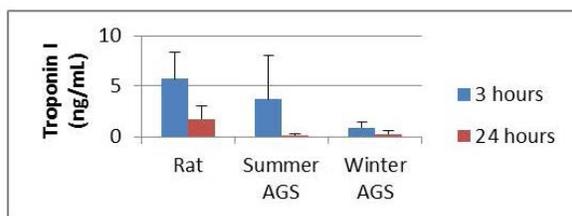
AUTHORS: Q. J. Quinones¹, Q. Ma¹, M. P. Smith¹, J. Staats², C. Chan³, M. V. Podgoreanu¹

AFFILIATION: ¹Anesthesiology, Duke University Medical Center, Durham, NC, ²Flow Cytometry Core Facility, Duke University Medical Center, Durham, NC, ³Biostatistics and Bioinformatics, Duke University Medical Center, Durham, NC

INTRODUCTION: Hibernation is a natural molecular adaptation to extreme environmental conditions with important implications for perioperative organ protection. We have previously shown in a surgical model of ischemia and reperfusion (I/R) robust cardioprotection in hibernating arctic ground squirrels (AGS) compared to rats. Although hibernating animals undergo significant natural immunomodulation, a phenomenon conserved among distinct species, innate immune activity in hibernators has not been characterized.¹ We hypothesized that hibernators cardioprotective phenotype is accompanied by altered expression of innate immune (pattern-recognition receptors, PRRs) and inflammatory pathways.

METHODS: With IACUC approval, peripheral blood monocytes and plasma were purified from rat, summer AGS, and winter AGS after sham, 3h or 24h I/R. Samples were analyzed by 4-panel multicolor flow cytometry and Luminex cytokine assay. Differences in flow cytometric markers of innate immune response were assessed across 3 groups (rats, winter AGS, summer AGS) and 3 time-points (sham, 3, and 24 hours) after I/R injury. In the marker-by-marker analysis, the outcome variable was the integrated median fluorescence (combining marker density on a single cell with the relative abundance of cell types expressing that marker). In the cell subset analysis, unbiased cell subsets with similar patterns of marker expression were identified across samples using a hierarchical Dirichlet process mixture model for clustering events and used as the dependent variable. ANOVA will test for main and interaction effects.

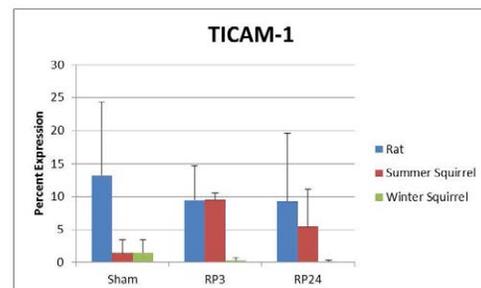
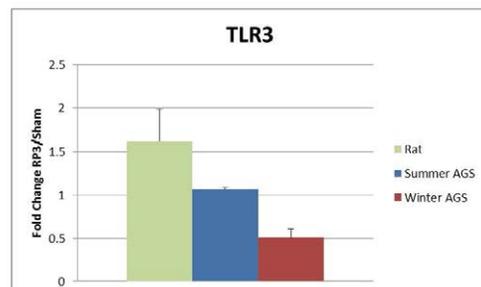
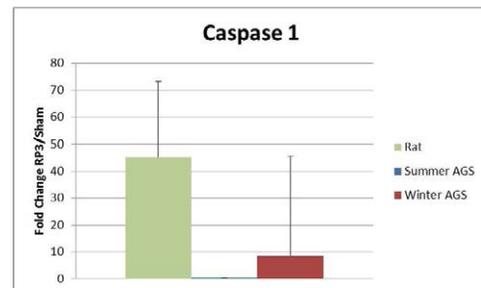
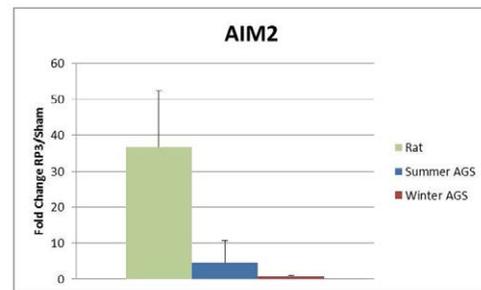
RESULTS: Initial data analysis reveals increased inflammasome (AIM2, caspase 1) activation in the rat compared with summer AGS or winter AGS, which correlate with increased myocardial injury observed in the rat. Comparison of summer AGS with winter AGS and rat reveals increased expression of PRRs (TLR3,TLR4), increased signal transduction along the TLR3/TICAM1 axis, increased cytokine production, and increased NFkB activation in the rat compared with AGS.



CONCLUSIONS: Using a multicolor flow cytometry approach we interrogated innate immunity in rat vs. AGS following surgical I/R. Several patterns emerged - compared to AGS, rats experience robust inflammasome activation in response to I/R as evidenced by >30-fold increases in AIM2 and Caspase 1. Hibernation state differences in innate immunity exist, including reduced expression of PRRs TLR3 and TLR4; additionally signaling via TLR 3 and 4 is greatly dampened in winter AGS due to nearly absent expression of TICAM1, which is preserved in summer AGS. As a result, circulating immune effector cells in winter AGS have an abrogated response to DAMPs compared to cells from summer AGS or rat, as evidenced by reduced cytokine production. Molecular switches that regulate innate immunity are difficult to manipulate, and given their importance in the pathogenesis of organ dysfunction in perioperative and critical care settings, understanding key events in immunomodulation naturally invoked by hibernators have high translational relevance.

REFERENCES:

1. J Leukoc Biol 88(4): 619-624. (2010).



S-81.**HIGH GLUCOSE ATTENUATES ANESTHETIC
CARDIOPROTECTION IN HUMAN STEM CELL-DERIVED
CARDIOMYOCYTES: A ROLE OF REACTIVE OXYGEN
SPECIES AND MITOCHONDRIAL FISSION**

AUTHORS: X. Bai¹, S. Canfield¹, I. Zaja¹, D. Twaroski², Y. Yan¹, J. Olson², Z. J. Bosnjak²

AFFILIATION: ¹Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, ²Anesthesiology and Physiology, Medical College of Wisconsin, Milwaukee, WI

INTRODUCTION: It has been shown in many animal and human cell models that volatile anesthetics can protect cardiomyocytes from ischemia/reperfusion injury. However, hyperglycemic conditions attenuate the cardioprotective effects and the underlying mechanisms remain unclear^{1,2}. Mitochondria are highly dynamic organelles that undergo continuous cycles of fusion and fission in order to maintain cellular homeostasis. Unbalanced fission-fusion can lead to various pathological processes including heart failure. To investigate the role of mitochondrial fission and its relationship with reactive oxygen species (ROS) in the high glucose-induced attenuation of anesthetic cardioprotection in a relevant human model, we utilized human pluripotent stem cell-derived cardiomyocytes (iPSC-CMs).

METHODS: iPSC-CMs were generated by culturing iPSCs in a chemically defined induction medium. The differentiated iPSC-CMs were characterized to express cardiomyocyte markers (e.g., troponin T) using immunofluorescence staining. iPSC-CMs were then exposed to varying glucose conditions (5, 11, 25 mM) for 24 hours followed by subsequent exposures to isoflurane for 30 minutes and 100 μ M hydrogen peroxide (H₂O₂) for 2 hours with or without ROS scavenger (Trolox) and mitochondrial fission inhibitor (mdivi-1). Cell viability was detected by lactate dehydrogenase (LDH) release in the media. ROS generation was evaluated by ethidium fluorescence generation. Mitochondrial fission was monitored by the visualization of fragmented mitochondria using confocal microscope. Expression level of activated dynamin-related protein-1 (Drp1), a key protein in regulation of mitochondrial fission was analyzed using Western blot.

RESULTS: iPSCs differentiated into spontaneously contracting cardiomyocytes. Isoflurane protected iPSC-CMs from H₂O₂ stress in 5 mM glucose and 11 mM glucose conditions but not in 25 mM glucose. Elevated glucose conditions (11 and 25 mM) significantly increased ROS generation while only the 25 mM high glucose condition induced mitochondrial fission in iPSC-CMs accompanied by the increase of activated Drp1 and mitochondrial fission. Scavenging ROS or inhibiting mitochondrial fission restored the anesthetic cardioprotective effects in iPSC-CMs in 25 mM glucose conditions.

CONCLUSIONS: Using human pluripotent stem cell-derived cardiomyocytes (iPSC-CMs), we demonstrate for the first time that the increased ROS and mitochondrial fission contributes to the attenuated isoflurane cardioprotective effect on iPSC-CMs in elevated glucose conditions. We could restore the cardioprotective effects in elevated glucose conditions by scavenging ROS or inhibiting mitochondrial fission individually. These findings may contribute to further understanding and restoring cardioprotection in hyperglycemic patients at the clinical level.

REFERENCES:

1. Kehl F, et al. *Anesthesiology* 2002; 96: 183.
2. Canfield SG, et al. Marked Hyperglycemia Attenuates Anesthetic Preconditioning in Human-induced Pluripotent Stem Cell-derived Cardiomyocytes. *Anesthesiology* 2012; 117: 735.

S-82.

INTRAVENOUS VERSUS INHALATION ANESTHESIA FOR PATIENTS UNDERGOING ON-PUMP OR OFF-PUMP CORONARY ARTERY BYPASS GRAFTING: A SYSTEMATIC REVIEW AND META-ANALYSIS

AUTHORS: A. R. Carvalho¹, R. El Dibi¹, F. Pugliesi¹, I. S. Rodriguez¹, L. G. Braz², M. P. Modolo¹, N. P. Modolo³

AFFILIATION: ¹Anaesthesiology, Univ Estadual Paulista, Botucatu, Brazil, ²Anaesthesiology, Botucatu Medical School - Univ Estadual Paulista (, Botucatu, Brazil, ³Anaesthesiology, Botucatu Medical School, Botucatu, Brazil

INTRODUCTION: Coronary artery disease is the most common cardiac disease with approximately 500,000 new and 300,000 recurrent events each year in the United States alone, making this disease one of the greatest public health concerns worldwide. Coronary artery bypass graft (CABG) is most commonly performed with the assistance of cardiopulmonary bypass (on-pump CABG). However, an increasing number of cardiac surgical procedures are being performed off-pump. Intravenous or inhalational techniques may be used to administer anaesthesia to patients undergoing CABG. Despite the evidence that inhalational anaesthetics protect the myocardium, some studies have suggested otherwise. To verify the efficacy and safety of intravenous versus inhalation anaesthesia in decreasing mortality and morbidity for patients undergoing on-pump or off-pump CABG.

METHODS: We searched the CENTRAL, MEDLINE, EMBASE, and LILACS (from inception to September 2014). We included randomized controlled trials of intravenous versus inhalation anaesthesia in adults undergoing on-pump or off-pump CABG.

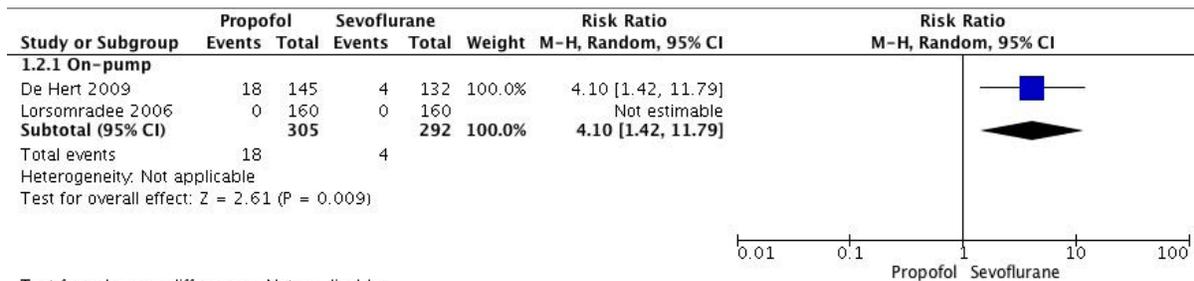
RESULTS: We included 34 studies with a total of 3201 participants in this review. The methodological quality was difficult to assess as it was poorly reported in almost half of the included studies, but the

other half was ranked as low risk of bias. We were able to include data from 33 studies in the meta-analysis. There was statistically significance difference favouring sevoflurane compared to propofol regarding death1-2 within 180 to 365 days of surgery RR 4.10 (95% CI 1.42 to 11.79), P = 0.009] (Figure 1) as well as related to length of stay in hospital [MD 4.00 (95% CI 2.75 to 5.25), P < 0.00001] and in the intensive care unit (ICU) [MD 1080.00 (95% CI 612.10 to 1547.90), P<0.00001]. There was no statistically significance difference between propofol versus isoflurane in on-pump for the death within 180 to 365 days of surgery [RR 3.84 (95% CI 0.43 to 34.22), P = 0.23, I²=0%] as well as for renal insufficiency [RR 1.31 (95% CI 0.09 to 19.00), P=0.84]. There was also no statistically significance difference between propofol versus desflurane regarding death within 180 to 365 days of surgery [RR 1.81 (95% CI 0.86 to 3.77), P = 0.12]. There was no evidence that intravenous and inhalation anaesthesia are effective with regards to renal insufficiency, cardiac depression, intraoperative awareness and adverse postoperative outcomes.

CONCLUSIONS: There is moderate quality evidence regarding the efficacy and safe of anesthetic agents in decreasing mortality and morbidity for patients undergoing on-pump or off-pump CABG. Some evidence showed a decrease regarding both death within 180 to 365 days of surgery and in both length of stay in hospital and in the intensive care unit rates favouring sevoflurane compared to propofol.

REFERENCES:

1. A comparison of volatile and non volatile agents for cardioprotection during on-pump coronary surgery. *Anaesthesia*. 2009;64(9):953-60.
2. Effects of sevoflurane on biomechanical markers of hepatic and renal dysfunction after coronary artery surgery. *Journal of Cardiothoracic and Vascular Anesthesia* 2006;20(5):684-90.



Test for subgroup differences: Not applicable

S-83.

NATURAL CARDIOPROTECTION IN HIBERNATING MAMMALS IS ASSOCIATED WITH INCREASED SIRTUIN-3 EXPRESSION AND SIGNALING

AUTHORS: M. V. Podgoreanu¹, Q. Ma², Z. Zhang², Q. J. Quinones², M. P. Smith³, J. R. Bain⁴, B. M. Barnes⁵

AFFILIATION: ¹Department of Anesthesiology, Duke University Medical Center, Durham, NC, ²Anesthesiology, Duke University Medical Center, Durham, NC, ³Anesthesiology, Duke University, Durham, NC, ⁴Duke Molecular Physiology Institute, Metabolomics Core Lab, Duke University Medical Center, Durham, NC, ⁵Institute for Arctic Biology, University of Alaska at Fairbanks, Fairbanks, AK

INTRODUCTION: A number of reports draw a link between loss of mitochondrial function, disturbed cardiac energy metabolism, and increased cardiac vulnerability to IR injury, but the underlying mechanisms remain ambiguous. Recently, sirtuin 3 (SIRT3), the primary mitochondrial NAD⁺-dependent protein deacetylase, has emerged as key regulator of metabolic and energy stress-response pathways in the heart. Mammalian hibernation involves a suite of adaptations comprised of metabolic rate depression and readjustments to cellular metabolism, including altered patterns of myocardial fuel utilization and upgrading cell preservation mechanisms to sustain viability during cold torpor. Having previously shown that hibernating arctic ground squirrels (AGS) are resistant to myocardial IR injury following deep hypothermic circulatory arrest (DHCA) compared to rats (Fig. 1), we hypothesized that differential regulation of SIRT3 and downstream target proteins are mechanistically implicated in the observed cardioprotective hibernator phenotype, by increasing fatty acid and ketone utilization and preventing accumulation of toxic intermediates of lipid metabolism in the heart.

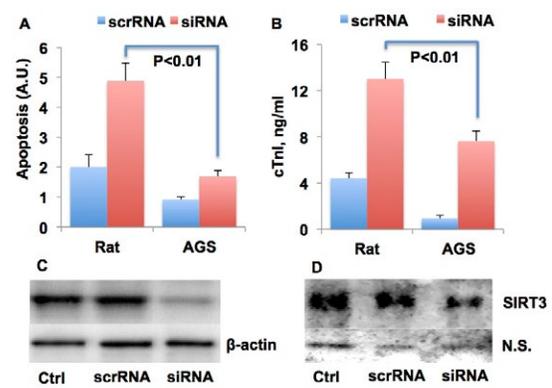
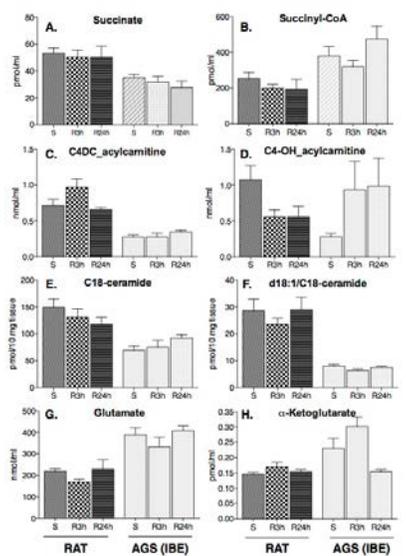
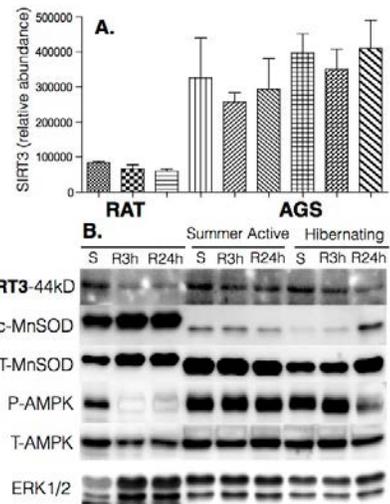
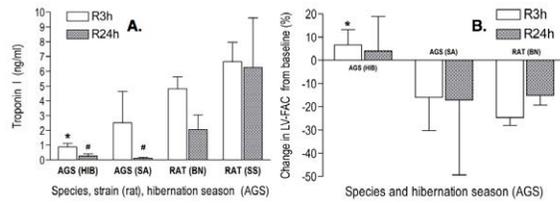
METHODS: With IACUC approval, expression of SIRT3 and downstream target proteins (MnSOD, AMPK) were assessed in LV myocardial biopsies from rat, summer AGS and winter AGS after sham, or 1h DHCA followed by 3h or 24h of reperfusion (n=3-6/group). Samples were analyzed using label-free mass-spectrometry and Western blot. IR induced changes in myocardial metabolism were assessed by mass-spectrometry based metabolomics. The effects of siRNA-mediated SIRT3 knock-down on cytoprotection following oxygen glucose deprivation/reoxygenation was compared in adult ventricular cardiomyocytes from AGS and rat.

RESULTS: SIRT3 expression was increased in AGS hearts compared to rat (Fig. 2A), and was corroborated with changes in proteins known to be regulated by SIRT3 (i.e. increased total expression of MnSOD, deacetylation/activation of MnSOD, which increases its ROS scavenging activity; increased phosphorylation of AMPK, which affects multiple downstream cardioprotective targets, Fig. 2B).

Metabolic correlates of the hibernator cardioprotective phenotype include preserved citric acid cycle flux and lack of accumulation of toxic intermediates of lipid metabolism (acylcarnitines, ceramides) in AGS vs rats. Elevated levels of glutamate may reflect known inhibition of GDH by SIRT3-deacetylation (Fig. 3).

siRNA SIRT3 knock-down increased cardiomyocyte apoptotic and necrotic death following simulated IR, with pronounced cross-species differences (Fig. 4)

CONCLUSIONS: Protein lysine acetylation is a highly evolutionarily conserved mechanism regulating fundamental cellular processes such as aging, mitochondrial function, and energy metabolism. We report differential regulation of the primary mitochondrial protein lysine deacetylase SIRT3 in hibernator hearts, associated with favorable metabolic consequences that limit myocardial lipotoxicity and the severity of myocardial injury following IR compared to a non-hibernator.



S-84.**SEVOFLURANE INHIBITS TNF- α -INDUCED INFLAMMATION VIA ENOS/NO SIGNALING PATHWAY IN HUMAN ENDOTHELIAL CELLS****AUTHORS:** W. Ruan¹, S. Li¹, J. Xu²**AFFILIATION:** ¹Department of Anesthesiology, The 2nd XiangYa Hospital, Central South University, Changsha, China, ²Department of Anesthesiology, Anesthesia Research Institute, Central South University, Changsha, China**INTRODUCTION:** Increased oxidative stress and inflammation induced endothelial dysfunction plays a critical role in the pathogenesis of cardiovascular diseases^{1,2}. Sevoflurane, a widely used anesthetic agent, confers cytoprotective effects through its anti-oxidative stress and anti-inflammatory properties in various disease such as septic shock, systemic inflammatory response syndrome and ischemic-reperfusion injury³⁻⁵. We hypothesized that sevoflurane pretreatment confer cytoprotective effects against endothelial dysfunction through its anti-inflammatory properties.**METHODS:** Primary cultured human umbilical vein endothelial cells (HUVECs) were placed in an airtight incubation chamber and exposed to different concentrations (0.5, 1.5 and 2.5 minimum alveolar concentration, MAC) of sevoflurane for 30 minutes, with or without tumor necrosis factor- α (TNF- α , 10 ng/mL) stimulation for 4 hours.**RESULTS:** Sevoflurane (1.5 and 2.5 MAC) significantly induced endothelial nitric oxide synthase (eNOS) phosphorylation in HUVECs. Furthermore, nitric oxide (NO) levels, both the content of intracellular NO and NO release in cell culture medium, were significantly up-regulated after sevoflurane treatment. Sevoflurane pretreatment significantly reduced TNF- α -induced phosphorylation of I κ B α and nuclear factor- κ B (NF- κ B) levels, which was associated with reduced NF- κ B activation (reduced NF- κ B nuclear translocation). In addition, sevoflurane significantly reduced the expression of vascular cell adhesion molecule-1 (VCAM-1) and intercellular adhesion molecule-1 (ICAM-1) by inhibiting binding of NF- κ B to their promoter regions and blocking the attachment of leukocytes to HUVECs. All these cytoprotective effects of sevoflurane pretreatment were totally abrogated by N-Nitro-L-arginine Methyl Ester, a non-specific nitric oxide synthase inhibitor.**CONCLUSIONS:** Sevoflurane plays a protective role in vascular endothelium by reducing oxidative stress and attenuating inflammation through activation of eNOS pathway and inhibition of NF- κ B pathway.**REFERENCES:**

1. PLoS One, vol. 9, no. 2, pp. e88501, 2014.
2. Curr Opin Hematol, vol. 18, no. 3, pp. 191-6, 2011.
3. Acta Anaesthesiol Scand, vol. 51, no. 7, pp. 893-9, 2007.
4. Cell Biochem Biophys, vol. 61, no. 1, pp. 123-9, 2011.
5. J Transl Med, vol. 11, pp. 87, 2013.

S-85.**DELTA OPIOID RECEPTOR MEDIATES EXERCISE-INDUCED CARDIOPROTECTION IN RATS: EX VIVO AND IN VIVO EVIDENCE****AUTHORS:** M. Lessa, J. Borges**AFFILIATION:** Laboratory of Cardiovascular investigation, Oswaldo Cruz Institute, Rio De Janeiro, Brazil**INTRODUCTION:** Recent evidence suggests that endogenous opioids may contribute to exercise-induced cardioprotection^{1,2}. However, the link between exercise-induced cardioprotection and the opioid system remains unclear. The present study aims to investigate the involvement of opioid receptors in exercise-induced cardioprotection in both model of ex vivo and in vivo in rats submitted to myocardial ischemia/reperfusion (I/R) injury.**METHODS:** This study was carried out in accordance with the Guide for the Care and Use of Laboratory Animals of the NIH and Institutional Animal Welfare Committee approved all protocols. The exercise protocol training consisted in 4 consecutive days of treadmill training (60 min at 70% of maximal oxygen consumption). Twenty-four hours after the last exercise session the animals were either killed for heart removal and connection to the Langendorff apparatus for the ex vivo protocol or anesthetized and manipulated for the in vivo protocol.

Ex vivo protocol: Male Wistar rats (250-300g) were randomly divided into one of three groups submitted to I/R: 1) control (CT; n=5); 2) exercised (Exe; n=5); and 3) exercised pretreated with naloxone (Exe+NAL; n=5).

In vivo protocol: Male Wistar rats were randomly divided into one of seven experimental groups: 1) control (CT; n=20); 2) exercised (exe; n=18); 3) exercised plus the non-selective OR antagonist (Exe+NAL; n=10); 4) control sham (Sham; n=10); 5) exercised plus the kappa OR (KOR) antagonist (Exe+KOR; n=5); 6) exercised plus the delta OR (DOR) antagonist (Exe+DOR; n=5); and 7) exercised plus a mu OR (MOR) antagonist (Exe+MOR; n=5).

In both protocols the hearts were exposed to 30min of ischemia followed by 1h of reperfusion. Left ventricle was sliced and incubated in triphenyltetrazolium and the myocardial infarct size (IS) was determined by planimetry.

RESULTS: In ex vivo protocol the EXE group presented a significant reduction in IS when compared to CT group (11.3 \pm 4.1 % vs 32.9 \pm 9.2 %, respectively; p < 0.05). Naloxone treatment completely blocked the exercise-induced cardioprotection (28.1 \pm 8.0 %). In the in vivo protocol Exe group showed a significant reduced IS compared to CT group (27.6 \pm 3.5 % vs. 42.0 \pm 3.0 %, respectively; p < 0.05). This cardioprotection was abolished when opioid receptors were blocked with naloxone, maintaining the IS similar to CT group (Exe+Nal: 39.5 \pm 2.9 % vs. 42.0 \pm 3.0 %, respectively; p > 0.05). KOR and MOR blockade did not change IS when compared to Exe group (Exe+MOR: 28.1 \pm 2.7 % and Exe+KOR: 28.2 \pm 4.8 %). However, DOR blockade prevented the exercise-induced cardioprotection with a IS similar to CT group (Exe+DOR: 39.6 \pm 2.0 % vs 42.0 \pm 3.0 %; p > 0.05).**CONCLUSIONS:** These results indicate that OR contribute to the cardioprotection conferred by endurance exercise, and the delta OR subtype plays a key role in this response.**REFERENCES:**

1. American journal of physiology. Heart and circulatory physiology 294, H402-408 (2008).
2. Basic Res Cardiol 107, 260 (2012).

S-86.**EVALUATION OF THE COAGULATION PROFILES OF STORED AUTOLOGOUS WHOLE BLOOD USING ROTATION THROMBOELASTOMETRY**

AUTHORS: S. Iwata¹, Y. Hirasaki¹, K. Hamada¹, I. Kondo¹, Y. Haramura¹, M. NOMURA¹, M. Ozaki²

AFFILIATION: ¹Department of Anesthesiology, Tokyo Women's Medical University Hospital, Tokyo, Japan, ²Department of Anesthesiology, Tokyo Women's Medical University, Tokyo, Japan

INTRODUCTION: Preoperative autologous whole blood (AWB) donation is performed to avoid perioperative allogeneic blood transfusion. In general, the main purpose of AWB donation is to preserve and replace the patient's red blood cells. The coagulation profile of stored AWB is unknown. We hypothesized that coagulation activity is maintained in stored AWB and investigated the coagulation profiles of stored AWB using rotation thromboelastometry (ROTEM)

METHODS: After obtaining IRB approval and informed consent, 46 adult patients undergoing elective cardiac surgery were enrolled. Patients taking warfarin were excluded. AWB donation was conducted according to our institute's protocol. The collected AWB was stored in a refrigerator until reinfusion. Blood specimen for the study was drawn from the storage bag at reinfusion. Standard hematologic tests [fibrinogen (FNG), hemoglobin (Hb) levels, and platelet count (PLT)], and ROTEM analysis were performed using the same specimen. The ROTEM analysis consisted of INTEM (ellagic acid-activated coagulation profile), EXTEM (tissue factor-activated coagulation) and FIBTEM (EXTEM with platelet deactivation) tests, and clotting time (CT), clot formation time (CFT) and maximum clot firmness (MCF) were determined in each test. In order to investigate the effect of storage on FNG, the samples were divided into three groups with respect to storage duration (Group 1: within 10 days, Group 2: 11 - 20 days or Group 3: longer than 21 days) and the FNG was compared among the groups. $P < 0.05$ was considered to be statistically significant.

RESULTS: In total of 141 AWB samples were analyzed. The mean duration for storage was 16.7 ± 7.3 days (mean \pm SD, range: 6-33 days). The mean Hb and FNG level was 10.6 ± 1.1 g/dL, and 228.6 ± 61.4 mg/dL, respectively. PLT was nearly zero in all samples. In ROTEM analysis, INTEM-, EXTEM- and FIBTEM-CT were significantly prolonged (288.7 ± 85.5 , 95.1 ± 74.9 and 90.1 ± 79.5 sec, respectively). CFT was not measurable in almost all traces. On the other hand, INTEM-, EXTEM- and FIBTEM- MCF were 14.1 ± 5.2 , 14.7 ± 5.4 and 13.2 ± 5.0 mm, respectively. There was a strong correlation between FIBTEM-MCF and FNG ($r = 0.86$) (Figure 1). There were no significant differences in FNG among the 3 groups (Group 1: Median 220, IQR=56.8, Group 2: Median 231, IQR=80.5, Group 3: Median 222 IQR=75.3) (Figure 2).

CONCLUSIONS: In our study, ROTEM demonstrated fibrin polymerization activity in stored AWB, which strongly correlated with the fibrinogen level. Prolonged clotting time was considered to be due to the loss of platelet function. Our data suggest that clot formation ability except for platelet function is retained in AWB even after a long storage.

REFERENCES:

Transfusion 2013;53:137s-149s

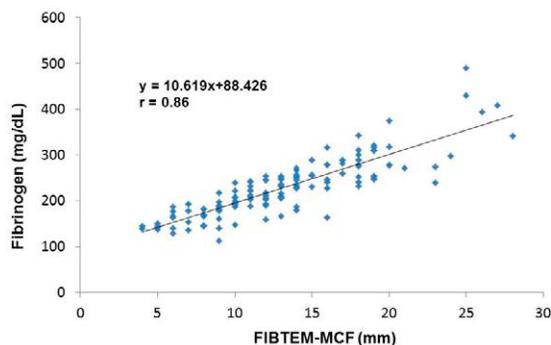


Figure 1: Relationship between FIBTEM-MCF and Fibrinogen

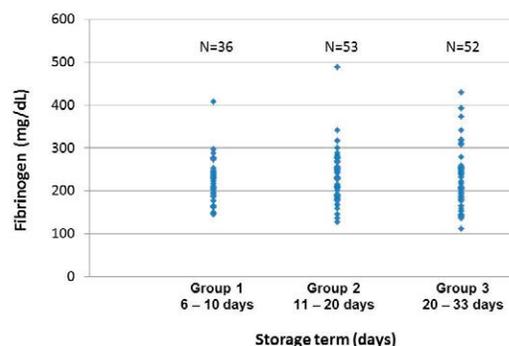


Figure 2: Relationship between storage term and fibrinogen

S-87.**UPREGULATION OF MIR-21 RESTORES
CARDIOPROTECTION IN STEM-CELL DERIVED HUMAN
CARDIOMYOCYTES CULTURED IN HIGH GLUCOSE****AUTHORS:** J. Olson¹, Y. Yan¹, X. Bai¹, M. Liang², Z. J. Bosnjak¹**AFFILIATION:** ¹Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, ²Physiology, Medical College of Wisconsin, Milwaukee, WI**INTRODUCTION:** Anesthetic cardioprotection has been shown to decrease myocardial infarct size following an ischemia reperfusion injury. This protective effect is attenuated under diabetic conditions in both human and animal models, but the underlying mechanisms are largely unknown. MicroRNAs are short, non-coding nucleotide sequences that negatively regulate gene expression through degradation or suppression of messenger RNA. In previous studies, we have shown the functional role of miR-21 as a novel mediator of anesthetic induced cardiac protection. Now, we show for the first time its role in the attenuated protection seen in diabetic conditions by using cardiomyocytes (CMs) derived from induced pluripotent stem cells (iPSCs) exposed to either normal or high glucose. We hypothesized that upregulation of miR-21 would restore cardiac protection in human iPSC-CMs cultured in high glucose conditions.**METHODS:** iPSCs were cultured to confluency and derived into cardiomyocytes using the Palecek protocol. Contracting cells were dissociated and immunostained with cardiac-specific markers to determine purity of cardiomyocyte culture. Cells cultured in 5, 11, or 35 mM glucose were exposed to 1 mM of isoflurane for 1 hour before oxidative stress with hydrogen peroxide. In order to test the functional role of miR-21, a GFP-tagged miR-21 adenovirus was transduced into cells. miR-21 expression was analyzed using qRT-PCR, and cell viability was assessed by measuring propidium iodide (PI) staining. Opening time of the mitochondrial permeability transition pore (mPTP) opening time was assessed using confocal microscopy.**RESULTS:** iPSC-CMs in 5 and 11 mM glucose conditions showed a cardioprotective response after exposure to isoflurane as evidenced by decreased PI positive-stained cells and delayed opening time of the mPTP. This response was abolished after knockdown of miR-21. In iPSC-CMs in 5 and 11 mM glucose, miR-21 was increased after exposure to volatile anesthetics. This phenomenon was abolished in iPSC-CMs cultured in 35 mM glucose media, which exhibited lower baseline levels of miR-21 and a significant decrease in expression levels after exposure to isoflurane. This cardioprotective effect was restored using adenoviral-mediated upregulation of miR-21.**CONCLUSIONS:** MicroRNA-21 has emerged as a key mediator of the cardioprotective effects of isoflurane, and is consistently upregulated after exposure to isoflurane in healthy models. The downregulation of miR-21 in iPSC-CMs cultured in high glucose may indicate an important role of miR-21 in the impairment of isoflurane-induced cardioprotection during diabetic conditions. Further investigation into this phenomenon may suggest new therapeutic targets for reducing perioperative cardiovascular morbidity and mortality in both healthy and diabetic patients.

S-88.

WITHDRAWN.

S-89.**LOXL2 A NOVEL TARGET IN VASCULAR STIFFNESS**

AUTHORS: J. Stepan¹, D. Hori¹, S. An², D. E. Berkowitz¹, L. Santhanam³

AFFILIATION: ¹Anesthesiology and Critical Care Medicine, Johns Hopkins University, Baltimore, MD, ²Environmental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, ³Anesthesiology and Critical Care Medicine, Johns Hopkins University SOM, Baltimore, MD

INTRODUCTION: Increased vascular stiffness and the resultant systolic hypertension is a hallmark of aging and hypertension. Vascular stiffening is a complex process that involves changes of vessel wall composition and changes smooth muscle cell function. We recently used an unbiased proteomic approach to identify Lysyl oxidase like 2 (LOXL2) as a potential new target in vascular stiffness. The goal of this study is to further characterize the role of LOXL2 in vascular stiffening.

METHODS: We used a co-culture experiment to determine LOXL2 abundance and activity in human aortic smooth muscle cells (HASMC) in the presence and absence of human aortic endothelial cells (HAEC). The influence of nitric oxide (NO) on LOXL2 activity and abundance was evaluated using an exogenous NO donor. Utilizing lentivirus delivery of LOXL2 shRNA, we created a knockdown cell line (L2/5) from rat thoracic artery SMC (A7r5). LOXL2 knockdown was confirmed by quantitative PCR (qPCR) and Western blotting. Wound healing was evaluated by growing cells to confluence and growth arrested them in serum-free media. Monolayers were scratched with a sterile pipet tip and cells were cultured in 2% serum media. Phase images were acquired at 0, 6, 18, 24, 30, and 48 h. Cell motility was examined with a fluorescence-based SMC proliferation kit. To measure proliferation cells were cultured on fibronectin coated coverslips, treated with serum-free media for 18h, and examined for cell proliferation in 2% media. De-adhesion of cells with 0.05% trypsin was examined by capturing phase contrast images for 2 min at 10s intervals. Cell stiffness was measured using spontaneous nano-bead tracer motion and magnetic torsion cytometry (MTC).

RESULTS: The presence of HAEC attenuated the expression and activity of LOXL2 in cell-derived ECM and in conditioned media. Exogenous NO dose-dependently reduced LOXL2 expression and inhibited its activity in the cell-derived media of HASMC. LOXL2 knockdown in L2/5 cells was confirmed by quantitative PCR and Western blotting. LOXL2 knockdown resulted in 1) delayed wound healing, 2) decreased cell motility, 3) decreased proliferation, and 4) decreased de-adhesion rates, all of which could be reversed with the addition of LOXL2. Furthermore L2/5 cells deposited less fibronectin in the cell-derived matrix than did wild-type cells. Furthermore LOXL2 accumulates with aging in old decellularized rat aorta compared to young. Lastly L2/5 cells are stiffer than their A7r5 counterparts as evidenced by less spontaneous nano bead tracer motion and higher forces encountered during MTC.

CONCLUSIONS: We have confirmed the results from our proteomic experiment and demonstrated the role of NO in the regulation of LOXL2. Furthermore LOXL2 appears to play a role in vascular stiffness during aging, given its dual effect on both SMC function, as well as matrix composition. We thereby identified a novel target involved in vascular stiffness that requires further characterization to elicit the possibility of therapeutic intervention.

S-90.

PREOPERATIVE BRAIN NATRIURETIC PEPTIDE IN PEDIATRIC CARDIAC SURGERY PATIENTS: ITS ASSOCIATION WITH POSTOPERATIVE OUTCOMES

AUTHORS: T. Kanazawa¹, M. Egi², Y. Toda³, K. Shimizu¹, T. Iwasaki¹, H. Morimatsu¹

AFFILIATION: ¹Anesthesiology and Resuscitology, Okayama University Hospital, Okayama, Japan, ²Anesthesiology and Resuscitology, Kobe University Hospital, Kobe, Japan, ³Anesthesiology and Resuscitology, Okayama University Hospital, Okayama-shi, Japan

INTRODUCTION: BNP is widely used as a predictor of long term prognosis in cardiac patients. However, there is lack of prospective study to investigate the relationship between BNP and postoperative acute prognosis in pediatric cardiac patients.

METHODS: This is a prospective observational study. Study period was 15 months from December 21, 2012 to February 26, 2014. Patients who received pediatric cardiac surgery under cardiopulmonary bypass were included. Patients who received simple cardiac surgery coded RACHS-1 category 1 were excluded. Data on age, emergency operation, minimum hemoglobin concentration and temperature during CPB were prospectively collected. BNP were measured on the morning of the day of surgery (BNP_{pre}), postoperative day (POD) 1 (BNP₁) and POD 3 (BNP₃). We defined primary outcome as the incidence of postoperative serious adverse events (SAEs). SAEs included 1) death in the ICU, 2) requirement of extracorporeal membrane oxygenation (ECMO), 3) cardiac arrest and 4) requirement of re-operation. We first separated patients into those with and those without SAEs. Categorical variables were summarized using proportions and compared between groups using the chi square test, and continuous variables were summarized using medians (interquartile ranges) and compared using the Wilcoxon rank-sum test as appropriate. If any BNP levels had significant association with the incidence of SAEs, we would performed Receiver Operating Characteristic (ROC)

analysis to investigate cutoff level of BNP levels for predicting the incidence of SAEs. To assess the independent association of BNP measurements above cutoff levels with the incidence of SAEs, we performed multivariate logistic regression analysis. Results from the multivariate models were reported using odds ratios (OR) with 95% confidence intervals. P<0.05 was considered statistically significant.

RESULTS: 71 children were included this study. Eight children (11%) had at least one SAEs after surgery. Preoperative BNP level was significantly higher in patients with SAEs than in patients without SAEs (1541 vs. 122, p=0.01). From the ROC curve, BNP_{pre} shows good diagnostic accuracy of SAEs with an AUC= 0.77. The best cutoff BNP_{pre} value was calculated by ROC analysis; BNP_{pre} =1000pg/ml, and its sensitivity and specificity were 63% and 92%. In our multivariate logistic regression model, BNP_{pre}>1000pg/dl was independently associated with risk of SAEs (p=0.005, OR 26, 95%CI(2.51,751)). Any other confounders didn't have independent correlation with SAEs.

CONCLUSIONS: In conclusion, increased preoperative BNP concentration was associated with risk of postoperative SAEs in pediatric cardiac surgery patients. Future studies should be conducted to confirm the potential utility of preoperative BNP as a future therapeutic target or trigger.

Figure 1 Result of Receiver Operating Characteristic analysis between BNP and SAEs

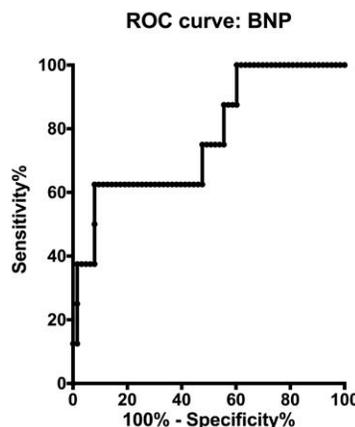


Table 1 Comparison of demographics between patients with and without SAEs

	SAE(+)	SAE(-)	p-value
Age(month)	1(0,11.3)	9(0,32)	p=0.25
CPB temp(°C)	28(24,30)	28(24,32)	p=0.37
RACHS1	4.5(3.75,6)	3(3,4)	p=0.01
Emergency	4/8(50%)	14/63(22%)	p=0.1
ICU Stay (day)	16(10.5,29)	6(5,8.75)	p<0.0001
Duration of MV(hr)	11.9(5.5,20.5)	1.12(0.11,2.6)	p=0.0003

Table 2 Comparison of perioperative BNP levels between patients with and without SAEs

n=71	SAEs(+) n=8	SAEs(-) n=63	p-value
BNP _{pre}	1541 (121, 5692)	122 (34, 342)	0.01
BNP ₁	258 (191, 1823)	412 (212, 804)	0.97
BNP ₃	901 (209, 1196)	302 (142, 508)	0.17

Table 3 Result of Multivariate Analysis

	Odds ratio	p-value
Age(month)	0.99 (0.95, 1.01)	0.62
CPB temp(°C)	1.02 (0.81, 1.35)	0.8
Minimum Hb(g/dl)	0.42(0.14, 1.01)	0.06
Emergency(+)	2.9 (0.25, 39)	0.39
RACHS-1	2.1(0.87, 5.8)	0.06
BNP _{pre} >1000 pg/ml	20 (2.5, 532)	0.008

S-91.**INCREASED INFLUENCE OF M-CSF RESULTS IN DIMINISHED ABILITY OF CIRCULATING MONOCYTE TO REGULATE IMMUNE SYSTEM**

AUTHORS: K. Laudanski¹, T. Dong², S. Badugu², H. Oszkiel³, N. Lapko⁴

AFFILIATION: ¹Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA, ²College, University of Pennsylvania, Philadelphia, PA, ³Faculty of Veterinary Medicine, Warsaw University of Life Sciences, Warszawa, Poland, ⁴Medical College, Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine

INTRODUCTION: Cardiopulmonary bypass (CPB) triggers intense inflammatory response that may affect the fate and the function of circulating monocytes (MO). These naïve MO can differentiate into variety of offsprings but frequently the excess of inflammatory macrophages (MAC) emerges with detrimental clinical outcome. Alternatively, competent MO surface with an ability to regulate the function of the immune system. Here, we conducted a study involving individuals undergoing CPB in which we examined the ability of MO to obtain regulatory capability. We hypothesize that CPB may diminish ability of MO to regulate immune system due to the large pro-inflammatory insult due to the subsequent MAC predominance.

METHODS: Blood from total of 15 subjects subjected to CPB was obtained. Their isolated MO were incubated with IL-4 & GM-CSF in X-VIVO15™ media in vitro as the optimal environment to generate cells with ability to regulate immune system. After 5 days the cells were harvested. Ability of IL-4 & GM-CSF stimulated MO to stimulate immune system was measured by expression of CD1a and CD83. We also evaluated the MAC like ability of circulating MO by measuring production of M-CSF and expression of M-CSFR. Each of the subjects had blood drawn shortly before bypass (t0) and 7 days (t7d) after CPB.

RESULTS: All patients MO after treatment with IL-4&GM-CSF acquired CD1a (t0 %CD1a+=67.2+12.56) and CD83 (t0 CD83+=17.2+4.61). However, approximately 33% patients' MO did not acquire ability to present antigens if the cells were obtained 7 days after CPB as demonstrated by low expression of CD1a (t7d %CD1a+=22.2+7.12). Remaining 67% acquired high expression of CD1a (%CD1a+=71.5+21.5). Interestingly, in either group of the patient increase of CD83 was minimal at 3.1%+2.2. In order to assess the macrophage like characteristic of circulating MO we assess M-CSF and M-CSFR, markers of macrophages-like MO characteristic. Serum M-CSF was increased 7d after CPB but recovered to baseline (Me M-CSFserum t0=176.6; t+7d=442.5; t+3m=227.4[pg/ml]; p<0.05). Interestingly, when we analyzed supernatants of the cultures of MO undergoing IL-4 & GM-CSF differentiation M-CSF levels were persistently increased (Me M-CSF [pg/ml] t0=1261; t+7d=2485; p<0.001). Also, expression of M-CSFR was elevated on circulating naïve MO (Me %M-CSFR t0=56%; t+7d=89%; p<0.01).

CONCLUSIONS: Our study demonstrates that CPB can induce persistent MAC like characteristic of the circulating MO up to 7 days after CPB. This results in diminished ability of peripheral blood MO to regulate immune system.

S-92.

COMPARISON OF OR VERSUS ICU PROVIDERS' PERCEPTION OF IMPORTANCE OF HANDOFF INFORMATION AT THE TIME OF PATIENT TRANSFER

AUTHORS: E. D. Wittwer, V. Herasevich, B. Pickering

AFFILIATION: Anesthesiology, Mayo Clinic, Rochester, MN

INTRODUCTION: Transfer of patient care (patient handoff) is required in our medical system. During this vulnerable time most medical errors are attributed to communication failures.¹ As multiple patient handoffs occur, the accuracy of information decreases² and in cardiac surgery 2.3 distractions occurred per minute during patient handoff.³ In an American Heart Association statement, patient handoffs had communication errors and many were believed to result in patient harm.⁴ In our institution the anesthesia provider completes a paper handoff form which is given to the ICU nurse on arrival to the ICU. While revising the form, we determined essential information is unknown and ICU providers may have different information needs than OR providers. This study was performed to gather data on what information is perceived to be necessary in patient handoff by OR versus ICU providers.

METHODS: A survey was constructed with current handoff information as well as additional information suggested by providers from the OR and ICU, including 56 potential pieces of information. Study participants included anesthesiology residents, CRNAs, cardiac anesthesiologists, critical care anesthesiologist, ICU nurses, and ICU NPs/PAs. Participation in the survey was voluntary. A Likert scale was used to rank each piece of information with 7 being "Essential" and 1 being "Not needed".

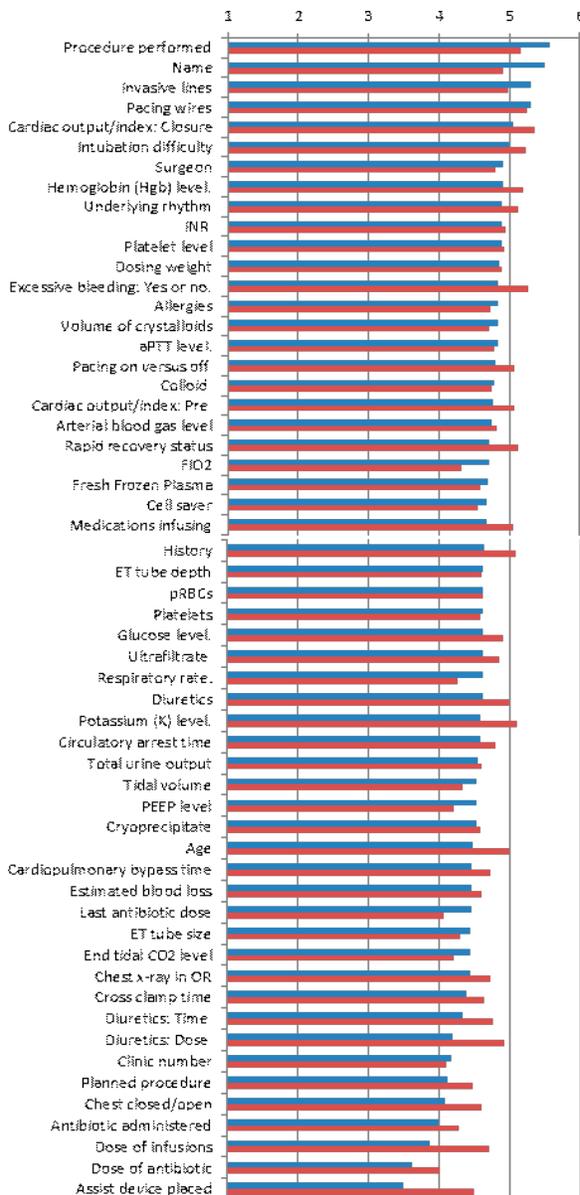
RESULTS: The survey was sent to 297 individuals with 134 responses (45%). To examine possible differences in perception of information importance the participants' responses were divided into two groups: OR and ICU. The information and average score can be seen in Figure 1. The five most essential pieces of information for OR providers were Procedure performed, Name, Invasive lines, Pacing wires, and Cardiac Index (CI) at closure and for ICU providers were CI at closure, Excessive bleeding, Pacing wires, Intubation difficulty, and Hemoglobin level. The average score given to items in the OR group was 4.6 and in the ICU group was 4.7.

CONCLUSIONS: Handoff periods are critical to patient care. Important information needs to be shared with non-critical information eliminated allowing providers to focus on and retain the information. OR and ICU providers have different work environments and priorities. This survey demonstrates that while some information is very important to both groups (CI at closure and Pacing wires) there are also important differences. There was not a significant difference in the average score given by one group versus the other. Using the data from this survey a more concise handoff tool can be developed that provides those working in the ICU with the information they need and eliminating less pertinent information.

REFERENCES:

1. J Am Med Inform Assoc. 2014;21:e352-7
2. J Surg Educ. 2014;71:480-5
3. Am J Med Qual. 2011;26:380-6

Figure 1: Potential handoff information and average importance as rated by OR providers and ICU providers
Blue: OR providers, Red: ICU providers. Values are ratings of importance for inclusion into a handoff form on a scale from 7 (Essential) to 1 (Not needed).



Subspecialty Abstracts

Critical Care

S-93.

DECREASED INCIDENCE OF HYPO-MAGNESEMIA IN THE ADULT SURGICAL ICU

AUTHORS: J. T. Denny¹, T. Jan¹, A. N. Patel¹, J. Tse², A. Ocampo-Salazar¹, M. Chaudhry¹, A. M. Mohiuddin³

AFFILIATION: ¹Anesthesia, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, ²Anesthesia, Rutgers-Robert Wood Johnson Medical School, New Brunswick, NJ, ³Anesthesia, Rutgers-Robertwood johnson Medical School, New Brunswick, NJ

INTRODUCTION: Hypo-magnesemia (HM) is a common laboratory abnormality encountered in hospitalized patients. It is found in as many as 20% of medical floor patients.¹ It has been described to occur in as many as 65% of patients in Intensive Care Units (ICU)² It is the second most plentiful intracellular cation, and the fourth most occurring cation in the body.³ Estimates of Magnesium (Mg) deficiency range from 20% to 61%.^{4,5} Rubeiz found that reductions in total serum Mg found at hospital admission are associated with increased mortality.⁶

METHODS: We reviewed patient records for 2001 and 2011. The last three months of each year was selected to compare similar times. Mg levels less than 2.0 were abnormal and noted.

RESULTS: Differences analyzed using Chi Square.

Magnesium Levels in ICU Patients

	Mg<2	N
2001	133(42.36%)	314
2011	93 (25.20%)	369
p<	0.001	

DISCUSSION: Our results show that in our hospital SICU sample, there was a significantly lower incidence of HM. (25.20%) in 2011 than in 2001. (42.36%) P<0.001. There are several non-mutually exclusive explanations possible for these results. One is the improved understanding of the importance of Mg in hospitalized patients. In the decade since the first sampling, it is possible that Mg is being monitored more regularly in ICU patients. One reason for this might be the increased prevalence of ICU fellowship training among practitioners in the ICU. Causes of HM are diverse. Diuretic therapy is the leading cause of Mg deficiency. Diuretic induced inhibition of sodium resorption will also interfere with Mg resorption. Antibiotics promoting Mg depletion are the aminoglycosides and amphotericin.⁷ Antibiotic associated diarrhea can also be accompanied by significant Mg stool losses. Other drugs associated with Mg depletion include digoxin and epinephrine which shift Mg into cells.⁸ In contrast, the chemotherapeutic agents cyclosporine and cisplatin promote renal Mg excretion.⁸ Since Mg concentration is high in lower gastrointestinal secretions, a secretory diarrhea can lead to Mg depletion.⁹ A change in any of these prescriptives could affect the incidence of HM observed. Alcohol is associated with perturbations in magnesium. HM is seen in 30% of hospital admissions for alcohol abuse, and in 85% of delirium tremens admissions.^{9,10} HM may be a common laboratory clue towards alcohol abuse in a hospitalized patient who is non-communicative. The incidence of alcohol abuse was not measured in our study, so we cannot comment on this influence.

CONCLUSIONS: In our hospital Surgical ICU sample, there was a significantly lower incidence of hypo-magnesemia (25.20%) in 2011 than in 2001. (42.36%) P<0.001. This is encouraging that magnesium is more often within normal range a decade later. The exact causes remain to be elucidated.

REFERENCES:

1. ICM.2002;28:667-79.
2. J of ICM 2005;20:3-17.
3. Am j of clinpath 1994;102:616-22.
4. CCM1985;13:19-21.
5. Chest 1989;95:391-7.
6. CCM1993;21:203-9.
7. Drug safety. 2005;28:763-88.
8. Arch of int med 1985;145:655-6.
9. J of the Am Soc of Nephrology : JASN 2009;20:2291-5.
10. Magnesium. 1991;10:263-8.

S-94.

IMPROVING NUTRITION PRACTICES AT THE TIME OF TRACHEAL EXTUBATION IN THE ICU: THE EXTUBATION SAFETY QUALITY IMPROVEMENT PROJECT

AUTHORS: D. Dorsey, A. Joffe, A. Dagal, J. Sunshine, M. Treggiari

AFFILIATION: Anesthesiology, University of Washington, Seattle, WA

INTRODUCTION: Removal of the endotracheal tube in the intensive care unit (ICU) is commonly associated with undesired events including interruption of enteral nutrition and increased serum glucose variability, as well as failed extubation leading to re-intubation. Re-intubation following planned extubation is independently associated with poor outcomes, including ventilator associated pneumonia, increased length of stay and death. In the context of a quality improvement (QI) initiative in a cohort of mechanically ventilated ICU patients (medical, surgical, and neuroscience) of one large academic medical center, we implemented an extubation safety algorithm to improve extubation safety, reduce the occurrence of re-intubation, enteral nutrition interruptions and glycemic instability.

METHODS: Eligible ICU patients were prospectively enrolled into pre and post-intervention cohorts over two consecutive six-month periods separated by a two-week rollout period. The QI intervention consisted of education of designated ICU team leaders who then disseminated the ICU extubation algorithm. We compared frequencies of re-intubation, tracheostomy, enteral feed interruptions and glycemic events in the peri-extubation period between the pre and post-intervention cohorts.

RESULTS: During the study period, 934 patients were included in

the baseline period and 799 patients during the QI implementation period. Out-of-operating room re-intubation was required for 20% of baseline patients compared to 18% in the post-intervention group (p = 0.24), with a reduction seen in the occurrence of tracheostomy (Table 1). Among patients receiving enteral nutrition, the interruption of continuous feeds in the 24 hours preceding extubation was 7.9 ± 2.8 hrs in the baseline period (n=428) and 5.8 ± 1.6 hrs in the QI implementation period (n=369) (P=0.52). A significant decrease in the use of IV dextrose and a trend toward reduced insulin needs was observed in the QI implementation period. There were no significant changes in post-extubation aspiration events, mean glucose level or hypoglycemic events between the two study periods.

CONCLUSIONS: The use of an ICU extubation safety algorithm led to similar occurrences of failed extubation and reduced tracheostomy procedures, with an overall increase in the proportion of patients successfully extubated. Although non-significant, nutrition interruption and insulin use tended to be reduced, and use of IV dextrose decreased. These changes were not accompanied by an increase in aspiration or hypoglycemic events. It cannot be determined definitively if these observed changes are due to the QI-intervention or unrelated differences in study cohort characteristics or in clinical practice.

REFERENCES:

1. Crit Care Med, 1999. 27(7):1252-6.
2. JAMA, 2013. (309): 2165-6.
3. Intensive Care Med, 2013. (7): 1221-6.

Outcome Variables	Pre-intervention	Post-intervention	P value
Patients requiring re-intubation, n (%)	179 (19.9)	146 (18.3)	0.24
Patients undergoing tracheostomy, n (%)	43 (4.4)	20 (2.0)	0.03
Aspiration events, n (%)	4 (0.9)	1 (0.3)	0.31
Hours of pre-extubation feed interruption, mean (SD)	7.9 (2.8)	5.8 (1.6)	0.52
Pre-extubation IV 5% dextrose use (mL), mean (SD)	1130 (43)	980 (46)	0.02
Post-extubation IV 5% dextrose use (mL), mean (SD)	1230 (49)	1012 (46)	<0.01
Pre-extub. Hypoglycemia, n (%)	10 (1.1)	6 (0.8)	0.49
Post-extub. Hypoglycemia, n (%)	3 (0.4)	4 (0.5)	0.57

S-95.

OUTCOMES AFTER MASSIVE TRANSFUSION AND CHEST COMPRESSIONS

AUTHORS: M. Kang, J. M. Berman

AFFILIATION: Department of Anesthesiology, University of North Carolina, Chapel Hill, NC

INTRODUCTION: The development and implementation of massive transfusion protocols (MTP) have improved outcomes for patients suffering severe hemorrhage. However, there is little data to guide clinicians in making the difficult decision to continue transfusion therapy or to stop. Several authors have found that survival for patients receiving massive transfusion is favorable and conclude that resuscitative efforts should not cease based on the quantity of blood transfused.¹⁻³ Barbosa, et al. conclude that markedly abnormal physiologic and/or biochemical data should not preclude initiation or continuation of MTP unless patients are over age 65 and have concomitant severe traumatic brain injury.⁴ In this analysis we compare survivors and non-survivors of massive transfusion who required chest compressions in an effort to identify potential prognostic markers.

METHODS: We conducted a retrospective chart review of the MTP registry at a single academic Level I trauma center from 2009-13. Trauma and nontrauma patients ages 18 and older who required chest compressions were included; obstetric patients were excluded. Survivors and non-survivors were compared on age, sex, units of red blood cells (RBCs) transfused, and etiology of hemorrhage. Continuous variables were analyzed using t-test and dichotomous variables were analyzed using Fisher’s exact test. Multivariate logistic regression was also performed to identify possible independent predictors of survival.

RESULTS: Only 8 of the 62 patients in the MTP registry from 2009-13 who required chest compressions survived (12.9%). There were no differences between survivors and non-survivors in terms of age or sex. Fewer survivors were trauma patients (38% vs 52%, p=0.71). Overall fewer units of RBCs were transfused in survivors than in non-survivors (8 vs 15, p=0.10). The percentage of survivors who required chest compressions for more than 30 minutes was also lower than in non-survivors (38% vs 70%, P=0.11). The multivariate logistic regression performed on these variables yielded no statistically significant results.

CONCLUSIONS: This comparison of survivors and non-survivors of massive transfusion and chest compressions yielded no statistically significant results in large part due to the small sample size. Another limitation of this analysis is that records from code situations are often incomplete and/or inaccurate. Nevertheless, the survival rate of only 12.9% in this group of patients seems to warrant further investigation in order to help direct therapy and manage finite resources. A large-scale analysis of survival rates for patients who require MTP and chest compressions may help to further characterize this population, develop better goal-directed therapies, and establish the evidence needed to assist in making the very difficult decision to continue or cease resuscitative efforts.

REFERENCES:

1. Velmahos GC, et al. Arch Surg. 1998 Sep;133(9):947-52.
2. Vaslef SN, et al. J. Trauma. 2002 Aug;53(2):291-5.
3. McDaniel LM, et al. Transfus Med. 2014 Jun;24(3):138-44.
4. Barbosa RR, et al. J. Trauma. 2011 Aug;71(2 Suppl 3):S364-9.

Comparison of survivors and non-survivors

	All	Survivors	Non-survivors	p-value
N	62	8 (12.9%)	54 (87.1%)	
Avg age (95% CI)	52 (48-56)	53 (40-65)	51(47-56)	0.84
Males	46/62 (74%)	6/8 (75%)	40/54 (74%)	1.0
Trauma	31/62 (50%)	3/8 (38%)	28/54 (52%)	0.71
Avg # U PRBCs transfused (95% CI)	14 (11-17)	8 (0-17)	15 (12-18)	0.14
Duration CPR > 30'	41/62 (66%)	3/8 (38%)	38/54 (70%)	0.11

Multivariate logistic regression of predictors of survival

	Odds ratio	95% confidence interval	p-value
Age (per 1 year)	1.01	0.95, 1.06	0.84
PRBCs transfused (per 1 unit)	0.93	0.84, 1.03	0.17
Male	1.28	0.20, 8.15	0.80
Duration CPR > 30'	0.29	0.06, 1.43	0.13
Trauma	0.64	0.10, 4.03	0.63

S-96.**INCREASED IN-HOSPITAL MORTALITY IN PATIENTS TRIGGERING A SEVERE SEPSIS ADVISORY WHILE IN THE INTENSIVE CARE UNIT****AUTHORS:** A. L. Ray¹, E. Shea², M. Sullivan², D. Shimabukuro³**AFFILIATION:** ¹Anesthesia and Critical Care, University of California-San Francisco, San Francisco, CA, ²Critical Care, UCSF, San Francisco, CA, ³Anesthesia and Critical Care, UCSF, San Francisco, CA.**INTRODUCTION:** The Surviving Sepsis Campaign recommends routine sepsis screening in all hospitalized adult patients.¹ In institutions with electronic medical records (EMR), screening is performed using real-time patient data with an alert generated after specific criteria are fulfilled. At our institution, an automated sepsis screening system was put in place to aid in the early identification of patients with severe sepsis in the intensive care unit (ICU). An advisory is created in the EMR to alert providers of a possible patient with severe sepsis when there are at least 2 systemic inflammatory response syndrome (SIRS) criteria and at least one other criterion for end organ dysfunction. In this study, we sought to determine if there was an increased mortality in patients receiving such an advisory during their ICU admission over those who did not.**METHODS:** A retrospective analysis was performed on patients admitted to our academic 32-bed adult medical-surgical ICU over a three-month period between April 01, 2014 and June 30, 2014. Patients were placed into group-A or group-B based on the presence or absence of a severe sepsis advisory during their ICU admission, respectively. Patient records were reviewed for death during their hospital stay and all-cause mortality rates were calculated separately for groups A and B. This study was approved by our Committee on Human Research.**RESULTS:** 502 patients were admitted to the medical-surgical ICU during the study period. 253 patients were placed in group-A based on the presence of a sepsis advisory and 249 patients were placed in group-B (no advisory). 20 of the 253 patients in group-A (advisory) died during their ICU admission for a mortality rate of 7.9%. 8 of the 249 patients in group-B (no advisory) died during their ICU admission for a mortality rate of 3.2%. The relative risk of mortality in patients with a sepsis advisory was 2.5 (95% CI, 1.10 to 5.48; P= 0.03).**CONCLUSIONS:** In our medical-surgical ICU, those patients with a sepsis advisory during their ICU stay had an increased risk of death as compared to those who did not receive such an advisory. Although our alert was specifically created for our institution, it can likely be used in other centers with a similar ICU population. There are several major limitations to our study. First, we used in-hospital mortality instead of 30- or 90-day mortality. Second, we used all-cause death. Therefore, patients who were transitioned to comfort care and then died were included in our analysis. Third, we did not adjust for severity of illness between the two groups.**REFERENCES:**

1. Critical Care Medicine 2013; 41(2):580-637.

S-97.

MANDATORY HOSPITAL SEPSIS SCREENING AND IMPROVED SEPSIS BUNDLE COMPLIANCE LEAD TO DECREASED SEPSIS-RELATED MORTALITY IN A TERTIARY CARE ACADEMIC MEDICAL CENTER

AUTHORS: P. D. Weyker¹, M. C. Sullivan¹, E. R. Shea¹, C. Fee², D. W. Shimabukuro¹

AFFILIATION: ¹Department of Anesthesia and Perioperative Care, University of California San Francisco, San Francisco, CA, ²Department of Emergency Medicine, University of California San Francisco, San Francisco, CA

INTRODUCTION: Early diagnosis and treatment of sepsis lead to substantial improvements in patient survival rates over the past decade. In 2001, Rivers and colleagues reported an in-hospital mortality rate of 46.5% in a cohort of septic patients assigned to standard therapy, while patients in the early goal directed therapy group had a mortality rate of 30.5%.¹ The results of this trial led to a paradigm shift in the early detection and treatment of sepsis. The Surviving Sepsis Campaign was formed in 2002 and has published guidelines to help clinicians make treatment decisions for management of septic patients. Their guidelines recommend “campaign bundles” which are time sensitive. They recommend measurement of lactate, blood cultures, antibiotics, and administration of 30 ml/kg of crystalloid within 3 hours.² Subsequently, if the patient’s MAP is below 65 mmHg, they recommend initiation of vasopressors, measurement of CVP and ScvO₂, and rechecking lactate.² The recent ProCESS and ARISE trials sought to determine if protocol-based resuscitation lead to better outcomes than usual care.^{3,4} Both trials found no mortality benefit of protocol directed treatment over usual care.^{3,4}

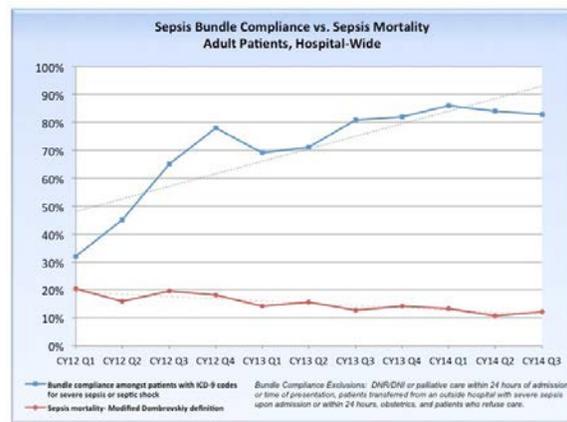
METHODS: RIPC was induced by four 5 minute cycles of transient upper limb ischemia/reperfusion using a blood pressure cuff. Right atrial tissue was obtained from patients receiving RIPC (N=19) and control patients (N=19) before and after CPB (Figure 1). Cell stress proteome profiler arrays as well as Westernblotting and ELISA experiments for thioredoxin were performed employing the respective tissue samples.

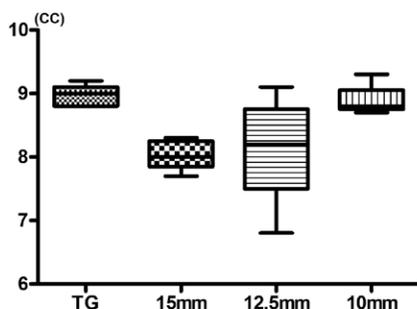
RESULTS: Our hospital is a tertiary care, academic medical center with 80 adult intensive care unit beds. In 2011, a quality improvement project was initiated to decrease sepsis-related mortality by improving early detection of sepsis, as well as sepsis bundle compliance within the hospital system. The goal was to achieve a bundle compliance rate of >50% for the sepsis resuscitation bundle by the end of 2013. The bundle includes measurement of lactate within 6 hours, blood cultures drawn before antibiotic administration, antibiotic administration within 1 hour from the time of presentation on the floor, fluid resuscitation of 20-30 ml/kg crystalloid within 6 hours, and the use of vasopressors as needed to treat fluid refractory hypotension. Importantly our sepsis bundle does not include the protocolized use of central venous catheter placement, CVP monitoring, or ScvO₂ guided fluid resuscitation.

CONCLUSIONS: Utilizing computerized mandatory sepsis screening of all patients within our institution, as well as an improvement in sepsis resuscitation bundle compliance from 30% to 80%, hospital-wide sepsis-related mortality has decreased from >20% to less than 15% during a two year time period.

REFERENCES:

1. Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. The New England journal of medicine. Nov 8 2001;345(19):1368-1377.
2. Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Critical care medicine. Feb 2013;41(2):580-637.
3. Investigators A, Group ACT, Peake SL, et al. Goal-directed resuscitation for patients with early septic shock. The New England journal of medicine. Oct 16 2014;371(16):1496-1506.
4. Pro CI, Yealy DM, Kellum JA, et al. A randomized trial of protocol-based care for early septic shock. The New England journal of medicine. May 1 2014;370(18):1683-1693.



S-98.**SEAL EFFECTIVENESS OF NOVEL DESIGN ENDOTRACHEAL TUBE CUFF COMPARED WITH CONVENTIONAL DESIGN CUFF IN VITRO MODEL.****AUTHORS:** N. Sato, T. Terada, R. Ochiai**AFFILIATION:** Anesthesiology, Keio University, Tokyo, Japan**INTRODUCTION:** It is known that aspiration around the endotracheal tube cuff is associated with ventilator associated pneumonia. In this study, we made endotracheal tube with novel shaped cuff and evaluated the ability of novel cuff design to prevent fluid leakage using an experimental model.**METHODS:** To make novel cuff shape, we change upper part adhesion position of cuff to the tube. To change adhesion position to distal position, we can make dent on top of the cuff. This dent can hold secreted material, and we can collect it when extubate the tube to fold the cuff like umbrella. We made three different size dent to change adhesion position down 15mm, 12.5mm, 10mm toward to the tip of the tube, and compared with conventional tapering shaped cuff. An artificial trachea (22mm I.D. clear polyvinyl chloride tube) was mounted on tilted table of 45 degrees. Four different ET tubes (Taperguard EVAC; COVIDIEN; TG (tapering shaped cuff)), three novel shape cuff tube) were located in the trachea. The cuff was inflated to 25cmH2O. Ten milliliters of egg yolk were injected over the top of the cuff in the trachea. 10 minutes later, we deflated the cuff and extubate tubes. Dropped egg yolk were collected and compared the amount. Each group was measured five times. Data are expressed as mean±SD. One way ANOVA was used to compare data and P<0.05 was considered statistically significant.**RESULTS:** The amount of dropped egg yolk were TG 9.0+/-0.2cc, 15mm 7.8+/-0.6cc, 12.5mm 8.3+/-0.9cc, 10mm 8.7+/- 0.5cc. There were not significant differences between the tubes (p=0.0526).**CONCLUSIONS:** Conventional tapering shape cuff could hold egg yolk when cuff was inflated. Once cuff was deflated, egg yolk on the cuff were dropped off. The novel shape cuff can hold egg yolk and collect it to avoid drop off. To avoid VAP, it is important to decrease the aspiration inflow in the trachea even after extubation. In this study, there was not quite significant difference between the groups, but 15mm of novel cuff hold egg yolk more than TG. With further improvement, we thought this unique shape cuff has an ability to prevent aspiration around tracheal tube effectively than conventional tubes.**Fig. Amount of dropped egg yolk****S-99.****INCREASED PRESEPSIN (SOLUBLE CD14 SUBTYPE) VALUES IN SURGICAL PATIENTS WITH CHRONIC KIDNEY DISEASE ON HEMODIALYSIS EVEN IN THE ABSENCE OF INFECTION****AUTHORS:** J. Saito¹, E. Hashiba², T. Kushikata¹, K. Hirota**AFFILIATION:** ¹Department of Anesthesiology, Hirosaki University Graduate School of Medicine, Hirosaki, Japan, ²Division of Intensive Care Unit, Hirosaki University Graduate School of Medicine, Hirosaki, Japan**INTRODUCTION:** Presepsin is a useful biomarker for differentiating sepsis from non-infection related systemic inflammatory response syndrome¹. However, there was one report describing presepsin levels in patients with chronic kidney disease (CKD) was elevated even in the absence of sepsis². To test this finding, we measured the presepsin levels in patients with CKD without clinical sign of infection.**METHODS:** After receiving IRB approval and written informed consent, ten patients on chronic maintenance hemodialysis (HD) were enrolled in this study. They were scheduled to undergo elective surgery under general anesthesia. Two of these patients were undergoing living renal transplantation. Plasma presepsin and procalcitonin levels were measured before induction of anesthesia, on admission to the ICU after surgery and postoperative day 1 (POD1). Plasma presepsin concentrations were determined with a compact automated immunoanalyzer based on a chemiluminescent enzyme immunoassay. Data are presented as mean±SD. Statistical analysis was performed using one-way repeated measures ANOVA followed by Student-Newman-Keuls test.**RESULTS:** The mean presepsin and procalcitonin levels before induction of anesthesia were 1562±650 pg/mL and 0.34±0.14 ng/mL, respectively. All presepsin levels before induction of anesthesia were higher than cutoff value (500 pg/mL). Presepsin levels did not change significantly on admission to the ICU and POD1 (1562±701 pg/mL and 1971±910 pg/mL, respectively). Only one procalcitonin level were elevated above the cut off value before induction of anesthesia, even though six procalcitonin levels were elevated on POD1. A consistent decrease in presepsin levels were observed in two patients after living renal transplantation close to 500 pg/mL on POD 1. Procalcitonin levels in these two patients remain unchanged throughout the study period.**Discussions:** This study revealed that presepsin levels in patients with CKD on HD were apparently higher than healthy adult (294±121 pg/mL)². The elevated presepsin concentrations in HD patients reflect a repeated stimulation of presepsin expression during HD session. Furthermore, two living renal transplantation data suggests that kidney plays an important role in the metabolism and excretion of the presepsin from the body.**CONCLUSIONS:** Presepsin levels were much higher than cutoff value in patients with CKD on HD, even if they had no clinical sign of infection. Presepsin levels higher than cutoff value in patients with CKD on HD must be interpreted with caution.**REFERENCES:**

1. Crit Care 2014;18:507
2. J Infect Chemother 2012;18:891-7
3. J Infect Chemother 2011;17:764-9

S-100.

RELATIONSHIP BETWEEN A HIGH-INSPIRED OXYGEN CONCENTRATION AND A GRAVITY DEPENDENT ATELECTASIS IN TRAUMA PATIENTS: SUBGROUP ANALYSIS.

AUTHORS: K. Ishii¹, H. Morimatsu², K. Ono¹, K. Miyasho³

AFFILIATION: ¹Department of Anesthesiology and Oncological Pain Medicine, Fukuyama City Hospital, Fukuyama, Japan, ²Department of Anesthesiology and Resuscitology, Okayama University Graduate School of Medicine, Dent, Okayama University Hospital, Okayama, Japan, ³Department of Critical Care Medicine and Emergency Medical Center, Fukuyama City Hospital, Fukuyama, Hiroshima, Japan

INTRODUCTION: It has been reported that a gravity dependent atelectasis develops soon after the induction of general anesthesia and 100% oxygen is a major cause of atelectasis during the induction and maintenance of anesthesia. We analyzed and reported that the association between a high-inspired oxygen concentration and a gravity dependent atelectasis formation in high-energy trauma patients, in which the higher oxygen concentration was not an independent risk factor for formation of gravity dependent atelectasis according to multivariate analysis. We also reported that higher age and injury severity of the patients were risk factors of them.

The aim of this study is to re-analyze the subgroups of our previous report sub-divided by their age, injury severity of the patients and status of mechanical ventilation. We are going to assess the impact of high inspired oxygen concentration on atelectasis.

METHODS: We performed a retrospective cohort study on 911 trauma patients who were admitted to the emergency department of our hospital and received CT scan at least twice. A first CT scan underwent on arrival and a second scan within 48 hrs after the first scan. By comparing these succeeding CT scans, we assessed the

incidence of the gravity dependent atelectasis in these patients. The gravity dependent atelectasis was defined as a formation of more than 10mm thick atelectasis on the second scan. We also studied the parameters including sex, age, injury severity score (ISS), thoracic abbreviated injury score (AIS), abdominal AIS, smokers, body mass index (BMI), surgical procedure under general anesthesia, mechanical ventilation, ordered complete bed rest, and a delivery of a high concentration of oxygen between the first and the second CT scans. The delivery of the high oxygen concentration was defined as either patient on mechanical ventilation (IPPV or NPPV) with high fractions of inspired oxygen (FIO₂) ranged from 60 to 100% or those who were on spontaneous breathing with 6 liter/minute or more oxygen delivery by mask with reservoir.

To analyze the subgroup, we used a propensity score analysis to adjust for the high and the low oxygen concentration groups using above parameters. Subgroup of Age is defined as less than 65 years old or not, subgroup of injury severity of the patients is defined as less than ISS 9 or not, and the mechanical ventilation group is defined as patients with mechanical ventilation or not.

RESULTS: The rate of each subgroup's atelectasis formation, and the result of each subgroup's propensity score analysis are shown in Table 1. None of the subgroups have a significant higher risk of gravity atelectasis formation in the higher oxygen group.

CONCLUSIONS: We assumed that the delivery of the high oxygen concentration might be one of the risk factors for the formation of the gravity dependent atelectasis in the trauma patients. However, subgroup analysis of age, injury severity of the patients, and mechanical ventilation did not show independent relationship between higher oxygen concentration and the gravity dependent atelectasis.

REFERENCES:

1. Lancet 1995; 345:1387-91

Table 1. Subgroup analysis: Rate of atelectasis formation, Result of propensity score analysis adjusted for the high and the low oxygen concentration.

Subgroup	Patients (n)	Rate of atelectasis formation(%)			Result of propensity score analysis		
		Total Patients	High oxgen	Low oxgen	Odds Ratio	95%CI(confidence interval)	p value
All patients	911	51	76.8	42.1	0.91	0.656 - 1.263	0.573
Age < 65 years old	635	42.3	49.3	38.9	0.891	0.611 - 1.298	0.547
Age ≥ 65 years old	276	71	75.8	66.7	1.071	0.595 - 1.298	0.818
ISS(injury severity score) < 9	336	31	34	29.6	1.116	0.639 - 1.946	0.7
ISS ≥ 9	575	62.8	71.5	57.1	0.918	0.605 - 1.393	0.688
Oxgen delivery by Mask	716	45.8	53.1	42.1	1.096	0.529 - 2.272	0.806
Mechanical Ventilation	137	70.3	76.8	64	0.942	0.662 - 1.341	0.741

S-101.

EXAMINATION OF THE CHANGE IN THE FEMORAL VEIN DIAMETER DUE TO LOWER LIMB FLEXION

AUTHORS: H. Iwata, T. Kimura, K. Kobayashi, S. Kawashima, H. Makino, T. Katoh, S. Sato

AFFILIATION: Department of Anesthesiology and Intensive Care, Hamamatsu University School of Medicine, Hamamatsu, Japan

INTRODUCTION: The femoral vein (FV) is sometimes chosen as the puncture site for central venous catheter insertion. The incidence of mechanical complications such as false puncture of the femoral artery (FA) and hematoma occur more often when the FV is chosen than inter jugular vein or subclavian vein for the catheterization. We thought the overlap length of FV and FA at the puncture site is one of the reasons. It is reported that hip abduction with external rotation increase the FV size and exposure width of the FV¹. However, there is no previous study in which the appropriate angle of the leg flexion was investigated. With knowledge of the proper angle, we might avoid excessive leg flexion and reduce the mechanical complications during the FV catheterization procedure. The purpose of this study is to investigate the changes in the FV diameter and positional relationship during the lower limb flexion by ultrasonographic apparatus.

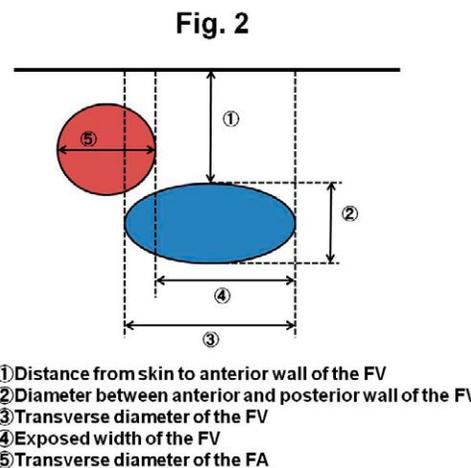
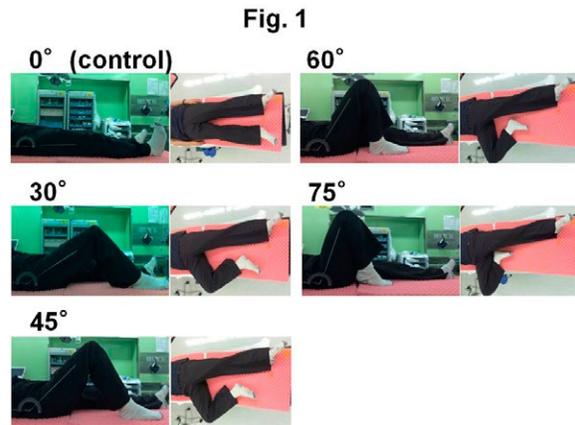
METHODS: This study was approved by the hospital ethics review committee. The subjects were fifteen male healthy volunteers. The participant positioned supine and natural leg straight position on the surgical bed. The hip joint was flexed to the target angles and the heel was always contacted with the bed, followed by hip joint external rotation and abduction (hemi frog position). The flexion angle of the hip joint was measured at the following angles using a goniometer (Tsutsumi-seisakusyo, Chiba, Japan): before flexion (0°, control), 30°, 45°, 60°, 75° (Fig.1). The ultrasonograph transducer was held over the line which was 2 cm distal and parallel to inguinal ligament (the line connecting the pubic symphysis and the anterior superior iliac spine). All ultrasound images were obtained from the right groin using Venue 40 (GE helthcare, Wauwatosa, WI, USA) with a 12 MHz linear transducer. The following length were measured: distance from skin to anterior wall of the FV, diameter between anterior and posterior wall of the FV, transverse diameter of the FV, exposed width of the FV (length not overlapped by the FA), transverse diameter of the FA (Fig.2). Each length was compared with that observed before hip joint flexion (control). Data were analyzed using a paired t-test and a Wilcoxon signed-rank test with a significance level of $p < 0.05$.

RESULTS: Compared with control, distance from skin to anterior wall of the FV was significantly shorter at 30° (14.3 mm vs 12.1 mm, $p < 0.01$) and longer at 75° (14.3 mm vs 16.4 mm, $p < 0.03$). Diameter between anterior and posterior wall of the FV was significantly longer at each angles than control. Compared with control, transverse diameter of the FV was significantly longer at 30° and 45°, and exposed width of the FV was longer at only 30° (10.8 mm vs 12.4 mm, $p < 0.03$). There were no significant changes in transverse diameter of the FA.

CONCLUSIONS: This study demonstrated that hemi frog position was associated with significant increases in diameter and exposed width of the FV. Especially, most effective angle of the hip joint flexion was about 30°.

REFERENCES:

1. Korean J Anesthesiol 61, 3: 205-209, 2011



S-102.

FACTORS ASSOCIATED WITH CATHETER-RELATED BLOODSTREAM INFECTIONS IN THE INTENSIVE CARE UNIT OF A UNIVERSITY HOSPITAL

AUTHORS: T. Yorozu¹, K. Moriyama¹, M. Kotani², T. Kohyama²

AFFILIATION: ¹Department of Anesthesiology, Kyorin University, School of Medicine, Tokyo, Japan, ²Department of Anesthesiology, Kyorin University, School of Medicine, Tokyo, Japan

INTRODUCTION: Catheter-related bloodstream infections (CRBSI) are a preventable cause of death. As successful CRBSI reduction by strict implementation of a preventive measure bundle has been reported in a study¹, we followed the same strategy to reduce CRBSI in our hospital’s intensive care unit (ICU). Moreover, we joined the national CRBSI surveillance system to receive feedback and to report our performance achievements.

In order to elucidate prominent CRBSI factors in our hospital ICU, we prospectively collected data of infection rate of CRBSI in the ICU for submission to the national CRBSI surveillance system as well as information on other possible CRBSI risk factors; these factors were compared between CRBSI and non-CRBSI cases.

METHODS: This prospective observational study was approved by the university ethical committee. The observation period was 6 months, from July 1 to December 31, 2013. Every central venous catheter inserted in patients enrolled for surveillance in the ICU was analyzed. Prior to surveillance, a bundle of preventive measures were applied in the ICU upon insertion of central venous catheters, including maximal barrier precautions and skin preparation with 1% chlorhexidine-alcohol. In addition to the data collected for the national CRBSI surveillance system, the following data were also collected: patient age, sex, APACHE II score, duration of ICU stays, duration of catheter insertion, number of catheter lumen, rate of multiple catheter indwelling, insertion sites, number of insertion attempts, and mechanical ventilation status. The CRBSI rate was calculated according to the rules of the national CRBSI surveillance system. Mann-Whitney U test or Chi-squared test was used to analyze the differences between CRBSI and non-CRBSI cases.

RESULTS: A total of 140 central venous catheters were analyzed. The infection rate was 3.5 per 1,000 catheter days for the first 3 months and 3.4 for the last 3 months. Other data are shown in the Table. CRBSI was identified in 6 catheters. Patients with CRBSI had higher APACHE II scores and longer ICU stays than those without CRBSI. The rate of the catheter duration more than 12 days and femoral insertion rate were higher in CRBSI cases. The rates of multi-catheter indwelling and mechanical ventilation tended to be greater in CRBSI cases.

CONCLUSIONS: The prominent CRBSI factors appeared to be associated with the initial condition severity, which might in turn be related to the observed longer ICU stays, increased catheter insertion duration, higher mechanical ventilation rates and multi-catheter requirement. As femoral insertion was associated with CRBSI, insertion sites should be carefully considered, especially for patients with critical conditions. Although we strictly implemented the bundle of preventive measures, the CRBSI rate was not satisfactory during the 6 months of observation. The next step is to share our results and data with the hospital staff and discuss further strategies for reducing CRBSI with the surveillance team.

REFERENCES:

1. N Engl J Med. 355:2725-32, 2006

Table Comparison of factors between catheter-related bloodstream infection (CRBSI) and non-CRBSI cases

CRBSI	Yes	No	p
Number of catheters	6	134	
Age (years; Mean ± SD)	64 ± 14	69 ± 14	ns
Male/Female	4/2	86/48	ns
APACHE II score Mean ± SD (Median)	33 ± 5 (32)	18 ± 7 (18)	P<0.01
Duration of ICU stays (days; Mean ± SD)	30.1 ± 16.9	16.5 ± 27.3	P<0.05
Duration of catheter insertion (days; Mean ± SD)	17.8 ± 10.9	10.3 ± 9.5	ns
More than 12 days; n (%)	5 (83.3)	44 (31.4)	p<0.05
Numbers of lumens; n Median (Min–Max)	3 (2–4)	3 (1–4)	ns
Multiple catheter indwelling; n (%)	3 (50)	49 (36.6)	ns
Insertion sites IJV/Subclavian/Femoral ; n (%)	3(50)/ 0(0)/ 3(50)	105(78.4)/ 3(2.2)/ 26(19.4)	P<0.05
Numbers of insertion attempts; n Median (Min – Max)	1 (1–2)	1 (1–4)	ns
Mechanical ventilation; n (%)	5 (83.3)	75 (53.6)	ns

SD; Standard Deviation, Min: Minimum, Max; Maximum, IJV: Internal jugular vein.

Mann-Whitney U test and Chi-squared test were used to analyze the differences between CRBSI and non-CRBSI cases where appropriate. P < 0.05 was considered to be statistically significant.

S-103.

GOAL DIRECTED HEMODYNAMIC MANAGEMENT USING THE THESPIS-SCORE IN SEVERE SEPSIS AND SEPTIC SHOCK IS ASSOCIATED WITH REDUCED MORTALITY - AN OBSERVATIONAL CROSS-SECTIONAL STUDY

AUTHORS: M. Habicher¹, F. Balzer², V. Mezger³, M. Sander⁴

AFFILIATION: ¹Anesthesiology and Intensive Care Medicine, Charite Universitaetsklinik Berlin, Berlin, Germany, ²Department for Anesthesiology and Intensive care medicine, Charite - Universitaetsmedizin Berlin, Berlin, Germany, ³Department for Anesthesiology and Intensive care medicine, Charite - University Medicine Berlin, Berlin, Germany, ⁴Department for Anesthesiology and Intensive care medicine, Charite-Universitätsmedizin Berlin, Berlin, Germany

INTRODUCTION: Severe sepsis and septic shock is still a leading medical problem. In recent years there has been substantial discussion whether early goal directed resuscitation using the Rivers approach is optimal and whether the suggested parameters are optimal to evaluate resuscitation¹⁻³. Transpulmonary thermodilution (TD) has been suggested to be an alternative to guide therapy.

Therefore, the aim of this retrospective study was to investigate the impact of cardiac index (CI), extravascular lung water index (EVLWI) and global enddiastolic volume index (GEDVI) in patients with septic shock on mortality and organ dysfunction from a large intensive care unit (ICU) database.

METHODS: After consent of the federal data protection officer and the hospital ethics commission (EA1/034/13), clinical routine data from all patients with the diagnosis of septic shock between 2006 and 2013 were extracted from electronic patient data management systems. Grouping was performed according to the published normal values for CI (>2.5 l/min/m²), EVLWI (3-7 ml/m²) and GEDVI (650-800mL/kg) measurement. For each parameter one point was

assigned if the parameter was within this range and no point if not (THESpIS-Score). We analyzed the first and the last documented TD measurement. Hospital and 1-year mortality, length of ICU and hospital treatment and time of mechanical ventilation were defined as outcome criteria. Data are shown as median (percentiles) and percentage.

RESULTS: Data from 1151 patients between 01/2006 and 12/2013 were analyzed. Regarding the first measurement patients with 0 points were significantly older and had a lower BMI (Table 1). ICU stay was significantly longer in patients with 0 points (p=0.012). Regarding the first TD measurement the patients with 0 points in THESpIS score had significantly higher hospital mortality (p=0.025) as well as the 1-year mortality was significantly higher (p=0.004). All data from the first TD measurement are shown in Table 1.

Concerning the last TD measurement patients with 0 points in THESpIS- Score had significantly longer hospital stay (p=0.014), as well as higher hospital mortality (p <0.001) and 1-year mortality (p=0.001). Regarding the last TD measurement all results are shown in table 2.

CONCLUSIONS: In our investigation patients who reached the goals in TD measurements had significantly shorter hospital stay and lower hospital and 1-year mortality. Therefore, the THESpIS score can serve as a prognostic tool, if the first TD measurement is used. As patients with a higher THESpIS score at the last TD measurement had improved outcomes, therapeutic efforts aiming at normalizing values for CI, EVLWI and GEDVI might prove beneficial and should be validated in prospective interventional studies.

REFERENCES:

1. Rivers, E et al. NEJM (2001) 345(19)
2. ProCESS Investigators et al. NEJM (2013) 370(18)
3. The ARISE Investigators et al. NEJM (2014) 371(16)

Table 1

	0N=82	1N=472	2N=468	3N=129	p valueoverall	N
Basic characteristics						
Age	71.6 [63.6;76.7]	62.5 [49.8;71.6]	64.5 [52.6;73.5]	64.2[53.4;73.6]	<0.001	1150
BMI	25.0 (5.46)	26.6 (6.99)	28.2 (7.02)	29.8 (7.47)	<0.001	1037
Outcome						
Hospital mortality	45 (54.9%)	225 (47.7%)	189 (40.4%)	53 (41.1%)	0.025	1151
1-year mortality	54 (83.1%)	256 (72.5%)	220 (64.1%)	63 (63.6%)	0.004	860
Hospital stay (d)	48.0 [36.0;71.0]	48.0 [32.5;72.5]	42.0 [27.0;68.0]	37.5 [27.0;62.2]	0.019	638
ICU stay (d)	42.0 [26.0;56.0]	39.0 [27.0;57.0]	32.5 [22.0;51.8]	30.5 [18.0;48.2]	0.012	638
Ventilation time (h)	475 [141;950]	521 [238;858]	414 [181;692]	376 [168;684]	0.126	639

Table 2

	0N=55	1N=444	2N=499	3N=153	p valueoverall	N
Basic characteristics						
Age	74.2 [66.7;79.0]	63.4 [49.7;72.5]	64.7 [52.2;73.3]	62.6 [51.9;71.8]	<0.001	1150
BMI	24.9 (5.70)	26.8 (7.52)	28.1 (6.68)	28.5 (7.02)	0.001	1037
Outcome						
Hospital mortality	39 (70.9%)	221 (49.8%)	190 (38.1%)	62 (40.5%)	<0.001	1151
1-year mortality	41 (87.2%)	244 (72.8%)	229 (62.6%)	79 (70.5%)	0.001	860
Hospital stay (d)	54.0 [39.8;78.5]	51.0 [30.5;79.5]	43.0 [28.0;64.2]	42.0 [29.0;73.0]	0.014	638
ICU stay (d)	41.5 [32.2;52.0]	39.0 [24.0;61.0]	34.0 [22.0;51.0]	35.0 [23.0;49.5]	0.105	638
Ventilation time (h)	136 [18.8;756]	462 [200;846]	414 [205;691]	534 [246;860]	0.080	639

S-104.

IDENTIFYING ICU PATIENTS AT HIGH RISK FOR CARDIAC ARREST: A RETROSPECTIVE ANALYSIS OF THE VISENSIA ALGORITHM

AUTHORS: C. Choukalas¹, S. TAKEMOTO², J. G. STOTTS³, A. WALLACE¹

AFFILIATION: ¹Anesthesia and Perioperative Care, UCSF, San Francisco, CA, ²Anesthesia, San Francisco VA Medical Center, San Francisco, CA, ³Nursing, UCSF, San Francisco, CA

INTRODUCTION: Cardiac arrest in critically ill patients carries a high mortality, but is rarely unanticipated. Patients frequently demonstrate alterations in mental, respiratory, and cardiac status in the hours leading up to these events. Much attention has been paid to identifying such decompensating patients, and data in emergency department and step-down patients suggests severity of illness scales^{1,2} or vital sign-based algorithms may have a role.^{3,4} Data are lacking for patients in intensive care units (ICU), presumably because they are monitored closely. We used a third-party algorithm-based software program (Visensia, OBS Medical, Oxford, UK) to identify retrospectively instability in a sample of adult ICU patients who suffered cardiac arrest and time-matched controls.

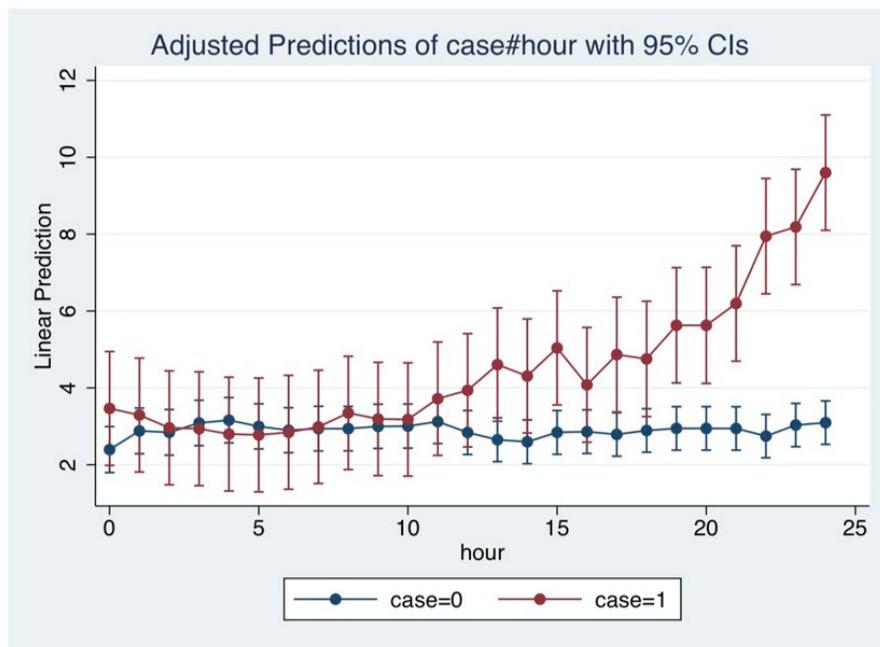
METHODS: The study took place in a large, urban, academic teaching hospital with 18 ICU beds. We extracted data sufficient to calculate a Visensia Stability Index (VSI) at one-minute intervals for the 24 hours prior to arrest for patients undergoing cardiac arrest in the ICU between 2005 and 2011 as identified by a hospital quality improvement database. Control patients were all patients in the ICU during the 24 hour periods which defined cases. Repeated measures t-tests defined the difference in hourly average VSI between the two groups.

RESULTS: Data from a total of 790 patients (61 who experienced cardiac arrest and 729 controls) were examined. Hourly average VSI was calculated. The VSI was similar for cases and controls at the beginning of the observation period, but diverged significantly as early as 10 hours prior to the arrest. Figure 1 shows the hourly average VSI for the cardiac arrest and control groups, with 95% confidence intervals.

CONCLUSIONS: Preventing cardiac arrest depends in part on early recognition of clinical instability. The VSI alert signaled clinical instability 10 hours prior to arrest, an amount of time that could reasonably be expected to allow assessment and stabilization, which may be sufficient to prevent arrest. Further analysis will describe performance characteristics of the VSI (predictive value, sensitivity, specificity).

REFERENCES:

1. Subbe, CP, Kruger M, Rutherford, P, Gemmel, L. (2001) Validation of a modified Early Warning Score in medical admissions. *Q J Med* 94:521-6.
2. Goldhill, DR, McNarry, AF, Mandersloot, G, et al. (2005) A physiologically-based early warning score for ward patients: The association between score and outcome. *Anaesthesia* 60:547-53.
3. Hravnak, M, Edwards, L, Clontz, A, Valenta, C, Devita, MA, Pinsky, MR. (2008) Defining the incidence of cardiorespiratory instability in patients in step-down units using an electronic integrated monitoring system. *Arch Intern Med* 168(12):1300-8.
4. Hravnak, M, Devita, MA, Clontz, A, Edwards, L, Valenta, C, Pinsky, MR. (2011) Cardiorespiratory instability before and after implementing an integrated monitoring system. *Crit Care Med* 39(1):65-72.



S-105.**ORGAN PROTECTION AND IMPROVEMENT OF SURVIVAL AFTER HEMORRHAGIC SHOCK BY TREATMENT WITH INHALED NITRIC OXIDE(NO) IN A RAT MODEL**AUTHORS: S. Mimuro¹, T. Katoh², S. Sato³

AFFILIATION: ¹Dept of Anesthesiology and Intensive Care, Hamamatsu University school of medicine, Hamamatsu, Japan, ²Anesthesiology, Hamamatsu University School of medicine, Hamamatsu, Japan, ³Anesthesiology, Hamamatsu University School of Medicine, Hamamatsu, Japan

INTRODUCTION: Organ dysfunction following hemorrhagic shock and the vital prognosis have not improved sufficiently over time. NO is considered to be closely involved in the development of hemorrhagic shock-induced organ dysfunction. Endothelial nitric oxide synthase (eNOS) activity decreases and NO production decreases during the early phase, and the inflammatory cascade is induced and excessively activates the inducible nitric oxide synthase (iNOS), resulting in excess NO production during the late phase. These events are involved in aggravation to a more severe state.

Control of NO production by intravenous administration of NO donors and NOS inhibitors has been attempted, but these are not suitable for clinical application.

Inhaled NO is an agent with sufficient clinical safety and experience, but it has not been reported for use in the treatment of hemorrhagic shock.

Thus, we investigated whether inhaled NO administration leads to differences in survival, central venous NO₂ levels, and organopathy in a rat hemorrhagic shock model.

METHODS: Thirty male SD rats were used. Tracheotomy was applied under general anesthesia, microdialysis probes were placed in the arterial line and central vein, and NO₂ was measured in the dialysis probes using an oxidized nitrogen analysis system (ENO-20, Eicom Japan, Kyoto). The systolic arterial pressure was maintained at 40 mmHg by withdrawing and returning blood for one hour (hemorrhagic shock). The animals were resuscitated with saline in a volume equivalent to the residual blood. After resuscitation, rats were exposed to 20 ppm NO by inhalation for 30 minutes.

The rats were randomly divided into the following 3 groups:

- (1) Sham (hemorrhagic shock-, inhaled NO-)
- (2) hemorrhagic shock+NO+
- (3) hemorrhagic shock+NO-

Hemodynamic changes and NO₂ levels were measured over time, and the survival rate was calculated.

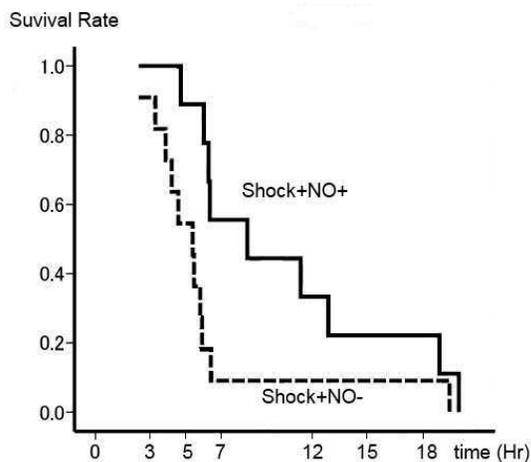
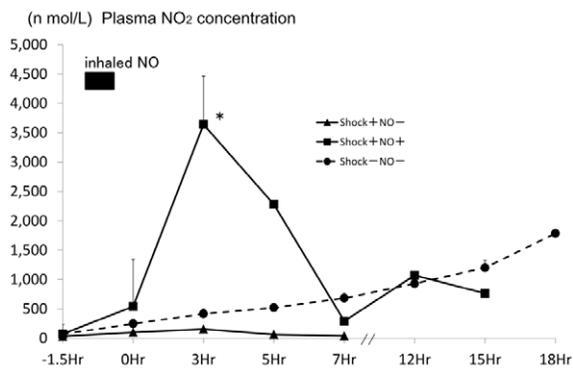
RESULTS: The survival rate was higher in the group with hemorrhagic shock followed by inhaled NO compared with the group without inhaled NO (p=0.033) (Fig. 1).

NO₂ levels were significantly lower in the Shock+NO- group (vs. Shock+NO+ group 3Hr, vs. Shock-NO- group 7Hr), and significantly higher in the Shock+NO+ group (vs. the Shock+NO- and Shock-NO- groups 3Hr) (Fig. 2).

NO₂ production was decreased during the early phase of hemorrhagic shock (-7hr), suggesting that the shock decreased survival, and that inhaled NO protected the organs and improved survival.

It was not possible to study the late phase of shock (12hr-) in this model due to excessive stress.

CONCLUSIONS: The survival rate increased in hemorrhagic shock rats that were treated with inhaled NO compared with rats that were not.



S-106.**DURATION OF ISCHEMIA AND OUTCOMES OF CARDIAC ARREST PATIENTS MANAGED BY EXTRACORPOREAL CARDIOPULMONARY RESUSCITATION (ECPR): FOURTEEN YEAR EXPERIENCE**

AUTHORS: P. K. Guru¹, D. Sanghavi², J. B. Riley³, T. Friedrich⁴, G. J. Schears⁵

AFFILIATION: ¹Pulmonary and Critical Care/ECMO Service, Mayo Clinic, Rochester, MN, ²Pulmonary and Critical Care, Mayo Clinic, Rochester, MN, ³Cardiovascular Surgery/ECMO Service, Mayo Clinic, Rochester, MN, ⁴Nursing Cardiovascular and Heart Transplant ICU/ECMO Service, Mayo Clinic, Rochester, MN, ⁵Anesthesiology, Pediatrics and Critical Care Medicine, Mayo Clinic, Rochester, MN

INTRODUCTION: Extracorporeal membrane oxygenation (ECMO) has increasingly been employed as a rescue strategy in patients with refractory cardiopulmonary arrest.¹ The survival and long term outcomes of in- and out-of hospital cardiac arrest patients supported by ECMO have been comparable to the management by conventional cardiopulmonary arrest algorithms.² We sought to describe our experience with ECMO use in patients during or after cardiopulmonary arrest undergoing resuscitation.

METHODS: Retrospective analysis of patients (n=55) at a mid-western ECMO excellence center who received ECMO support for cardiorespiratory arrest between Jan 2001 and October 2014. Excluded patients were those who required ECMO for reasons other than cardiorespiratory arrest, and absence of CPR and consent documents in the medical record. The primary outcome studied was survival at thirty days from arrest.

RESULTS: During the study period a total of 475 patients received ECMO in our center and 65 patients registered as ECPR in the registry. Median age was 39 (IQR 4-61) years, 28(50%) were male, and 46 (84%) were Caucasian. Ventricular tachycardia or ventricular fibrillation was the initial cardiac rhythm in 34.5% and asystole/pulseless electrical activity in 40%. ECMO was initiated during CPR in 40 (73%) patients. Average time to ECMO from beginning of CPR (duration of ischemia) was 57± 32 (1 SD) minutes. The median (IQR) ECMO time was 76 hours (29-156). Renal failure and thrombocytopenia were the two most commonly observed complications during ECMO support. In these patients who received ECMO during CPR the 30 days survival was 45% (n=18) and those who received ECMO after CPR the survival was 40% (n=6). The median (IQR) ICU stay was 9 (1-21) days and median hospital stay was 12 (1-28) days for the entire ECPR cohort.

CONCLUSIONS: ECPR is feasible and shows promising results from our small cohort of patients. However, the challenges yet to be addressed are appropriate patient selection, shortening the duration of ischemia and proper implementation of ECPR protocols.

REFERENCES:

1. Curr Opin Crit Care 2014, 20:259-265
2. Lancet 2008; 372 (9638):554-61.

S-107.**EVEN PROTECTIVE VENTILATION CAN CAUSE ACUTE LUNG INJURY IN A MOUSE MODEL OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE****AUTHORS:** L. Ring, J. D'Armiento**AFFILIATION:** Department of Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Since recognized in the ARDSNet trial¹, lung protective ventilation using low tidal volumes has become a mainstay of ventilator management in critically ill patients. This protective ventilation, experimentally and in practice, has been shown to significantly reduce the incidence of ventilator associated lung injury (VALI) and improve outcomes in patients with normal or acutely injured lungs. Less well studied is the appropriate ventilatory strategy for patients suffering from chronic lung disease, especially chronic obstructive pulmonary disease (COPD). Up to 25% of patients admitted to the ICU suffer from COPD, and amongst patients admitted to the ICU for an acute exacerbation of COPD, 25% are likely to die during that hospitalization². Invasive ventilation has been shown to be an independent risk factor for death in these patients. These findings suggest that some degree of VALI may be occurring in these patients, worsening outcomes. Investigations in to the occurrence and nature of VALI in lungs already damaged from COPD could yield new ventilation protocols for patients with COPD that could reduce overall morbidity and mortality from the disease.

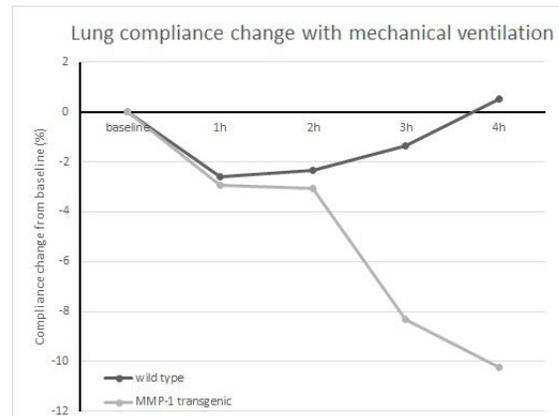
METHODS: Mice transgenic for lung-specific expression of human matrix metalloproteinase-1 (MMP-1, known to develop emphysematous changes similar to those in humans with the disease) were compared with age-matched wild type animals. Animals were anesthetized and tracheotomized and either immediately sacrificed or exposed to 4 hours low tidal volume (7ml/kg) ventilation and then sacrificed.

RESULTS: Assessing acute lung injury via both in vivo and post-mortem methods, "protective" ventilation was found to cause significant lung injury in MMP-1 transgenic mice. Over the course of 4 hours of ventilation, pulmonary compliance gradually decreased in MMP-1 transgenics, such that after 4 hours of ventilation, lung compliance decreased by more than 10% (Fig. 1). Age-matched controls showed essentially no change in compliance after 4 hours of ventilation. Ventilated MMP-1 transgenic mice also exhibited a marked increase in bronchoalveolar lavage protein over non-ventilated mutants (74%) whereas ventilated wild types controls exhibited a more modest increase in bronchoalveolar lavage protein over non-ventilated wild types (43%), reflecting greater lung injury in the transgenic animals.

CONCLUSIONS: Acute lung injury has been found to occur employing what is thought to be, "protective" ventilation in a mouse model of COPD. With further study, these results may suggest the need to reevaluate ventilation protocols in patients with COPD or other chronic lung diseases.

REFERENCES:

1. NEJM. 342:1301-1308, 2000
2. Am J Respir Crit Care Med 185;2012:A3042



S-108.

EFFECT OF ANEMIA ON MORTALITY AND LENGTH OF STAY IN SEVERE TRAUMATIC BRAIN INJURY

AUTHORS: A. Ottesen¹, M. Rodriguez¹, K. Carr², A. Seifi²

AFFILIATION: ¹School of Medicine, University of Texas HSC San Antonio, San Antonio, TX, ²Neurosurgery, University of Texas HSC San Antonio, San Antonio, TX

INTRODUCTION: Traumatic brain injury is an important cause of morbidity and mortality worldwide, with an annual incidence in developed countries approximated at up to 250 per 100,000 population¹. Anemia is a common complication of TBI, and may be cause for concern if it limits the delivery of oxygen to the injured brain. Despite this, there are no clear cut guidelines outlining the hemoglobin level at which a red blood cell transfusion should be initiated². The aim of our study was to characterize the impact of hemoglobin level on outcomes in patients with severe TBI.

METHODS: We looked retrospectively at patients admitted to a level 1 trauma center with severe traumatic brain injury from January 2011 to December 2013. Severe TBI was defined as those patients requiring ICP monitoring within the first 48 hours after admission. Patients were excluded if they were under 18 years of age, pregnant, were transfused in the first 24 hours after admission, or if they underwent any surgery unrelated to their brain injury in the first 24 hours after admission. To analyze the data, we used the independent sample t-test method.

RESULTS: During three years of study, our initial search revealed 486 patients with severe TBI, and after exclusion criteria were applied there were 88 patients included in the study. The mean

age of the cohort was 45 years old, of which 82% were male and 57% received transfusions. The average hemoglobin on admission was 13.5, the lowest hemoglobin reported during admission was 5.3. Only 5% of patients were anemic on admission, however 88% developed anemia at some point during their hospital stay. Overall mortality of the cohort was 17%. Our analysis found that the discharge GCS, hospital length of stay (LOS), and ICU LOS were not affected by the hemoglobin values. Urinary tract infection (UTI) and pneumonia significantly increased hospital LOS, [95% CI: 10.475-47.077, $p < 0.002$] and [95% CI: 2.595-33.321, $p < 0.023$], respectively. For ICU LOS, pneumonia and adult respiratory distress syndrome (ARDS) had the greatest impact, [95% CI: 4.325-10.296, $p < 0.001$] and [95% CI: 26.528-52.856, $p < 0.001$].

CONCLUSIONS: Anemia is a common finding in neurotrauma patients, and in our cohort 88% of patients developed anemia during their hospital stay. Our analysis determined that the level of Hb does not affect inpatient outcomes such as discharge GCS and LOS. Nevertheless, complications such as pneumonia, UTI, and ARDS do significantly affect length of stay in this population. Further prospective randomized control studies are required in this field.

REFERENCES:

1. Bruns, Hauser. The epidemiology of traumatic brain injury: a review. *Epilepsia* Vol 44 Suppl 10, 2003.
2. Anglin, et al. Effects of platelet and plasma transfusion on outcome in traumatic brain injury patients with moderate bleeding diatheses. *J Neurosurg* 118:676-686, 2013

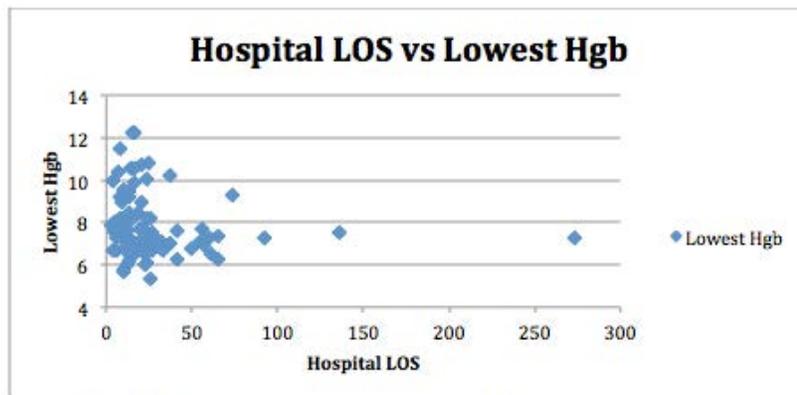


Fig. 1: Hospital length of stay versus lowest hemoglobin.

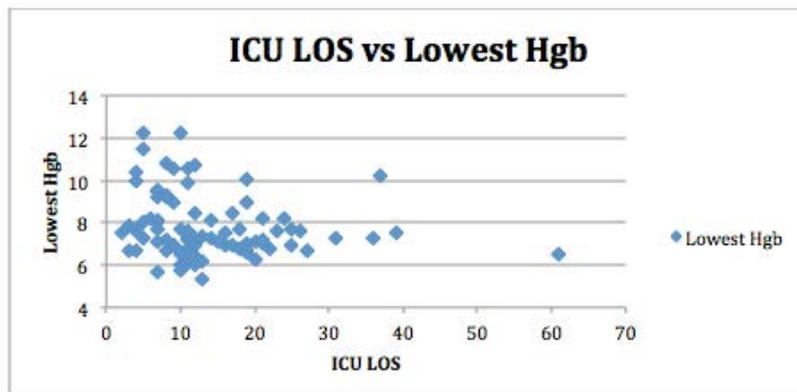


Fig. 2: ICU length of stay versus lowest hemoglobin.

S-109.**COMPARISON OF THE SHORT ACTING BETA1 BLOCKER LANDILOL WITH AMIODARONE FOR PHARMACOLOGICAL CARADIOVERSION FOR ATRIAL FIBRILLATION IN INTENSIVE CARE UNIT PATIENTS**

AUTHORS: Y. Matsumoto, S. C. Shibata, A. Maeda, T. Imada, K. Okitsu, Y. Fujino

AFFILIATION: Department of Anesthesiology and Intensive Care Medicine, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan

INTRODUCTION: Atrial fibrillation (AF) is one of the most common arrhythmias in the intensive care unit (ICU). In cases where patients in the ICU become hemodynamically unstable due to the onset of AF, pharmacological cardioversion (PC) followed by electrical cardioversion (EC) is often attempted. In general, antiarrhythmic drugs such as amiodarone and beta-blockers are recommended. Intravenous amiodarone in the ICU is primary used for restoration of sinus rhythm and rate control. Beta-blockers are also administered though side effects such as hypotension can be contraindicative in the critically ill. For this reason, landiolol, an ultra short acting beta-1-blocker with a lesser negative inotropic effect has gained wide use in Japan. It is unclear which drug is more time effective for PC in the ICU setting. We designed the following study to compare the time effectiveness of landiolol with amiodarone for PC.

METHODS: A comprehensive database was created by reviewing the records of patients who were admitted to the ICU at our institution between April 2012 and March 2014. The incidence of newly developed AF after admission, the type of treatment, sinus conversion rate, and time required for sinus rhythm recovery after PC Patients were excluded from our analysis if the following factors were observed; prior history of arrhythmia, pace makers, ventricular assist devices, and post heart transplant. From our database we compared the time effectiveness of the single drug administration of amiodarone or landiolol for PC. Our primary outcome was the time required for sinus conversion using either a single drug administration of amiodarone or landiolol. In cases where a second antiarrhythmic drug was added or EC was attempted, the case was withdrawn. Secondary outcomes were the success rate of sinus conversion and patient hemodynamic parameters.

RESULTS: A total of 276 records were reviewed. Amiodarone was administered by a loading infusion of 150mg over 30 minutes followed by a continuous infusion of 20 mg/h. For landiolol a bolus infusion of 7.5mg followed by continuous infusion of 2.5 - 7.5 mg/h was administered. The number of patients receiving amiodarone and landiolol was 116 and 160, respectively. Single drug PC was attempted with amiodarone in 26 cases with a conversion rate of 50%, single drug PC with landiolol was attempted in 42 cases with a conversion rate of 67%. The mean time to sinus conversion was 124 minutes (95% confidence interval [CI] 66-182) for amiodarone and 72 minutes (95% CI 52-91) for landiolol. Sinus conversion rates between the two drugs groups did not differ significantly. An analysis using Kaplan-Meier curves revealed patients receiving landiolol for single drug PC had significantly faster sinus rhythm recovery compared to amiodarone. ($p < 0.001$) Rapid recovery to sinus rhythm and stabilizing hemodynamic status is important in ICU patients. Our results suggest landiolol maybe beneficial as first choice drug in the ICU for PC.

CONCLUSIONS: Single drug administration of landiolol required significantly less time for PC compared to single drug administration of amiodarone.

S-110.**ROLE OF TRANSIENT RECEPTOR POTENTIAL V1 AND A1 ION CHANNELS, SUBSTANCE P AND ITS NEUROKININ 1 RECEPTOR IN ENDOTOXIN-INDUCED SYSTEMIC INFLAMMATION OF THE MOUSE**

AUTHORS: O. Lengl¹, E. Pintér², Z. Helyes², J. P. Quinn³, L. Kereskai⁴, J. Szolcsányi²

AFFILIATION: ¹Department of Anaesthesiology and Intensive Care, University of Pécs, Pécs, Hungary, ²Department of Pharmacology and Pharmacotherapy, University of Pécs, Pécs, Hungary, ³School of Biomedical Sciences, Liverpool University, Liverpool, United Kingdom, ⁴Department of Pathology, University of Pécs, Pécs, Hungary.

INTRODUCTION: Activation of Transient Receptor Potential Ankyrin 1 (TRPA1) and Vanilloid 1 (TRPV1) receptors on capsaicin-sensitive peptidergic sensory nerves by inflammatory mediators induces the release of neuropeptides, such as substance P (SP) and neurokinin A (NKA) encoded by the preprotachykinin A (TAC1) gene. This evokes vasodilatation, plasma protein extravasation and inflammatory cell accumulation/activation via predominantly by the neurokinin 1 (NK1) receptor^{1,2,3}. Since the role and mechanisms of these neurogenic inflammatory components in severe systemic inflammation is unclear, we investigated the involvement of TRPA1, TRPV1, SP/NKA and NK1 receptors in a mouse model.

METHODS: Escherichia coli endotoxin (lipopolysaccharide: LPS; 400 µg; i.p.) was injected to male C57BL/6 wildtype, TRPA1, TRPV1, TAC1 and NK1 gene-deleted mice (TRPV1^{-/-}, TRPA1^{-/-}, TAC1^{-/-}, NK1^{-/-}; n=10/group) to induce a systemic inflammatory response modelling the early symptoms of sepsis. Saline-treated mice served as non-inflamed controls. The lung, heart, liver and kidney were excised 4 h after the treatment following exsanguination in deep sodium-thiopental anaesthesia. The inflammatory cytokine IL-1β was measured with ELISA in the tissue homogenates and histopathological alterations were semiquantitatively evaluated.

RESULTS: LPS treatment significantly increased neutrophil infiltration and alveolar wall thickness in the lung, granulocyte accumulation in the liver, as well as IL-1β concentrations in each organ of wildtype mice 4 hours later. IL-1β elevation in the lung and liver, as well as inflammatory histopathological alterations were significantly decreased in all gene-deleted groups, compared to the wildtypes. In the heart the increased IL-1β level detected in wildtype mice was significantly smaller in NK1^{-/-}, TRPV1^{-/-} and TRPA1^{-/-} ones, while in kidney it was increased in the TRPA1^{-/-} group.

CONCLUSIONS: Activation of peptidergic sensory nerves through the TRPA1 and TRPV1 ion channels and consequent release of SP/NKA clearly increase endotoxin-induced early inflammatory changes in the lung and liver via NK1 receptor activation. However, these sensory-immune interactions are more complex in the cardiac muscle and the kidney, where elucidation of the precise mechanisms needs further investigations.

REFERENCES:

1. TRPA1 channels mediate acute neurogenic inflammation and pain produced by bacterial endotoxins *Nature Communication* 2014;5:3125.
2. Aging reverses the role of the transient receptor potential vanilloid-1 channel in systemic inflammation from anti-inflammatory to proinflammatory *Cell Cycle* 2012 Jan 15;11(2):343-9.
3. Involvement of preprotachykinin A gene-encoded peptides and the neurokinin 1 receptor in endotoxin-induced murine airway inflammation *Neuropeptides* 2010 Oct;44(5):399-406

S-111.**EVALUATING DOPPLER RENAL ARTERY RESISTIVE INDEX FOR PREVENTION OF CONTRAST NEPHROPATHY IN EMERGENCY DEPARTMENT**

AUTHORS: Y. Kashiwagi, Y. Toyama, A. Suzuki, H. Iwasaki

AFFILIATION: Anesthesiology and Critical Care, Asahikawa Medical University, Asahikawa, Japan

INTRODUCTION: According to the guidelines, taking precautions to prevent contrast nephropathy should be recommended for patients with their examined estimated Glomerular Filtration Rate (eGFR) less than 45 when taking contrast radiography. However it spends time to draw blood and confirm eGFR in emergency department. Present study was conducted to investigate whether we could quantitatively evaluate renal function and the risk of contrast nephropathy by using ultrasound Doppler sonography in emergency department.

METHODS: We performed Doppler sonography for patients transported to a hospital in ambulance. Measured data was renal interlobular arterial resistive index (RI). RI was calculated as below: (peak systolic velocity - end diastolic velocity)/ (peak systolic velocity). Then, we examined eGFR with a blood test. Patients were divided into high risk group of contrast nephropathy (Group R, eGFR<45ml/min/1.73m²) and non-risk group (Group N, eGFR≥45ml/min/1.73m²). We investigated the association between RI and eGFR in the two groups. eGFR was estimated as follows: $194 \times Cr - 1.094 \times Age - 0.287$ ($\times 0.739$; Female). Statistical analysis was performed with Mann-Whitney U test and Pearson's correlation coefficient. Differences were regarded as significant at $p < 0.05$.

RESULTS: Twenty two patients were included in the study. Two patients were excluded because their ultrasound images of kidney couldn't be created. Average age and eGFR of all patients were 72.3 ± 18.7 years old and 68.3 ± 41.245 ml/min/1.73m² respectively. The Group R was associated with higher RI (0.7992 ± 0.04475 vs 0.6651 ± 0.01713 ; $p=0.0028$) than the Group N. Also, RI was negatively-correlated with GFR ($r=-0.6130$; $p=0.0041$).

CONCLUSIONS: Evaluation of Doppler renal arterial resistive index may be useful to assess the renal function and the risk of contrast nephropathy for patients who need contrast radiography in emergency department.

S-112.**PERITONEAL APPLICATIONS OF LIPO-POLYSACCHARIDE INDUCE LYMPHANGIOGENESIS IN DIAPHRAGM IN MICE VIA UPREGULATION OF AN INDUCIBLE CYCLOOXYGENASE, COX-2.**

AUTHORS: H. MATSUDA¹, H. Okamoto², M. Majima³

AFFILIATION: ¹Anesthesiology, Kitasato University Hospital, Sagamihara-City, Japan, ²Anesthesiology, Kitasato University, Sagamihara-City, Japan, ³Pharmacology, Kitasato University, Sagamihara-City, Japan

INTRODUCTION: Anesthesia management of the patients with resistant ascites due to chronic peritonitis is extreme difficult because of circulation dynamics change. It is said that lymphatic vessels in a diaphragm are essential for draining the inflammatory fluid during peritonitis. Lymphangiogenesis as well as angiogenesis plays an important role in homeostasis of interstitial fluids, metabolism and immunity. Recent studies suggest that lymphangiogenesis is also found during development of inflammation, but little is known about their function in pathogenesis of peritonitis. In the present study, we tested whether or not COX-2-derived prostaglandins (PGs) enhance the lymphangiogenesis in peritonitis.

METHODS: Male C57/BL6 mice (8 to 10 weeks old) were obtained. Peritonitis was induced by injections of lipopolysaccharide (LPS, Sigma, E coli, 0111-B4, 20µg/mouse/2days) into peritoneal cavities of mice for from 1 day to 14 days. As a parameter of lymphangiogenesis, we evaluated lymphatic microvessels using whole-mounted diaphragm tissues.

RESULTS: Lymphatics were visualized with topical injections of Indian ink, and were stained with antibodies against Lyve-1. These lymphatic vessels were increased time dependently. A week after LPS application, gene expressions of COX-2 and VEGF-C in the diaphragm were up-regulated with the increased lymphangiogenesis in the diaphragm. Celecoxib treatment (100mg/kg/day) significantly reduced lymphangiogenesis in the diaphragm. In addition, thromboxane synthase was up-regulated in the diaphragm of peritonitis mice, and lymphangiogenesis were suppressed in the diaphragm of TP knock out mice. These results suggested that lymphangiogenesis is up-regulated by COX-2 and TP signaling possibly via induction of VEGF-C.

CONCLUSIONS: These results suggested that draining function of interstitial fluids through lymphatic vessels is upregulated by COX-2 possibly via generation of PG. TXS generated by COX-2 and facilitated lymphangiogenesis by inducing VEGF-C. PGs may become therapeutic tools via enhancement of lymphangiogenesis in peritonitis.

S-113.

CEREBROVASCULAR SIGNAL COMPLEXITY AND RELATIONSHIP WITH OUTCOME AFTER SEVERE TRAUMATIC BRAIN INJURY

AUTHORS: L. Gao¹, P. Smielewski², M. Czosnyka², A. Ercole³

AFFILIATION: ¹Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA, ²Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, ³Neurointensive Care and Neuroanesthesia, University of Cambridge, Cambridge, United Kingdom.

INTRODUCTION: Physiological signals display fluctuating behaviour resulting spontaneously from non-linear interplay between large ensembles of sub-units. Within this model, disease is associated with a breakdown in healthy interactions and is often characterised by reduced complexity. Low intracranial pressure (ICP) complexity during an entire intensive care admission has been shown to be a predictor of poor outcome in traumatic brain injury (TBI)¹. We explored whether complexity of mean arterial pressure (MAP) and heart rate (HR), in addition to that of ICP within the first 24 hours after admission to an intensive care unit (ICU), are related to neurological outcome at 6 months after severe TBI.

METHODS: Data recordings from 174 patients admitted to a single-centre neurocritical care unit after severe head injury, over a nine-year period, were included for retrospective analysis. We calculated the approximate entropy (ApEn), an indicator of complexity², for ICP (ApEn-ICP), MAP (ApEn-MAP), and HR (ApEn-HR), and a combined Interaction-ApEn (product of the three ApEns) during the first 24 hour periods after admission. This was compared to outcome at 6 months after head injury using the Glasgow Outcome Scale (GOS). GOS was then further dichotomised into Dead vs Survived and Favourable vs Unfavourable groups for analysis. Statistical analysis was carried out using IBM's SPSS.

RESULTS: Low signal complexity (low ApEn scores) in the first 24 hours, as shown by ApEn-ICP ($p = 0.00008$), ApEn-MAP ($p = 0.01$), ApEn-HR ($p = 0.004$), and Interaction-ApEn ($p = 0.000001$) was correlated with poor outcome (Figure 1). When GOS was dichotomised, Dead and Unfavourable groups had significantly lower ApEn scores compared to Survived and Favourable respectively ($p < 0.05$). The mean ICP was not associated with outcome ($p = 0.8$).

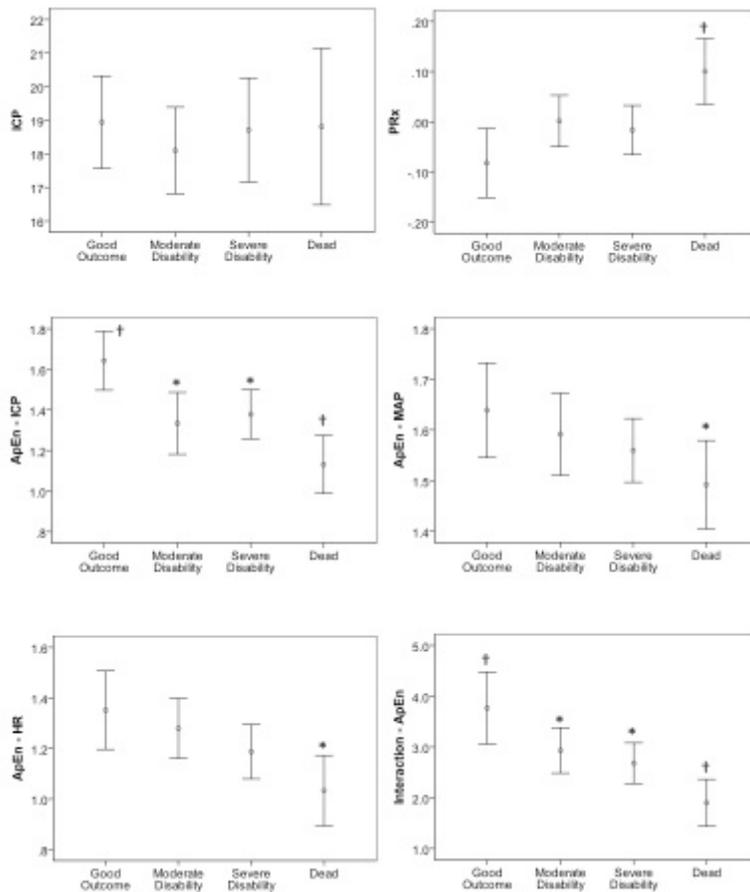
CONCLUSIONS: Complexities of ICP, MAP and HR, as early as the first 24 hours of ICU admission are correlated with poor neurological outcome. The Interaction-ApEn, utilising multiple signal complexities, was the strongest correlate. Physiological signal complexity may carry more prognostic information than the absolute or mean value alone. Further work is underway to use signal complexity to identify the sickest patients and track pathophysiological changes in TBI.

REFERENCES:

1. Complexity of intracranial pressure correlates with outcome after traumatic brain injury. *Brain* 135, 2399-408 (2012).
2. A regularity statistic for medical data analysis. *J. Clin. Monit.* 7, 335-345 (1991).

Figure 1: Calculated parameters for first 24hr of monitoring separated by GOS groups.

Results represent mean and 95% confidence intervals. ICP intracranial pressure, PRx pressure reactivity index, ApEn-ICP approximate entropy of ICP, ApEn-MAP approximate entropy of mean arterial pressure, ApEn-HR approximate entropy of heart rate and Interaction-ApEn product between ApEn-ICP, ApEn-MAP, and ApEn-HR. Symbols express difference in groups using independent T-test. *Differed significantly from Good Outcome. †Differed significantly from all other groups. Significance level set at $p < 0.05$.



S-114.

SULFANEKEN LYSINE UPDATE ON STUDIES IN MICE: MOVING FORWARD TOWARDS BECOMING A NEW CYANIDE ANTIDOTE

AUTHORS: H. Singh¹, S. E. Patterson², S. S. Sra¹, A. Chang¹, D. Beebe¹, K. Belani¹

AFFILIATION: ¹Anesthesiology, University of Minnesota, Minneapolis, MN, ²Anesthesiology, The University of Minnesota, Minneapolis, MN

INTRODUCTION: Sulfanegen Lysine is a cyanide toxicity reversal drug currently under investigation. Its administration via an intramuscular route will make it a preferred candidate in mass casualties associated with cyanide exposure. Prior studies have evaluated efficacy, pharmacokinetics, and dose related effects of Sulfanegen in rabbits. This study describes the efficacy of Sulfanegen Lysine in a second animal (mouse) model.

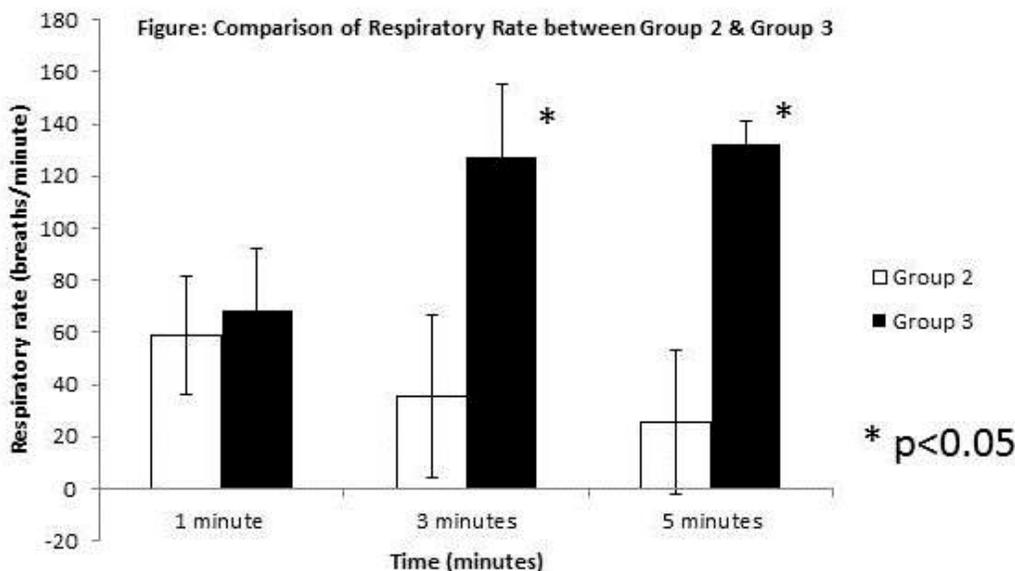
METHODS: After IACUC approval, Swiss-Webster ND-4 mice weighing 31-34 g were acclimatized for a period of three days before the experiment. On the day of the experiment, the mice were anesthetized with isoflurane. The animals were then divided into 3 different groups with 15 animals in each group. Group 1 served as control -control (saline i.p. + saline i.m.) group, Group 2 was cyanide - control (KCN i.p. + saline i.m.) group, and Group 3 was cyanide - antidote (KCN i.p. + Sulfanegen Lysine i.m.) group. The intramuscular injections (either saline or antidote) were given 30 seconds after the intraperitoneal injections. In the immediate post intervention phase of the study, the mice were followed till they regained normal motor activity, and regular breathing. Death was one of the end points. Surviving mice were followed for one week before being euthanized. Data was recorded as mean±S.D. Significance was determined by unpaired t test.

RESULTS: 15 out of 15 animals in Group 1 survived with no complications. 14 of the 15 mice in Group 2 died. 1 animal that survived in this group had right hind limb weakness noted throughout the one week monitoring period. 14 out of the 15 animals in Group 3 survived with no complications during the monitoring period. The time of death for the mice in Group 2 was 8.44±4.39 minutes. The mice in Group 1 returned to normal activity immediately (0.11±0.05 minutes). The time for return to normal activity for the mice in Group 3 was 8.92±5.28 minutes after the administration of antidote whereas 14 out of the 15 mice in Group 2 never returned to normal activity. 1 mouse that survived in this group returned to normal activity 240 minutes after the intramuscular injection of the placebo. The mice in Group 3 returned to regular breathing quickly (as seen in the Figure). As seen in Fig 1, there was a significant difference in respiratory rates at 3 min and 5 min (p<0.0001) between Groups 2 & Groups 3. The respiratory rate could not be recorded in Group 1 mice due to their return to normal activity immediately.

CONCLUSIONS: In this mouse model Sulfanegen Lysine was highly effective in reversing severe cyanide. Follow up studies are required to determine minimal effective dose of Sulfanegen. Additional studies are being planned to evaluate toxicity of Sulfanegen.

REFERENCES:

This study is sponsored through the CounterACT Mechanism (National Institute of Health, NINDS 1 U01 NS0058087-04



S-115.**VASOPRESSIN INHIBITS MITOGEN-ACTIVATED PROTEIN KINASES ACTIVATION IN ENDOTOXIN-ACTIVATED MURINE MACROPHAGES****AUTHORS:**C. Huang¹, P. Tsai²**AFFILIATION:** ¹Department of Anesthesiology, Taipei Tzu Chi Hospital, New Taipei City, Taiwan, ²College of Nursing, Taipei Medical University, Taipei, Taiwan**INTRODUCTION:** Previous data have demonstrated that vasopressin can inhibit endotoxin-induced upregulation of inflammatory molecules in activated macrophages. Expression of inflammatory molecules is regulated by mitogen-activated protein kinases (MAPKs). We sought to elucidate whether vasopressin could inhibit endotoxin-induced MAPKs activation.**METHODS:** RAW264.7 cells, an immortalized murine macrophage-like cell line, were randomized to receive phosphate buffered saline (PBS), vasopressin (1000pg/ml), lipopolysaccharide (LPS; 100ng/ml) or LPS plus vasopressin (designated as the PBS, V, LPS and LPS+V groups, respectively). After reaction for 0, 30 and 60 minutes, cell cultures were harvested and the cytosolic protein concentrations of phosphorylated extracellular regulated kinase (p-ERK), phosphorylated c-jun N-terminal kinase (p-JNK), and phosphorylated p38 MAPK (p-p38 MAPK) were then measured.**RESULTS:** The baseline protein concentrations of p-ERK, p-JNK and p-p38 MAPK (i.e., harvested at 0 minutes) of these four groups were low. The protein concentrations of p-ERK, p-JNK and p-p38 MAPK of the PBS and the V groups that harvested at 30 and 60 minutes after reaction were also low. In contrast, the protein concentrations of p-ERK, p-JNK and p-p38 MAPK that harvested at 30 and 60 minutes after reaction of the LPS group were significantly higher than those of the PBS group (all $P<0.001$). Moreover, the protein concentration of p-ERK harvested at 60 minutes, but not 30 minutes, of the LPS+V group was significantly lower than that of the LPS group ($P=0.013$). The protein concentration of p-JNK and p-p38 MAPK harvested at 30 minutes, but not 60 minutes, of the LPS+V group were also significantly lower than those of the LPS group (both $P<0.001$).**CONCLUSIONS:** Vasopressin inhibits MAPKs activation in endotoxin-activated macrophage.

S-116.

DYNAMIC CHANGE IN BACH1 EXPRESSION IN A RAT MODEL OF GLYCEROL-INDUCED ACUTE KIDNEY INJURY

AUTHORS: M. Yamaoka¹, H. Shimizu¹, T. Takahashi², E. Omori¹, N. Tanioka¹, R. Nakamura¹, H. Morimatsu¹

AFFILIATION: ¹Department of Anesthesiology and Resuscitology, Okayama University Medical School, Okayama, Japan, ²Faculty of Health and Welfare Science, Okayama Prefectural University, Okayama, Japan

INTRODUCTION: Rhabdomyolysis is associated with extensive muscle injury that is accompanied by the release of myoglobin, which causes severe oxidative damage, ultimately leading to acute kidney injury (AKI). Oxidative damage can cause destruction of myoglobin, resulting in an increase in the concentration of free heme, a potent pro-oxidant. It has been reported that heme oxygenase-1 (HO-1), the rate-limiting enzyme in heme catabolism, is induced in the kidney of a rodent model of rhabdomyolysis-induced AKI and plays a protective role against renal oxidative damage. BTB and CNC homology 1 (Bach1) is a heme-responsive transcription factor that represses HO-1 under basal conditions. In the presence of excess free heme, Bach1 is exported from the nucleus, allowing induction of HO-1. However, the dynamic changes and the significance of Bach1 in the pathogenesis of rhabdomyolysis-induced AKI remain elusive. Thus, in the present study, using a rat model of glycerol-induced AKI, we examined changes in the gene expression of Bach1, HO-1 and delta-aminolevulinatase synthase (ALAS1, the rate-limiting enzyme in heme biosynthesis), and protein expression of HO-1 and nuclear Bach1.

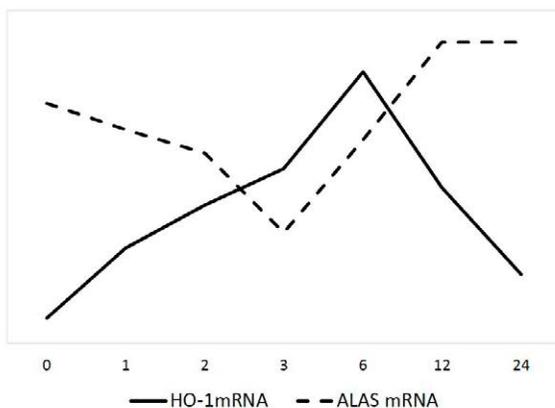
METHODS: This experiments were approved by the Animal Use and Care Committee of Okayama University Medical School. Male

Sprague-Dawley rats were injected with 50% glycerol (10 ml/kg body weight) into bilateral limbs to induce a rhabdomyolysis. Control rats received the same volume of saline. Rhabdomyolysis was assessed by serum creatinine kinase and aspartate aminotransferase concentrations, and AKI was evaluated by the levels of blood urea nitrogen (BUN) and serum creatinine (Cr). Bach1, HO-1, and ALAS1 mRNA levels were measured by Northern blot analysis, and Bach1 and HO-1 protein expression levels were determined by Western blot analysis. For statistical evaluation, two-way ANOVA without replication followed by Turkey's honestly significant difference test or unpaired Student's t test was used. P<0.05 was considered statistically significant.

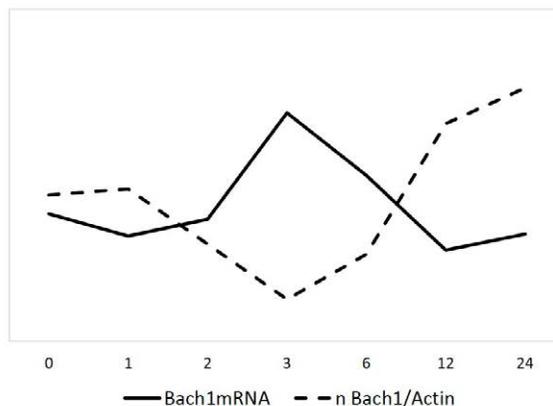
RESULTS: Glycerol treatment caused rhabdomyolysis-induced AKI as revealed by marked increases in serum CK, AST, BUN and creatinine levels 24 h after the treatment. HO-1 mRNA in the kidney started to increase 1 h after glycerol injection and reached a maximum at 6 h with an accompanying by the increase in HO-1 protein expression, while renal ALAS1 mRNA expression decreased and reached a minimum 3 h after the treatment, indicating that there was a significant increase in intracellular free heme concentration since heme is known to induce HO-1 and suppress ALAS1 expression. Following glycerol injection, nuclear Bach1 protein levels were significantly decreased 2–3 h after the treatment, followed by a gradual restoration back to normal levels. In contrast, Bach1 mRNA rapidly increased and reached a maximum at 3 h after the treatment.

CONCLUSIONS: Our findings suggest that Bach1 mRNA was induced to compensate for a depletion of nuclear Bach1 that was exported from the nucleus after glycerol treatment in a rat model of rhabdomyolysis-induced AKI.

Comparison of HO-1 mRNA and ALAS1 mRNA



Comparison of Bach1 mRNA and nuclear Bach1



S-117.**ASSESSMENT OF TRADITIONAL AND NOVEL
CARDIOPULMONARY INDICES TO DETECT
PNEUMOTHORAX IN A SWINE MODEL**

AUTHORS: M. Khan¹, M. Salter², N. Ribeiro Marques¹,
D. Deyo¹, M. Kinsky¹, G. Kramer¹

AFFILIATION: ¹Anesthesiology, University of Texas Medical
Branch, Galveston, TX, ²Anesthesiology, UTMB, Galveston, TX

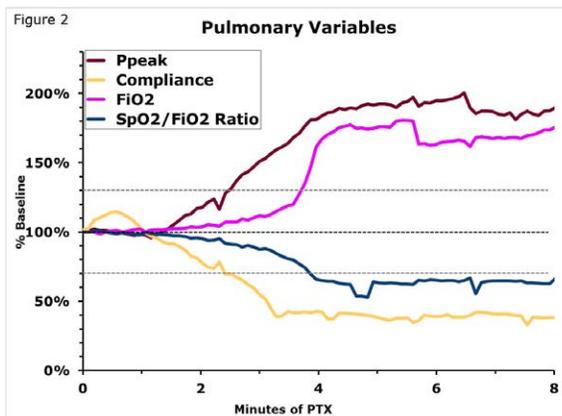
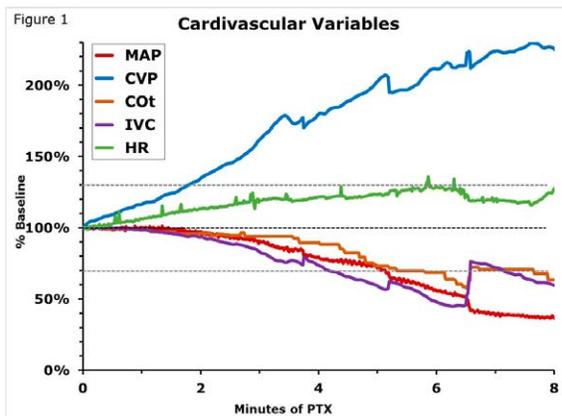
INTRODUCTION: Pneumothorax (PTX) is a complication of trauma that can occur in the prehospital setting from the emergency department to the intensive care unit. The fast progression of an undetected PTX can be life threatening due to lung collapse, vena cava compression, cardiac tamponade, hypotension, inadequate perfusion, and hypoxemia. Early detection and diagnosis is crucial for prompt treatment, and avoiding the worsening effects on the cardiopulmonary system. Ideally, PTX would be auto-detected.

Our goal is to define cardiopulmonary variables that provide the earliest warning and suggest an improved means to autonomously monitor and detect PTX in mechanically ventilated patients. We assessed traditional, invasive, and novel cardiopulmonary indices during closed-loop oxygenation.

METHODS: Propofol anesthetized swine (n=10) were induced with a PTX in an IACUC approved study. Animals were splenectomized and prepared with surgical insertion of catheters in both femoral arteries and veins, a central venous oxygen catheter in the external jugular vein, a pulmonary artery catheter (Swan-Ganz), and a flow probe on Inferior Vena Cava. They were intubated and mechanically ventilated on Hamilton S1 Adaptive Support Ventilation mode to achieve an end-tidal CO₂ of 35-40 mmHg. Moreover, the Intellivent closed-loop oxygenation algorithm was used to maintain the SpO₂ within a target range of 92-96% prior to PTX. Air was introduced into the left pleural cavity via a chest tube with a 60 mL syringe in 500 mL increments, and stopped when the MAP reduced to 40mmHg. High resolution (1Hz) data was recorded and analyzed for perfusion and ventilation variables, which include traditional vital signs, such as Mean Arterial Pressure (MAP), peak airway pressure (Ppeak), Airway Compliance, and Heart Rate (HR). Invasive perfusion indices include Inferior Vena Cava (IVC) blood flow, Central Venous Pressure (CVP), thermodilution Cardiac Output (CO). Autonomous novel indices analyzed include, CO₂ Production (VCO₂), and SpO₂/CLC-FiO₂ Ratio.

RESULTS: The time (Mean minutes ± SEM) for a 30% change from baseline in cardiovascular parameters was CVP: 2.2 ± 0.4, CO: 6.7 ± 1.3, MAP: 6.4 ± 1.1, IVC Flow: 4.7 ± 0.7, and HR: 6.7 ± 1.4. Similarly, the values for pulmonary parameters was Ppeak: 2.9 ± 0.3, Compliance: 2.3 ± 0.3, CL-FiO₂: 5.6 ± 1.3, and SpO₂/CLC-FiO₂ Ratio 6.0 ± 1.2. Several variables (SpO₂, ETCO₂, HLI, VT, and RR) did not change more than 30% from the baseline values. Figures 1 and 2 show means of cardiovascular variables and pulmonary variables plotted against time respectively. The data shows that of all measured variables, CVP was the fastest to deteriorate during induction of PTX followed by Compliance, Ppeak, CL-FiO₂, and SpO₂/CLC-FiO₂ Ratio. The more traditional variables, such as MAP and HR took longer to exhibit a 30% change.

CONCLUSIONS: This acute anesthetized swine study suggests that pulmonary variables associated with mechanical ventilation may provide the most sensitive and earliest warning of pneumothorax development. The sensitivity of these variables may be increased during the use of closed loop ventilation and oxygenation.



S-118.

IMPLEMENTATION OF AN EXTUBATION CHECKLIST REDUCES MECHANICAL VENTILATION TIME AND HOSPITAL LENGTH OF STAY AFTER CARDIAC SURGERY

AUTHORS: P. J. Neuberger¹, P. Ursomanno², A. Rabinovich², G. Cuff¹

AFFILIATION: ¹Department of Anesthesiology, NYU Langone Medical Center, New York, NY, ²Department of Cardiothoracic Surgery, NYU Langone Medical Center, New York, NY.

INTRODUCTION: Tracheal extubation in under 6 hours following cardiac surgery (also known as fast track extubation) is associated with decreased intensive care unit (ICU) length of stay, hospital length of stay and the potential for improved recovery and decreased resource utilization¹. This involves a collaborative effort from anesthesiologists, intensivists, critical care nursing and respiratory therapists. The Society of Thoracic Surgeons (STS) reported that postoperative ventilation time was less than 6 hours in 34.3% of cases, which was not being achieved at our institution². There has been increased interest in the use of checklists for perioperative procedures, which have been shown to reduce morbidity and mortality³. As a result, a multidisciplinary team was formed to create a fast track extubation checklist using clinical assessment, ventilator data and laboratory values (Figure 1). Our goal was to meet the STS benchmark. In this study we review the results of this protocol.

METHODS: After IRB approval, we retrospectively reviewed the records of 1,028 adult patients undergoing cardiac surgery at a single institution between January 1 2013 and August 31st, 2014. Patients undergoing cardiac surgery before initiation of the extubation protocol on November 1st, 2013 were compared to those who received surgery after implementation. Descriptive statistics for categorical variables were analyzed using Fisher’s exact test and continuous variables were compared using t-sample t tests.

RESULTS: A total of 529 patients underwent surgery before and 499 patients after implementation of the extubation protocol. Preoperative data, intraoperative data and procedure type were similar in both groups (Table 1). After implementation, patients were significantly more likely to be extubated in under 6 hours (25.9% vs. 60.1%, p=0.01, Table 2). Hospital length of stay was numerically less but not significantly less (9.4 days vs. 8.8 days, p=0.160) however post procedural length of stay was significantly

less(8.0 days vs. 7.2 days, p=0.036) after protocol implementation. Reintubation rates remained unchanged (3.9% vs. 2.6%, p=0.295).

CONCLUSIONS: Implementation of the multidisciplinary extubation checklist appears safe and may expedite discontinuation of mechanical ventilation and decrease length of stay after cardiac surgery. These have been previously reported to decrease morbidity and financial expense. The extubation rate under 6 hours at our institution now exceeds the STS benchmark. This suggests that our collaborative approach to extubation involving a well-defined checklist may be beneficial at other cardiac centers.

REFERENCES:

1. Anesthesiology 2003; 98:651-7
2. New England Journal of Medicine 2009; 360: 491-9
3. Society of Thoracic Surgeons National Adult Cardiac Surgery Database, 2014

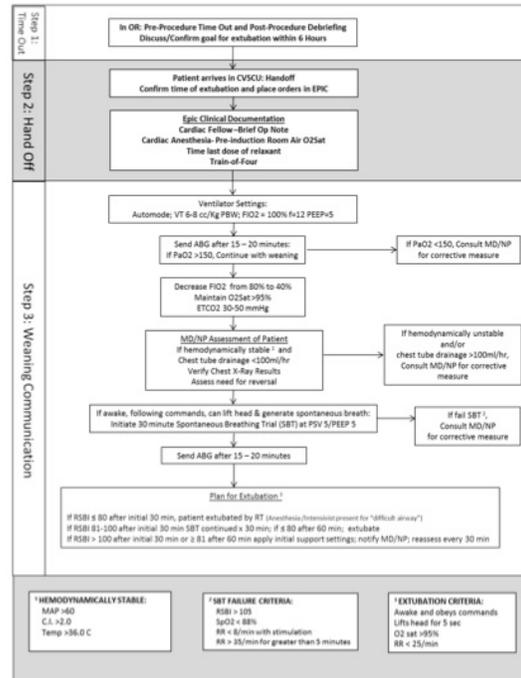


Table 1. Preoperative and Intraoperative Patient Demographic Data

	Pre Protocol	Post Protocol	p Value
N	529	499	
Age (yr)	67.5±12.4 (69)	67.1±13.1 (68)	0.608
Male, n (%)	329 (62.2)	313 (62.7)	0.898
Cardiopulmonary bypass time (min)	107.0±44.2 (97)	102.6±39.7 (94.5)	0.107
Aortic cross clamp time (min)	77.7±33.5 (69)	76.4±32.2 (70)	0.545
Isolated CABG, n (%)	109 (20.6)	94 (18.4)	0.482
Isolated AVR, n (%)	177 (33.5)	162 (32.5)	0.741
Isolated MVR, n (%)	136 (25.7)	107 (21.4)	0.123
AVR+MVR, n (%)	31 (5.9)	24 (4.8)	0.490
Valve+CABG, n (%)	53 (10.0)	38 (7.72)	0.188

NOTE: Values are in numbers, means ± SD (medians), or numbers (percentages).
Abbreviations: CABG, coronary artery bypass grafting; AVR, aortic valve replacement;
MVR, mitral valve replacement or repair.

Table 2. Postoperative Patient Data Data

	Pre Protocol	Post Protocol	p Value
N	529	499	
ICU arrival time to extubation (hours)	22.5±53.0 (10.5)	9.8±17.9 (4.9)	0.001
Extubation in <6 hours, n (%)	137 (25.9)	300 (60.1)	0.001
Hospital LOS (days)	9.4±7.6 (7)	8.8±5.9 (7)	0.160
Hospital LOS post procedure (days)	8.0±6.7 (6)	7.2±5.1 (6)	0.036
Reintubation, all cause, n (%)	21 (3.9)	13 (2.6)	0.295

NOTE: Values are in numbers, means ± SD (medians), or numbers (percentages).
Abbreviations: ICU, intensive care unit; LOS, length of stay.

S-119.

WITHDRAWN.

S-120.**PLASMA LEVELS OF HISTIDINE-RICH GLYCOPROTEIN IN CRITICALLY ILL PATIENTS****AUTHORS:** K. Kuroda¹, H. Morimatsu¹, H. Wake², S. Mori³, M. Nishibori²**AFFILIATION:** ¹Anesthesiology and Resuscitology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan, ²Pharmacology, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan, ³Pharmacy, Shujitsu University, Okayama, Japan**INTRODUCTION:** Sepsis is a systemic illness and represents one of the worst mortality in intensive care unit (ICU). There are many biomarkers and therapies for sepsis used in clinical practices but a few become the standard.

Histidine-rich glycoprotein (HRG) is a plasma glycoprotein produced in the liver. It is considered to be involved in many functions in biological systems such as coagulation, immune response, angiogenesis and so on. Our group reported that plasma HRG levels decreased in mice with sepsis and supplemental HRG infusion significantly improved survival rate in mice model of sepsis. In this study, we assessed the HRG levels in human critically ill patients.

METHODS: The study was approved by the Institutional Review Board of the Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences. Patients who were newly admitted to the ICUs of the Okayama university hospital were prospectively enrolled in the study if they fulfilled at least two of the diagnostic criteria for systemic inflammatory response syndrome (SIRS). We collected blood samples for the HRG analysis within 24 hours of ICU admission, and HRG levels were determined with a quantitative sandwich enzyme-linked immunosorbent assay (ELISA). Clinical and laboratory data were collected daily while patients were in the ICU. For comparison, blood samples from healthy volunteers were also collected and analyzed to determine the normal level of HRG in this study.**RESULTS:** The HRG levels in SIRS patients (n=60) were significantly lower compared to the healthy volunteers (n=13) ($26.67 \pm 14.76 \mu\text{g/ml}$ vs. $60.41 \pm 7.82 \mu\text{g/ml}$; $p < 0.01$). Moreover, the HRG levels in SIRS patients with infection (n=19) were significantly lower than those in SIRS patients without infection (n=41) ($10.26 \pm 4.85 \mu\text{g/ml}$ vs. $34.28 \pm 11.11 \mu\text{g/ml}$; $p < 0.01$). Furthermore, the HRG levels were negatively correlated with SOFA scores and CRP levels of ICU day1.**CONCLUSIONS:** In this prospective study, we demonstrated that the HRG levels in SIRS patients were significantly low, and that the HRG levels in sepsis patients were still lower than those in non-septic SIRS patients. These results suggested that the lower HRG levels might indicate the higher severities of patients, and that HRG could be a useful marker for the severity of septic patients.

S-121.

CHRONIC PAIN INTERFERENCE OF DAILY LIFE FOLLOWING CRITICAL ILLNESS

AUTHORS: C. J. Hayhurst¹, J. L. Thompson², C. G. Hughes¹

AFFILIATION: ¹Anesthesia Critical Care, Vanderbilt University Medical Center, Nashville, TN, ²Biostatistics, Vanderbilt University, Nashville, TN

INTRODUCTION: With improvement in ICU survival rates, increasing interest is being placed on post-ICU quality of life and long-term outcomes^{1,2}. Recent studies have shown high rates of cognitive impairment and depression in survivors of critical illness^{3,4}. Chronic pain symptoms have been shown in previous cohorts of ICU survivors to occur in patients up to 11 years after ICU admission⁵⁻⁷, likely impacting quality of life. We tested the hypothesis that chronic pain is common after critical illness and is associated with interference of daily life.

METHODS: This prospective cohort study was nested within a larger multicenter prospective cohort study evaluating long-term cognitive impairment in survivors of critical illness. We enrolled adult ICU patients at a community and university hospital within 72 hours of respiratory failure or shock. At 3 and 12 months post-hospital discharge, we assessed pain levels using the Brief Pain Inventory (BPI) (score 0-10 with 10 indicating pain as bad as you can imagine.) The overall impact of pain on daily life was also assessed using the BPI interference score, with additional focus on pain interference with normal activities, work, or enjoyment of life (0-10, 10 being completely interferes). We categorized both pain levels and pain interference into mild¹⁻⁴, moderate⁵⁻⁶, and severe⁷⁻¹⁰.

RESULTS: BPI outcomes were obtained in 194 patients at 3 months and in 253 at 12 months. The median (interquartile range) pain intensity score was 3 (IQR) at both 3 and 12 months. 31% had moderate to severe pain 3 months after their ICU stay and 35% had moderate to severe pain 12 months after their ICU stay. The median pain interference score was 2.1 (IQR) overall, with 2 (IQR) for normal activities, 2 (IQR) for work, and 0 (IQR) for enjoyment of life. Pain interfered with their daily life moderately to severely (interference score of 5-6 or 7-10) in 24% of patients at 3 months and in 22% of patients at 12 months.

CONCLUSIONS: Conclusions: In this cohort of critically ill patients, a significant proportion had chronic pain following their ICU stay. Nearly a quarter of patients had chronic pain that interfered with their ability to work, do normal activities, and enjoy life. Additionally, these deficits did not improve from 3 to 12 months. Further studies are needed to elucidate modifiable risk factors for chronic pain after critical illness.

REFERENCES:

1. Critical Care Medicine 2006, 34(1),15-21.
2. Critical Care 2010, 14:R6.
3. Lancet Resp Med 2014, 2: 369-379.
4. NEJM 2013, 369 (14):1306-16.
5. Critical Care 2006, 10(5):R134.
6. Intensive Care Med 2006, 32:1115-1124.
7. Critical Care 2013, 17(3):R101.

	3 month	12 month
N	194	253
BPI Average pain		
No pain (0)	22% (43)	26% (65)
Mild pain (1-4)	46% (90)	39% (99)
Moderate pain (5-6)	20% (39)	23% (59)
Severe pain (7-10)	11% (22)	12% (30)
BPI overall pain intensity		
No pain (0)	27% (53)	30% (76)
Mild pain (1-4)	51% (98)	43% (109)
Moderate pain (5-6)	15% (30)	20% (51)
Severe pain (7-10)	7% (13)	7% (17)
BPI Interference		
N	192	253
No interference (0-0.9)	41% (78)	38% (97)
Mild interference (1-4.9)	35% (67)	40% (100)
Moderate interference (5-6.9)	12% (24)	13% (34)
Severe interference (7-10)	12% (23)	9% (22)

Table 1: BPI scores at 3 and 12-month followup.

S-122.

EARLY BIOMARKERS OF MYOCARDIAL INJURY

AUTHORS: W. Boyle¹, T. Maruta², J. McQuillan¹, T. Yano², I. Tsuneyoshi², J. Morrissey¹, R. Bach³

AFFILIATION: ¹Anesthesiology, Washington University in St. Louis, St. Louis, MO, ²Department of Anesthesiology and Intensive care, Miyazaki Medical College, University of Miyazaki, Miyazaki, Japan, ³Medicine, Washington University in St. Louis, St. Louis, MO

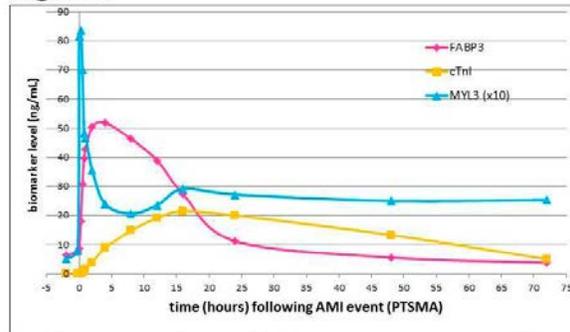
INTRODUCTION: Detection of acute myocardial injury (AMI) remains challenging, particularly as it relates to identification of patients with significant evolving AMI events that could benefit most from early use of invasive approaches. Cardiac specific biomarkers have the potential to help distinguish high risk groups, although the cardiac troponins now widely used to specifically identify AMI events typically rise slowly following AMI, and very small elevations which are now detectable early with high sensitivity assays can be nonspecific and difficult to interpret. In this study we examined cardiac biomarker profiles in patients with severe hypertrophic cardiomyopathy (HCM) undergoing percutaneous septal myocardial ablation (PTSMA) in the cardiac catheterization lab. This procedure provides a human model of AMI with a defined time of occurrence.

METHODS: This study was approved by the institutional human studies review board and informed consent was obtained. Plasma samples were obtained from HCM patients prior to, and then at frequent intervals immediately following, the PTSMA procedure. Plasma was processed and stored at -80 degrees C for analysis. Proteomic approaches using mass spectrometry were used to identify putative early biomarkers of AMI, and immunoassays for biomarkers of interest were developed and validated.

RESULTS: Cardiac troponin I (cTnI), heart fatty acid binding protein (FABP3), and ventricular myosin alkali light chain (MYL3), display markedly different time-dependent changes in plasma levels following AMI (PTSMA). Comparing the three markers, cTnI rises slowly and peaks late (16-24h), while FABP3 rises more rapidly and peaks much earlier (2-4h), and MYL3 peaks very early and declines very rapidly (<2h). As shown in Figure 2, the early (2-4h) FABP3 peak can predict the peak in cTnI, and the cTnI AUC.

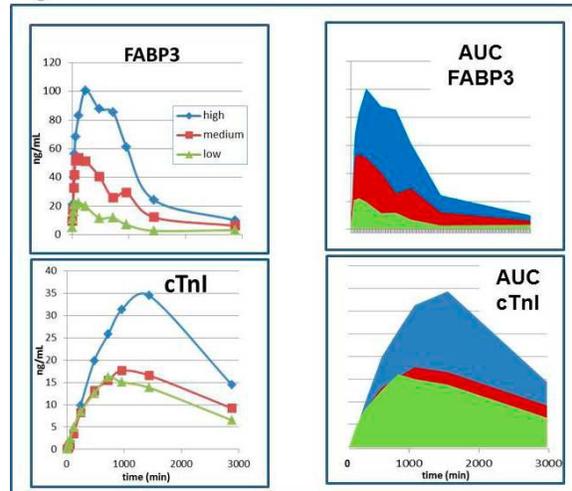
CONCLUSIONS: These data demonstrate significantly different time courses for changes in plasma levels of the three cardiac biomarkers studied following an AMI event. While measurement of cTnI will remain important with respect to cardiac specificity (both MYL3 and FABP3 are also expressed in skeletal muscle), and sustained cTnI elevations provide a reliable indicator of a cardiac event, MYL3 and FABP3 appear to provide considerable additional information to help distinguish AMI at early time-points, and allow improved ability to interpret early low level elevations of cTnI. Additionally, used in combination, these early biomarkers provide an opportunity to both clarify the time that has elapsed since the onset of the AMI event, and to potentially distinguish higher risk groups with larger evolving AMI events, who may benefit most from early aggressive intervention.

Figure 1



Time dependent changes in plasma levels of cardiac troponin I (cTnI), heart fatty acid binding protein (FABP3) and cardiac ventricular myosin alkali light chain (MYL3) following AMI (PTSMA)

Figure 2



FABP3 and cTnI levels following AMI (PTSMA), and areas under the curves (AUC) for each biomarker in 15 subjects separated into "high", "medium" and "low" groups based on FABP3 peak levels (n=5 per group). Note that "high" FABP3 (at 2-4h) predicts higher peak cTnI (at 16-24h) and larger cTnI AUC.

S-123.

WITHDRAWN.

S-124.**MECHANICAL VENTILATION INCREASES ACTIVATION OF ALVEOLAR EPITHELIUM AND ENDOTHELIAL CELL SUR1/TRPM4 CHANNELS IN RATS: A NOVEL THERAPEUTIC MOLECULAR MODEL FOR VENTILATOR-INDUCED LUNG INJURY**

AUTHORS: C. M. Hong¹, C. Tosun², K. Keledjian², V. Gerzanich², J. Simard², L. Chua¹

AFFILIATION: ¹Department of Anesthesiology and Critical Care Medicine, University of Maryland School of Medicine, Baltimore, MD, ²Department of Neurosurgery, University of Maryland School of Medicine, Baltimore, MD

INTRODUCTION: Lung injury, including ventilator-induced lung injury and adult respiratory distress syndrome, continues to have more than 50% mortality with little progress in regards to prevention and acute treatment outside of supportive care. Ventilator-induced lung injury has been attributed to high tidal volumes and pressures and low tidal volumes secondary to cyclic opening and closing of the peripheral airways. This results in inflammation, an increase in airway resistance and gross histological injury demonstrated by edema and hemorrhage. There is limited data demonstrating specific channels responsible acute lung injury after mechanical ventilation. The transient receptor potential melastatin 4 (TRPM4) is a calcium-dependent channel that acts as a sodium influx channel and is known to depolarize cells. Sulfonylurea receptor 1 (SUR1) serves as a regulatory subunit for TRPM4, forming a SUR1/TRPM4 channel. This channel has been shown to be up-regulated in neuronal and vascular cells after ischemia and play a key role in edema and outcome in many neurological disease states.¹⁻⁹ We investigate the presence and possible role of the SUR1/TRPM4 channel in ventilator-induced lung injury.

METHODS: Wistar male rats are anesthetized with isoflurane and maintained with > 2.0 MAC during the procedure (IACUC protocol 0814007). Each animal is mechanically ventilated for 4 hours with a 10 cc/kg tidal volume and a respiratory rate 20-30 which was adjusted for normalization of PaCO₂ and PaO₂ on arterial blood gas analysis during the procedure. SUR1 and TRPM4 was assessed using immunohistochemistry in controls and mechanically ventilated animals.

RESULTS: We demonstrate a significant increase in expression of SUR1 and TRPM4 in animals after mechanical ventilation (compared with vehicle) in the alveolar epithelium (SUR1:21.5 + 4.2, 6.59 + 1.96, p<0.001 and TRPM4: 27.1 + 6.5, 4.55 + 2.76, p<0.001, respectively) and arterial endothelium (SUR1:32 + 13, 0.77 + 0.53, p<0.02 and TRPM4: 32.8 + 8.95, 0.77 + 1.26, p<0.005 respectively).

CONCLUSIONS: We created a rat mechanical ventilation model that eliminates all other major stressors (i.e. major surgeries, infection, etc.), to investigate the sole effects of ventilation on normal lungs. This data is the first to demonstrate an increase in expression of SUR1 and TRPM4 in the lungs after mechanical ventilation. Activation of SUR1/TRPM4 channels may lead to depolarization of the cells, an excessive influx of sodium, causing cell swelling resulting in weakening of tight junctions and an increase in the permeability of these cells, ultimately worsening pulmonary edema. We provide insight towards a novel mechanism of ventilator-induced lung injury and yield way to a potential therapeutic model utilizing a specific SUR1 inhibitor, glibenclamide.

REFERENCES:

1. Tosun et al. Stroke 2013;44
2. Simard et al. Neurocrit Care 2014;20
3. Simard et al. J Neurosurg 2010;113
4. Simard et al. J Cereb Blood Flow Metab 2009;29
5. Simard et al. Exp Neurol 2012;233
6. Simard et al. Stroke 2010;41
7. Simard et al. Exp Neurol 2012;233
8. Simard et al. Transl Stroke Res 2012;3
9. Simard et al. Stroke 2009;40

S-125.

THE ROLE OF TRANSCRIPTION FACTOR BACH1 IN A RAT MODEL OF ACUTE LIVER INJURY INDUCED BY EXPERIMENTAL ENDOTOXEMIA

AUTHORS: N. Tanioka¹, H. Shimizu¹, T. Takahashi², E. Omori¹, M. Yamaoka¹, R. Nakamura¹, H. Morimatsu¹

AFFILIATION: ¹Department of Anesthesiology and Resuscitology, Okayama University Medical School, Okayama, Japan, ²Department of Health and Welfare Science, Okayama Prefectural University, Okayama, Japan

INTRODUCTION: Sepsis and septic shock frequently lead to multiple organ failure, and the liver is one of the major target organs. Oxidative stress is thought to play an important role in the pathogenesis of acute liver injury during sepsis. Free heme released from heme proteins is anticipated to be a contributor to the liver injury. Intracellular heme is regulated by heme oxygenase 1 (HO1), the ratelimiting enzyme in the heme catabolism, and δ-aminolevulinate synthase (ALAS1), the ratelimiting enzyme in the heme biosynthesis. And the transcription factor Bach1 normally represses HO1 expression, but is released from the promoter region and exported from nucleus to allow transcriptional activation of the HO-1 gene in the presence of excess free heme and oxidative stress. In the present study, we used a rat model of endotoxemia caused by lipopolysaccharide (LPS) and examined the gene expression of HO-1, ALAS1, Bach1, and nuclear protein level of Bach1 in the liver in association with hepatic injury.

METHODS: he animal experiments were approved by the Institutional Animal Care and Use Committee. Male Sprague-Dawley rats were administered intravenously (i.v.) with LPS (10mg/kg). Under light anesthesia, animals were sacrificed at each defined time point (0-48 h). Blood was collected to measure serum AST and ALT activity, and the livers were excised. Liver samples were used for hematoxylin and eosin staining of liver tissue sections and assessment of hepatic gene and protein expression. Hepatic mRNA levels were examined by Northern blot analysis. Hepatic protein level was examined by Western blot analysis. For statistical evaluation, multiple group comparisons were made by ANOVA followed by Bonferroni correction post hoc tests. P<0.05 was considered statistically significant.

RESULTS: Histologic examination of liver showed focal hepatocellular necrosis with congestion around portal areas (Figure 1). Serum levels of AST and ALT were significantly elevated 24 hours after LPS treatment compared with control groups (Figure 2). HO1 mRNA expression started to increase 13 h after LPS injection, reaching a maximum at 6 h prior to a gradual decrease. The levels of hepatic ALAS1 mRNA decreased below baseline by 3 h after treatment, followed by a rapid increase and return to over baseline (Figure 3). Bach1 mRNA expression, like HO-1 expression, started to increase immediately after LPS injection, reaching a maximum at 3-6 h prior to a rapid decrease to baseline level by 24 h. On the other hand, the levels of nuclear Bach1 protein showed transient significant decline 1 h after LPS injection (Figure 4). This result is consistent with a recent study reporting nuclear export of Bach1 protein by heme-mediated oxidative stress.

CONCLUSIONS: In a rat model of acute liver injury induced by experimental endotoxemia, the reciprocal responses of the HO1 and ALAS1 genes strongly suggest intracellular free heme involvement in hepatic tissue injury. Moreover, Bach1 protein transiently disappears from nucleus probably by binding with increased intracellular free heme. Our findings may be the first to show nuclear export of Bach1 protein in vivo.

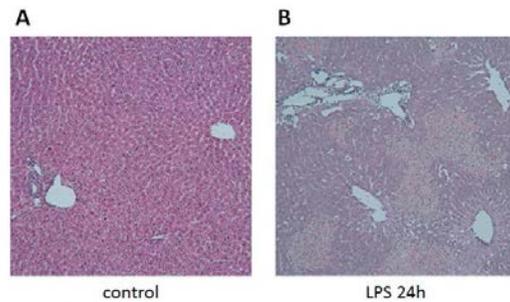


Figure 1. Histologic findings in the rat liver. (A) Normal liver tissue in the untreated control group. (B) Liver in the LPS group, at 24 hours after injection of LPS, showed focal hepatocellular necrosis with congestion. (Original magnification × 100)

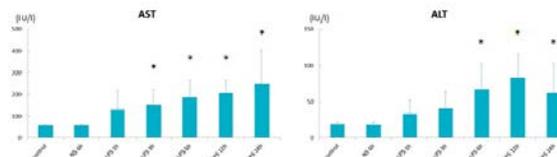


Figure 2. Effect of LPS treatment on serum AST and ALT levels. The rats were injected with LPS (10 mg/kg, i.v.), and sacrificed at 0, 1, 3, 6, 12, and 24 h after treatment (n=6-10). Data are expressed as the means ± standard deviation and were statistically evaluated using ANOVA followed by Bonferroni correction post hoc tests. *P<0.05 vs control group.

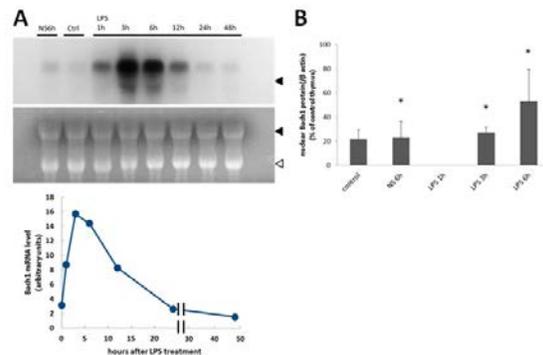


Figure 4. Effect of LPS treatment on Bach1 gene and nuclear protein expression. The rat livers were excised and total RNA (20 µg) was subjected to northern blot analysis, and nuclear protein (25µg) was subjected to western blot analysis. (A) Bach1 mRNA peaked at 3-6 h after LPS treatment. (B) Nuclear Bach1 protein declined transiently 1 h after LPS treatment (n=3-4). Data are expressed as the means ± SD. *P<0.05 vs LPS 1h group.

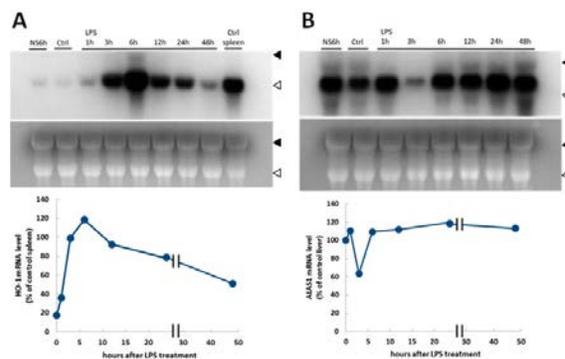


Figure 3. Effect of LPS treatment on HO-1 and ALAS1 gene expression. The rats were sacrificed at 0, 1, 3, 6, 12, 24 and 48 h after injection of LPS (10 mg/kg, i.v.), their livers were excised and total RNA (20 µg) was subjected to northern blot analysis. Closed arrowhead, 28S ribosomal RNA; and open arrowhead, 18S ribosomal RNA. (A) HO-1 mRNA peaked at 3 h after LPS treatment. (B) ALAS1 mRNA was downregulated at 3 h after LPS treatment.

S-126.

WITHDRAWN.

S-127.

WITHDRAWN.

S-128.

ROLE OF SURGERY REQUIRING ANESTHESIA IN POSTOPERATIVE COGNITIVE IMPAIRMENT

AUTHORS: C. G. Hughes¹, M. B. Patel², T. D. Girard³, S. K. Geevarghese², B. C. Norman³, P. P. Pandharipande¹

AFFILIATION: ¹Department of Anesthesiology, Vanderbilt University School of Medicine, Nashville, TN, ²Department of Surgery, Vanderbilt University School of Medicine, Nashville, TN, ³Department of Medicine, Vanderbilt University School of Medicine, Nashville, TN

INTRODUCTION: Emerging data have called into question whether postoperative cognitive dysfunction is attributable to surgery and anesthesia vs. patient characteristics or the hospital course.¹⁻⁵ We tested the hypothesis that surgery requiring general anesthesia (GA) is an independent risk factor for long-term cognitive impairment.

METHODS: In this multicenter prospective cohort study, we enrolled adult ICU patients within 72 hours of respiratory failure or shock. Hospital course data, including surgery requiring GA, were collected from hospital admission to 30 days after enrollment. At 3 and 12 months post-hospital discharge, we assessed global cognition with the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS: mean population adjusted score 100±15; lower scores indicate worse global cognition) and executive function with the Trail Making Test, Part B (Trails B: mean population adjusted score 50±10; lower scores indicate worse executive function). Multivariable linear regression was used to study the associations of surgery requiring GA with outcomes in 2 separate models: 1) after adjusting for only baseline covariates (age; Charlson comorbidity index; education; Informant Questionnaire on Cognitive Decline in the Elderly score; Framingham stroke risk score) and 2) with the addition of in-hospital covariates (duration of coma, delirium, severe sepsis, and hypoxemia; Sequential Organ Failure Assessment score; doses of analgesics, sedatives, and antipsychotics).

RESULTS: Of the 1,040 patients enrolled, 402 (39%) had surgery requiring GA. After accounting for death prior to follow-up (n=329) and loss to follow-up or withdrawal (n=177), 534 patients had testing at 3 and/or 12 months, 219 (41%) of whom had surgery. Median RBANS global cognition scores were similar at 3 and 12 months in patients who had surgery requiring GA vs. those who did not (Figure 1), approximately 1.5 standard deviations below the population mean. Median Trails B executive function scores were also similar in those who had surgery requiring GA vs. those who did not (Figure 2), approximately 1 standard deviation below the population mean. Surgery requiring GA was not associated with global cognitive or executive dysfunction at 3 or 12 months in models incorporating baseline covariates with and without in-hospital covariates (Table 1). Increasing age, lower education years, and longer delirium duration were associated with worse global cognitive function at 3 and 12 months (all p<0.02), and longer delirium duration was associated with worse executive function at 3 and 12 months (p<0.01).

CONCLUSIONS: In this cohort of patients with critical illness, surgery requiring GA was not a risk factor for long-term global cognition or executive function deficits. Such deficits were common and associated with baseline patient characteristics and in-hospital delirium.

REFERENCES:

1. Avidan M. Anesthesiology 2009; 111:964-70
2. Evered L. Anesth Analg 2011; 112:1179-85
3. Silbert B. Br J Anaesth 2014; Epub
4. Sazynski J. N Engl J Med 2012; 367:30-9
5. Neufeld K. Anesth Analg 2013; 117:471-8

Figure 1. Global Cognition in Patients with vs. without Surgery

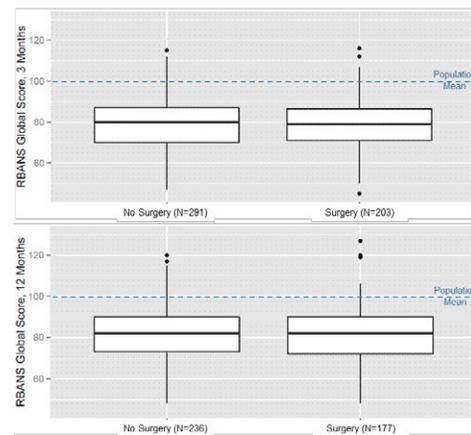


Figure 2. Executive Function in Patients with vs. without Surgery

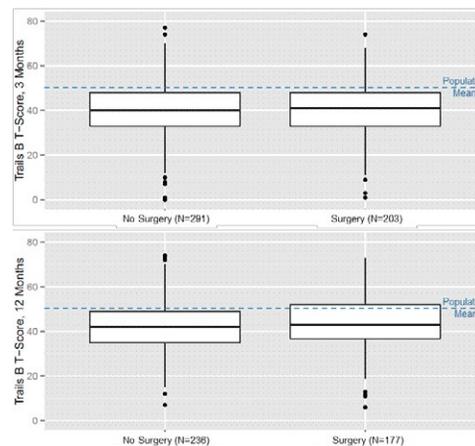


Table 1. Surgery, Demographic, and Hospital Characteristics vs. Global Cognition and Executive Function

3-Month Follow-up (N=494)	25 th Percentile		75 th Percentile		Adjusted RBANS Difference	P-value	Adjusted Trails B Difference	P-value
	No	Yes	No	Yes				
Surgery	No	Yes	-1.15 (-3.59, 1.28)	0.353	0.29 (-2.33, 2.92)	0.826		
Age at enrollment, years	51.3	69.7	-1.22 (-4.81, 2.37)	0.002	0.38 (-3.56, 4.31)	0.217		
Education, years	12	14	4.47 (2.29, 6.66)	<0.001	-0.26 (-2.68, 2.17)	0.905		
Charlson score	1	3.75	-2.67 (-5.74, 0.40)	0.266	-3.80 (-7.12, -0.48)	0.019		
Framingham stroke risk	6	14	1.41 (-1.99, 4.81)	0.500	1.23 (-2.45, 4.91)	0.400		
IQCODE	3.00	3.12	-0.82 (-2.37, 0.74)	<0.001	0.87 (-0.83, 2.57)	0.102		
Delirium duration, days	0	5	-5.89 (-9.33, -2.46)	0.004	-3.50 (-7.82, 0.82)	0.008		
Coma duration, days	0	3	-1.40 (-4.65, 1.85)	0.579	2.11 (-3.34, 7.56)	0.093		
Severe sepsis duration, days	0	5	2.57 (-0.30, 5.43)	0.205	1.41 (-1.81, 4.63)	0.675		
Hypoxemia, 15 min intervals	0	9	0.45 (-2.06, 2.97)	0.236	-1.91 (-4.65, 0.82)	0.360		
Mean SOFA score	3.50	6.67	1.33 (-1.52, 4.18)	0.747	0.64 (-2.52, 3.81)	0.893		
12-month Follow-up (N=413)	25 th Percentile		75 th Percentile		Adjusted RBANS Difference	P-value	Adjusted Trails B Difference	P-value
No	Yes	No	Yes					
Surgery	No	Yes	-0.43 (-3.26, 2.41)	0.767	1.08 (-1.62, 3.78)	0.432		
Age at enrollment, years	51.3	69.7	-1.90 (-6.17, 2.36)	0.019	0.50 (-3.57, 4.56)	0.635		
Education, years	12	14	3.94 (1.36, 6.53)	<0.001	-0.82 (-3.28, 1.65)	0.642		
Charlson score	1	3.75	0.61 (-3.20, 4.42)	0.268	1.43 (-2.14, 4.99)	0.151		
Framingham stroke risk	6	14	0.91 (-3.40, 5.22)	0.852	0.87 (-3.24, 4.98)	0.072		
IQCODE	3.00	3.12	1.19 (-0.82, 3.20)	0.110	-0.47 (-2.79, 1.85)	0.002		
Delirium duration, days	0	5	-7.26 (-11.29, -3.22)	0.003	-6.46 (-10.32, -2.60)	0.005		
Coma duration, days	0	3	0.49 (-3.44, 4.43)	0.520	0.09 (-3.61, 3.79)	0.999		
Severe sepsis duration, days	0	5	0.90 (-2.61, 4.41)	0.696	1.36 (-2.02, 4.74)	0.554		
Hypoxemia, 15 min intervals	0	9	2.04 (0.37, 3.70)	0.043	0.47 (-1.11, 2.05)	0.842		
Mean SOFA score	3.50	6.67	-0.71 (-4.27, 2.85)	0.595	-1.30 (-4.64, 2.05)	0.686		

*A negative value is indicative of worse global cognition or executive function; adjusted difference of 75th vs. 25th percentile (95% confidence interval) is reported.

Subspecialty Abstracts

**Economics, Education
and Policy**

S-129.

ENHANCING FEEDBACK ON PROFESSIONALISM AND INTERPERSONAL AND COMMUNICATION SKILLS

AUTHORS: . D. Mitchell¹, A. DiLorenzo², S. Karan³, D. E. Lee⁴, R. M. Schell², C. B. Diachun⁵, S. Jones¹

AFFILIATION: ¹Anesthesia, Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA, ²Anesthesiology, University of Kentucky, Lexington, KY, ³Anesthesiology, University of Rochester Medical Center, Rochester, NY, ⁴Anesthesiology and Pediatrics, University of California, San Diego, San Diego, CA, ⁵Anesthesiology, University of Florida – Jacksonville, Jacksonville, FL

INTRODUCTION: Gaps in professionalism and interpersonal and communication skills (PICS) can undermine trainee competence. Trainees with uncorrected deficits in professionalism are more likely to have performance issues and face disciplinary action during their careers.^{1,2} Feedback by faculty is critical for correcting any defects, but existing tools are not adapted to the unique needs of anesthesia faculty and training programs. We hypothesized that a program aimed at teaching faculty how to provide feedback and at increasing awareness of PICS could enhance the quantity and specific attributes of feedback to residents.

METHODS: Faculty from four institutions, where faculty are asked to provide daily feedback to residents, were invited to participate in this multicenter cohort study in 2014. We implemented a program consisting of a survey on the institutional climate of PICS and two video-based discussion sessions to teach faculty how to provide feedback (video screenshots in Figure 1). Feedback records three months prior to and after the intervention were collected for analysis. All de-identified and randomized feedback records are being scored by blinded experts in feedback as having or not having each of the following attributes: detailed, specific, behavior-focused, not destructive or harmful, actionable, related to PICS, and contains negative feedback. The attributes of pre-intervention feedback records were compared to those of post-intervention feedback records with chi-square tests ($p < 0.05$ was considered significant).

RESULTS: The number of feedback records increased 6.5% from 998 in the pre-intervention period to 1063 in the post-intervention period. Scoring of the feedback records is in progress. In a preliminary analysis of 287 pre-intervention records and 300 post-intervention records, the percent of records that were detailed, specific, behavior-focused, and related to PICS increased from pre-intervention to post-intervention (Figure 2). No significant differences were detected (Table 1).

CONCLUSIONS: The quantity of feedback records increased after the intervention. While no significant differences were detected, we noticed an increase in the percent of feedback records related to PICS that trended toward significance. This finding suggests that the intervention may have increased awareness of PICS, but further scoring of feedback records and subsequent data analysis are necessary.

REFERENCES:

1. Rhoton MF. Professionalism and clinical excellence among anesthesiology residents. Acad Med. Apr 1994;69(4):313-315.
2. Papadakis MA, Teherani A, Banach MA, et al. Disciplinary action by medical boards and prior behavior in medical school. N Engl J Med. Dec 22 2005;353(25):2673-2682.

Figure 1: Screenshots of Video

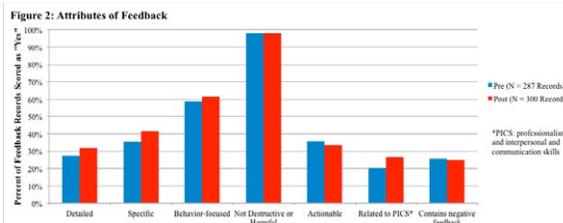
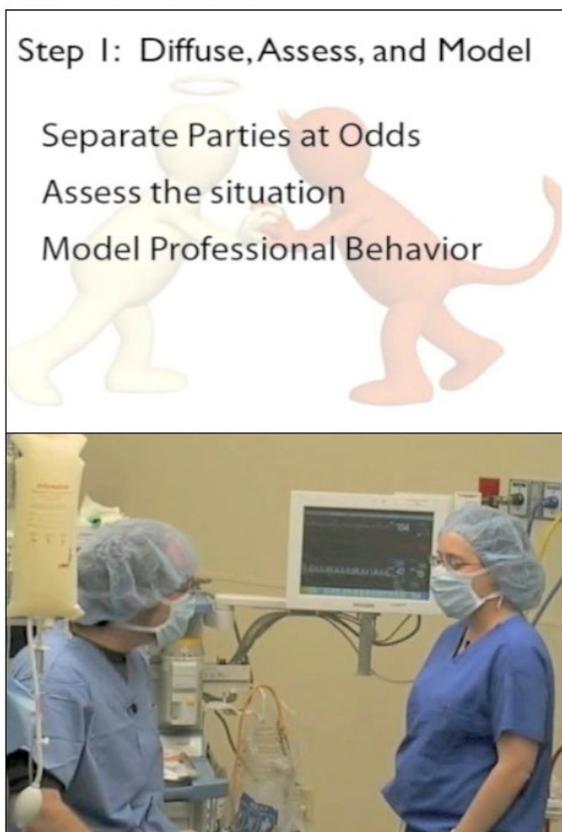


Table 1: Results from Preliminary Analysis of Feedback

Attribute	Pre (N = 287 Records)	Post (N = 300 Records)	Chi-Square p-value
Detailed	27%	32%	0.201
Specific	36%	42%	0.128
Behavior-focused	59%	62%	0.439
Not Destructive or Harmful	98%	98%	0.944
Actionable	36%	33%	0.515
Related to PICS*	20%	27%	0.065
Contains negative feedback	26%	25%	0.827

*PICS: professionalism and interpersonal and communication skills

S-130.**A COMPETITIVE OSCE EVENT TO ASSESS THE DEVELOPMENT OF ANESTHESIOLOGY RESIDENT SKILL SET DURING CARE HANDOFF IN PACU**

AUTHORS: A. Rebel, R. Fragneto, A. DiLorenzo, D. Nguyen, R. M. Schell

AFFILIATION: Anesthesiology, University of Kentucky, Lexington, KY

INTRODUCTION: Residency programs are charged with teaching, assessing, and documenting competency for a multitude of skills throughout the course of the training program. An annual skill assessment event (Anesthesia Olympics) was developed to assess requisite skills in an environment of friendly competition.^{1,2} After conducting the event for 2 years in the PGY1 and PGY2 residents, we are testing the hypothesis that the event can provide adequate standardization to appropriately document progression in professional, non-technical, and non-cognitive skills.

METHODS: After IRB approval, 21 anesthesia residents participated in the Anesthesia Olympics project during both their PGY1 and PGY2 training years between 2012-2014. The event consisted of 6 workstations, one of which assessed the quality of transition of care (ToC) in the Postanesthesia Care Unit (PACU). Using a simulated ToC process in the PACU, video recording was used to assess the completeness and communication during the ToC. Completeness was assessed by faculty using a checklist developed by the authors. Completeness score reports the percentage of information transferred to the next provider. Organization and communication were rated using 4 Likert scales questions (1 = poor, 5 = outstanding, maximum 20 points). The resulting professionalism score is presented as a fraction of maximum score. Data are shown as mean \pm SD, paired t-test is used for statistical significance.

RESULTS: A total of 21 residents participated in both events: n=10 2012/13, n=11 2013/14. The workstation scenario and faculty assessor were identical in the PGY1 and PGY2 years.

Table 1

Score	PGY-1	PGY-2	p-value
Completeness score	0.56 \pm 0.17	0.77 \pm 0.18	0.018
Professionalism score	0.77 \pm 0.12	0.90 \pm 0.09	< 0.001

Comparing individual performances from the PGY1 to PGY2 year, only 2 residents out of 21 performed better in the PGY1 year than as PGY2 in completeness and professionalism. However, the difference was below 0.1 from the maximum score.

CONCLUSIONS: The PGY2 residents outperformed their PGY1 performance in this workstation evaluating technical and professional skills during the ToC process in PACU. The annual skill assessment event (Anesthesia Olympics) is able to objectively assess and document progression in anesthesia resident skill development and may be useful for evaluation of less objective milestones throughout residency.

REFERENCES:

1. Rebel A et. al Simulation in Healthcare. San Francisco, CA. January 2014.
2. DiLorenzo A et. al. Society for Education in Anesthesia. Boston, MA. May 2014.

S-131.**USE OF A COGNITIVE AID IMPROVES RESIDENT TRANSITION OF CARE PROCESS QUALITY IN SIMULATED CRISIS SITUATIONS**

AUTHORS: A. Rebel¹, A. DiLorenzo¹, P. A. Sloan¹, R. Latif², K. Christie², M. Lukens¹, R. Fragneto¹

AFFILIATION: ¹Anesthesiology, University of Kentucky, Lexington, KY, ²Anesthesiology, University of Louisville, Louisville, KY

INTRODUCTION: Communication during transition of care (ToC) must be correct, complete and efficient since loss of important information can compromise patient care. The need is magnified in crisis situations. We developed patient simulation (PS) scenarios to assess and improve the quality of the ToC process of anesthesiology residents. The aim of this PS project was to assess whether the use of a cognitive aid (CA) improves the quality of the ToC process in crisis.

METHODS: Rapid response PS scenarios were developed by the authors. After IRB approval residents were randomly assigned to scenarios in which he/she assumed care of an unstable patient. A bedside nurse provided essential patient information and remained available to answer questions. Following this report, the patient deteriorated further allowing the team leader to guide the team through an ACLS code. After stabilization, he/she provided a verbal ToC report to the intensive care unit provider. The resident performance during the scenario was video recorded. Completeness and quality of the ToC process were assessed by seven expert faculty from two institutions using checklists and Likert scales. The completeness score is reported as percentage from the maximum score. Leadership, organization and communication skills were assessed by a point system, with the score expressing the percentage from the maximum score. Intervention measurements (with CA) were taken 8 months after baseline measurements (without CA) to avoid participant recall. Statistical analysis was performed using mean \pm SD, and paired t-test with statistical significance set at $p < 0.01$ to compare ToC at baseline and Toc with cognitive aid. A linear mixed model was utilized to account for the nested structure of the data and investigate the associations between all data collected

RESULTS: Completeness scores increased with the use of CA.

The scores for communication, organization and leadership also benefitted from use of the CA, suggesting that the CA might provide a structure for the ToC process. (Table 1). The linear mixed model analysis indicated that there were no differences in scores from the training versus the non-training institution.

CONCLUSIONS: The use of a cognitive aid improved the completeness and quality of ToC process of anesthesiology residents when assessed by expert faculty from different institutions. Further studies and refinement of the cognitive aid are needed to optimize the impact and format of the tool, and to assess its impact on both individual and team performance during ToC in crisis situations.

Table 1

	ToC baseline	ToC with CA
	N=14	N=14
Completeness score	0.67 \pm 0.16	0.87 \pm 0.08*
Communication score	0.76 \pm 0.13	0.85 \pm 0.14*
Organization score	0.77 \pm 0.17	0.85 \pm 0.14*
Leadership score	0.77 \pm 0.15	0.85 \pm 0.13*

Data of faculty assessment from the training institution (UK) are shown as mean \pm SD . ToC Baseline = ToC without cognitive aid. Toc with CA = ToC with cognitive aid. * $P < 0.05$ (paired t-test)

REFERENCES:

1. Blum RH et. al. Anesth Analg 2005;100:1375-80.
2. Rebel A et. al. Loss of Information During Transfer of Care: Preliminary Results of a Simulation Project. PGA, New York, NY 2013.

Funding: This project was supported in part by the Southern Group on Educational Affairs Research in Medical Education Grant.

S-132.**PERCEPTIONS OF ACUPUNCTURE AND ACUPRESSURE BY ANESTHESIA PROVIDERS**

AUTHORS: A. Faircloth¹, C. Biddle¹, J. F. Butterworth², A. Dubovoy¹

AFFILIATION: ¹Anesthesiology, VCU Medical Center, Richmond, VA, ²Anesthesiology, VCU School of Medicine, Richmond, VA

INTRODUCTION: Randomized controlled trials show acupuncture and acupressure support anesthesia management by decreasing anxiety, opioid requirements and treating post-operative nausea and vomiting.¹⁻³ Acupuncture and acupressure have demonstrated clinical usefulness and received governmental support (US Military, NIH, WHO, PPACA), but have not yet diffused into mainstream anesthesia practice.⁴⁻⁷ To date, this is the first study to assess US anesthesia providers' perceptions of acupuncture and acupressure.

METHODS: After receiving Institutional Review Board approval, 96 anesthesiology departments stratified by geographic region (Northeast, South, West, and Midwest) and institution type (university medical centers, community hospitals, children's hospitals, and VA hospitals) were selected for participation in an anonymous, pretested, online survey. The target sample was 1,728 providers of which N = 292 (54% anesthesiologists, 44% CRNAs, 2% AAs) responded yielding an overall 17% response rate.

RESULTS: Spearman's correlation coefficient revealed a statistically significant correlation between acupuncture and geographic region, with the West having the highest predisposition toward acupuncture use ($r_s = 0.159$, $p = 0.007$). Females are more likely to use acupuncture than men ($r_s = -.188$, $p = 0.002$). Age yielded a moderate effect size with providers between the ages of 31-50 years old experiencing the best outcomes administering acupuncture ($r_s = 0.65$, 95% CI = 2.79, 3.06). A strong effect size exists between acupuncture and country of pre-anesthesia training ($r_s = 1.00$, 95% CI = 1.08, 1.16). Some providers have used acupuncture (27%) and acupressure (18%) with positive outcomes, however the majority have not used these modalities, but would consider using them (54%, SD = 1.44 acupuncture; 60%, SD = 1.32 acupressure). Seventy-six percent of respondents would like acupuncture education and 74% would like acupressure education (SD = 0.43, SD = 0.44, respectively). Providers reported lack of scientific evidence (79%, SD = 0.73) and unavailability of credentialed providers (71%, SD = 0.92) as the primary reasons why acupuncture and acupressure may not be used in anesthesia practice.

CONCLUSIONS: While most US anesthesia providers have not used these modalities, they still report a favorable perception of acupuncture/acupressure's role as part of an anesthetic and the majority of providers express an interest in receiving education. This study adds to the body of acupuncture and acupressure research by providing insight into anesthesia providers' perceptions of these alternative medicine modalities.

REFERENCES:

1. Anesthesia & Analgesia 2007; 104 (2): 312-17.
2. Anesthesia & Analgesia 2012; 115(1): 31-7.
3. British Journal of Anaesthesia 2008; 101(2): 151-160.
4. Military Medicine 2006; 171(10): 1010-14.
5. National Institutes of Health 2014; retrieved from http://nccam.nih.gov/sites/nccam.nih.gov/files/NCCAM_SP_508.pdf
6. World Health Organization 2003; retrieved from <http://apps.who.int/medicinedocs/en/d/Js4926e/5.html>
7. Global Advances in Health and Medicine 2014; 3(4): 6-7.

S-133.**HYPERTENSION OR INAPPROPRIATE BLOOD PRESSURE CUFF? EDUCATION IN THE PERIOPEARATIVE SETTING****AUTHORS:** S. Pai, G. J. Mickus, I. I. Logvinov**AFFILIATION:** Anesthesiology, Mayo Clinic Florida, Jacksonville, FL

INTRODUCTION: Intraoperative blood pressure (BP) measurement, a standard ASA monitor, is integral in perioperative care. It is crucial for anesthesia providers to have accurate BP measurements to properly assess and treat aberrancies. The most common BP measurement error is “miscuffing” whereby the vast majority involve under-cuffing large arms¹. In addition to the rising prevalence of obesity in the US², research indicates increasing mean arm circumferences³ with higher measurement error when under-cuffing versus over-cuffing^{4,5}. This data anticipates a rise in measurement error if trends persist, and ultimately will result in decreased patient safety as well as accelerate unnecessary medication costs. In our clinical practice, patients regularly present to the operating room with inappropriately sized cuffs. Our investigation involved perioperative staff, included a pre-test, a brief presentation of current literature, and a post-test to measure effected change.

METHODS: The sample (n=26) consisted of pre- and postoperative nurses who routinely select BP cuffs for surgical patients. Prior to the presentation, each individual completed an 8-question pre-test to determine baseline BP measurement knowledge, with 3 questions assessing appropriate BP cuff selection for different-sized model “arms” of rolled sheets. Subsequently a 15-20 minute presentation included a review of current American Heart Association BP measurement guidelines, focused on common reasons for false BP readings, reviewed correct size selection with proper application based on cuffs provided by the facility, illustrated special considerations for BP measurement, reviewed radial BP measurement, and included an interactive slide for participants to point out common errors. Questions were answered, and an 8-question post-test was provided.

RESULTS: The sample (n=26) consisted of pre- and postoperative nurses who routinely select BP cuffs for surgical patients. Prior to the presentation, each individual completed an 8-question pre-test to determine baseline BP measurement knowledge, with 3 questions assessing appropriate BP cuff selection for different-sized model “arms” of rolled sheets. Subsequently a 15-20 minute presentation included a review of current American Heart Association BP measurement guidelines, focused on common reasons for false BP readings, reviewed correct size selection with proper application based on cuffs provided by the facility, illustrated special considerations for BP measurement, reviewed radial BP measurement, and included an interactive slide for participants to point out common errors. Questions were answered, and an 8-question post-test was provided.

CONCLUSIONS: In our investigation, respondents did not demonstrate any difference in overall knowledge post-presentation, and several explanations may exist. These include inappropriate BP cuff selection provided at the facility, short presentation duration, pre/post-test complexity, staff inattentiveness, long-standing experiential practice, or random answer selection. Further initiatives are absolutely necessary to achieve evident change. In our continued pursuit to identify causality, it is imperative for providers to educate perioperative staff on this topic, thereby providing quality patient care with precise blood pressure measurements for accurate interpretation and appropriate treatment.

REFERENCES:

1. Circulation. 1983; 68:763-66
2. JAMA. 2002; 288:1723-27
3. Blood Press Monit. 2003; 8:223-27
4. Lancet. 1982; 2(8288):33-6
5. Arch Intern Med. 1984; 144:1482-85

Over-cuffing: Cuff too large for the arm

Under-cuffing: Cuff too small for the arm

S-134.

WITHDRAWN.

S-135.**AUTOMATED CASE CANCELLATION REVIEW SYSTEM IMPROVES SYSTEM BASED PRACTICE LEARNING****AUTHORS:** J. R. Starnes, M. D. McEvoy, J. M. Ehrenfeld, W. Sandberg, J. P. Wanderer**AFFILIATION:** Department of Anesthesiology, Vanderbilt University, Nashville, TN**INTRODUCTION:** An automated system to facilitate anesthesiology resident review of cancelled operating room cases was implemented on the Preoperative Evaluation Clinic (PEC) rotation at the authors' institution. This study aims to evaluate the impact of this system on resident education.**METHODS:** Residents on the PEC rotation during the six months immediately preceding and following implementation in 2014 were surveyed about their experience performing cancelled case reviews on the rotation in order to ascertain the effect of the intervention on their training.**RESULTS:** 35 out of 40 residents (88%) completed the survey. Significant changes were reported in the number of cases reviewed by each resident ($p < 0.0001$), perceived importance of review ($p = 0.03$), and ease of review ($p = 0.03$) after system implementation. There was also an increase in the total proportion of cancelled cases reviewed from 17.3% (34 of 196) to 95.6% (194 of 203) ($p < 0.0001$). Non-significant trends were seen in perceived rotation effect on Accreditation Council for Graduate Medical Education (ACGME) competencies, including systems-based practice. Several specific improvements to our clinical practice, including the creation of standardized guidelines, arose directly from these case reviews.**CONCLUSIONS:** Implementation of automated systems can improve compliance with educational goals by clarifying priorities and simplifying workflow. This system increased the number of cases reviewed by residents and the perceived importance of this review as a part of their educational experience.

S-136.**CURRICULUM DEVELOPMENT FOR MEDICAL STUDENT
ULTRASOUND EDUCATION****AUTHORS:** L. Maloney¹, K. Zach¹, C. Page², P. A. Seidman³**AFFILIATION:** ¹School of Medicine, Stony Brook SOM, Stony Brook, NY, ²Anesthesiology, Stony Brook SOM, Stony Brook, NY, ³Anesthesiology and Pediatrics, Stony Brook SOM, Stony Brook, NY**INTRODUCTION:** Given the AAMC mandate to develop procedural skill (PS) competency in medical students, the cost and time effective teaching of PS are increasingly important¹. With evolving technology and cross-disciplinary usage, we believe Ultrasound (US) training to be integral to PS. This study reports our experience using² methods to introduce US training to preclinical students at minimal cost.**METHODS:** Prior to their first PS training session, 95 medical students from the class of 2017 was given didactic US learning materials and randomly divided into Group A (GA) and Group B (GB). Project was granted an IRB educational exemption.

For GA, each student was given 5 minutes to practice scanning a large Jell-O phantom (LJP) using an US machine. Each LJP contained a total of 6 objects (pitted olives, pimento olives, and grapes); at least one of each type of object, with the remaining 3 a random mix of the 3 (Fig. 1). Students were required to identify various shapes, densities, and textures using US including differentiating between the 3 objects (Fig. 2). After the practice session, students received a different LJP, and were given 90 seconds to identify and count the 6 objects (Fig. 3).

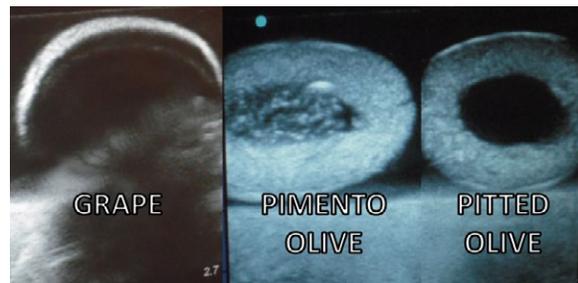
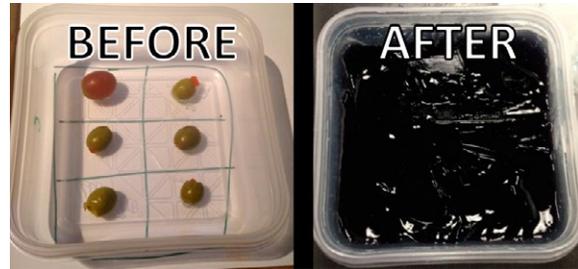
For GB, each student was given a muffin phantom (MP), which contained a grape, a pitted olive, and a pimento olive (Fig. 4). Each student was given 5 minutes to practice scanning their MP to identify the three objects, as well as a 21g spinal needle to attempt to hit the various objects, practicing in-plane and out-of-plane. After the practice session, students were given the same 90 second assessments with the same LJP as GA.

Before and after the skill sessions, students were asked to complete surveys rating their opinion on the value of US, and their experience during the session.

RESULTS: Data was analyzed using a Chi Square ($p < 0.05$). There was no difference in prior US experience between GA and GB, yet there was a very significant difference in the ability of GA over GB to correctly identify all 6 objects in the LJP within 90 seconds. Both groups equally found the objects to be identifiable, though GB was more likely to feel 90 seconds was not enough time for the summative scan. GA and GB found the overall experience to be valuable and enjoyable. The cost per student in GA was \$0.56 and \$1.30 for GB. Assembly time for GA phantoms was 2 hours, and 7 hours for GB.**CONCLUSIONS:** This study highlights the importance of critically evaluating proposed changes to medical student PS curriculum. A novice student's ability to learn and apply PS can easily be overestimated by the skill experts who develop the curriculum. The group of students who practiced only a simple US scanning technique during the session were more successful during the summative assessment than the group of students who had an active experience of scanning and using needles. This suggests that educators may overestimate the ability of students to learn a complex skill, and that a slower skill progression is required for successful US education.**REFERENCES:**

1. "Recommendations for Clinical Skills Curricula for Undergraduate Medical Education" Association of American

Medical Colleges 2008: 28-29



S-137.

THE DEVELOPMENT AND USE OF SIMULATION SCENARIOS INDUCING MEDICATION ERRORS FOR USE IN MEDICAL EDUCATION

AUTHORS: A. Motoyasu¹, T. Yorozu², K. Moriyama³, Y. TATSUYA⁴

AFFILIATION: ¹Dept. of Anesthesiology, Kyorin university, Mitaka, Tokyo, Japan, ²Dept. of Anesthesiology, Kyorin University, School of Medicine, Tokyo, Japan, ³Dept. of Anesthesiology, Kyorin University School of Medicine, Tokyo, Japan, ⁴Dept. of Anesthesiology, Kyorin University, Mitaka city, Tokyo, Japan

INTRODUCTION: Junior residents who rotate to anesthesia during residency occasionally inject an incorrect dose of ephedrine to patients during anesthesia. We expected that the experience of injecting the incorrect dose of ephedrine during simulation training for medical students would prevent medication errors during residencies; therefore, we designed a scenario that might induce medication errors. Using a high fidelity patient simulator (HPS), we investigated students' responses to a mock experience of a medication error during anesthesia.

METHODS: The participants were 5th year medical students in the clinical clerkship rotation in the department of anesthesiology from 2013 July to 2014 Jun. A group of seven to eight students are part of each rotation. On the first day of the clinical clerkship, students observed the actual induction of anesthesia in the operating room. Students were then taken to a simulation room. Before the simulation scenario began, the students received a short lecture about the method of induction of anesthesia, including the usual dose of anesthetics and ephedrine as a basic vasopressor drug. The concentration of ephedrine was described as "5 mg/ml" with a "standard injection of 5 mg" of ephedrine intravenously every time blood pressure decreased profoundly during the induction of anesthesia. The preparation of the drugs used for the induction of anesthesia is shown in Table 1. There were four scenarios used in the simulation (Table 2). The planned injection doses of drugs in the simulation are shown in Table 3. For the first round of simulations, a student played the role of the anesthetist and an instructor injected the mock anesthetic agent into the venous line connected to a mock vein. In the cases where sudden hypotension occurs, the instructor injected 5 mg of ephedrine, which is 1 ml. For the second round of simulations, the same scenarios in the first round were used, but students took the roles of both anesthetist and instructor. We observed the dose injected by the students during the scenarios.

RESULTS: Thirteen groups were enrolled in this study. The medication errors that occurred during the simulations are shown in Table 4. In every group, one or more medication errors occurred. All but one of these cases was overdoses. Of the 14 cases in which the wrong dose of ephedrine was injected, nine cases were injected with 40 mg, which was the gross quantity filled in a prepared syringe. Four cases involved injecting 5 ml (25 mg) instead of 1 ml (5 mg).

CONCLUSIONS: Students tended to inject a gross quantity filled in a prepared syringe even when they had been taught about the doses of the drugs during the induction of anesthesia before the simulation scenarios began. Another incorrect injection was five times as much as the intended dose, which was possibly due to confusing the mg and ml units.

We successfully established simulation scenarios to expose medical students to medication errors. The simulator provided a useful and safe method of experiencing such errors during the urgent situation of treating sudden hypotension.

Table 1: Preparation of the drugs used during induction of anesthesia

Drug	Preparation for the solution (Concentration)
Fentanyl	100µg in 2 ml (50µg/ml)
Propofol	200 mg in 20 ml (10 mg/ml)
Rocuronium	50 mg in 5 ml (10 mg/ml)
Ephedrine	40 mg in 8 ml (5 mg/ml)

Table 2: Profiles of the simulated patients

Scenario	Profile
1	Healthy young man.
2	Elderly man with hypertension and obstetric lung disease. Sudden hypotension occurs immediately after the induction of anesthesia.
3	Elderly woman with hypertension and history of angina. Sudden hypotension occurs immediately after the induction of anesthesia.
4	Middle-aged man with sever obesity (BMI > 40).

Table 3: Planned injection doses of drugs for each scenario

Scenario	1	2	3	4
Fentanyl	100µg (2 ml)	100µg (2 ml)	100µg (2 ml)	200µg (2 ml×2)
Propofol	100 mg (10 ml)	100 mg (10 ml)	100 mg (10 ml)	200 mg (20 ml)
Rocuronium	50 mg (5 ml)	50 mg (5 ml)	50 mg (5 ml)	50 mg (5 ml)
Ephedrine	5 mg (1 ml) each time hypotension less than 70 mm Hg of systolic blood pressure occurs.			

Table 4 Medication errors

Group \ Scenario	1	2	3	4
1	—	—	E(40mg/8ml)	—
2	P(200mg/20ml)	—	—	—
3	—	E(25mg/5ml)	—	P(150mg/15ml)
4	—	E(40mg/8ml)	E(40mg/8ml)	—
5	P(200mg/20ml)	E(40mg/8ml)	E(25mg/5ml)	—
6	—	—	E(25mg/5ml)	—
7	—	E(40mg/8ml)	—	—
8	—	E(40mg/8ml)	—	—
9	—	—	E(35mg/7ml)	—
10	—	—	E(40mg/8ml)	—
11	—	E(40mg/8ml)	—	—
12	—	—	E(25mg/5ml)	—
13	P(180mg/18ml)	E(40mg/8ml)	—	—

—: no medication error, P: propofol, E: ephedrine.
Drug doses in brackets (mg/ml) are wrong doses injected by students.

S-138.

RADIAL ARTERIAL LINE LC-CUSUM LEARNING CURVE AMONG FIRST YEAR RESIDENTS

AUTHORS: P. Hussey, K. Ueda, E. Bayman

AFFILIATION: Carver College of Medicine, University of Iowa, Iowa City, IA

INTRODUCTION: Radial arterial cannulation is essential during major surgeries to allow accurate real-time hemodynamic monitoring and repeated arterial blood sampling.¹ To date, there is no study available for a standard learning curve of radial arterial cannulation to assess the performance of each individual cumulative success rate as “competent” or “not competent” for anesthesia residents. CUSUM is one of the emerging methods to evaluate learning curves.² There are two different CUSUM methods: standard CUSUM and learning curve (CUSUM). LC-CUSUM is designed to not to penalize new learners with consecutive failures during the initial period due to immediate inexperience.³ Therefore, the primary objective of the study was creating a learning curve using the LC-CUSUM model for adult radial arterial cannulation for anesthesia residents based on the electronic anesthesia records (Epic system) to identify outlier residents (slow learner residents).

METHODS: This was a retrospective observational study that developed by LC-CUSUM model of first attempt success in radial arterial line placement. We reviewed the Epic electronic intra-operative anesthesia record from July 1, 2012 to June 30, 2013 of first attempt success of arterial cannulation. 13 CA-1 anesthesia residents were included in the study and 587 arterial line attempts were identified. Other data were also obtained from medical records, such as gender, first valid blood pressure, and presence of peripheral vascular disease. Data was analyzed using SAS 9.3

statistical software and Cusum plots were generated. Acceptable failure rate and unacceptable failure rates are pre-determined. Based on these rates, each anesthesia resident’s performance was classified as “competent” or “not competent”.

RESULTS: Table 1. Arterial line cannulation attempts of Clinical Anesthesia Year 1 residents

77% of first year anesthesia residents were unable to achieve an acceptable failure rate (40%) based on raw data. When observing with CUSUM method, 54% of residents were unable to achieve an acceptable failure rate. In comparison with standard CUSUM, at least five residents benefitted with the LC-CUSUM model at $h_0=2.4$. Using the LC-CUSUM model, 23% of residents were unable to achieve an acceptable failure rate as compared to 77% when using raw data.

CONCLUSIONS: LC-CUSUM can develop a standard curve of radial arterial cannulation skill for anesthesia residents and can determine when a resident becomes proficient. Outlier residents, if available, can also be identified for continuing educational opportunities. This model can also be applied in the many other procedures residents must learn to become proficient anesthesiologists.

REFERENCES:

1. Learning manual skills in anesthesiology: Is there a recommended number of cases for anesthetic procedures? *Anesth Analg* 1998;86:635-9.
2. LC-CUSUM test. *Anaesthesia* 2010;65:755-6.
3. A method for monitoring a process from an out of control to an in control state: application to the learning curve. *Statist Med* 2010;29:1900-9.

Operator	Total	Total success	CUSUM	LC-CUSUM	LC-CUSUM	LC-CUSUM
$h_0=$			-2.75	-2	-2.4	-2.8
CA1.1	40	24 (60%)	16	15	16	37
CA1.2	36	23 (64%)	16	13	14	15
CA1.3	34	15 (44%)	-	26	27	28
CA1.4	62	35 (56%)	56	21	24	25
CA1.5	63	29 (46%)	-	20	56	57
CA1.6	41	14 (34%)	-	13	-	-
CA1.7	49	19 (46%)	-	-	-	-
CA1.8	38	18 (47%)	16	13	14	15
CA1.9	60	30 (50%)	-	31	34	35
CA1.11	20	7 (35%)	-	-	-	-
CA1.12	62	32 (51%)	-	31	56	57
CA1.13	40	23 (58%)	36	14	15	20
CA1.14	42	26 (62%)	28	19	22	23
Median (IQR)	45 (38,60)	23 (51%)	28 (16,34)	20 (14,24)	28 (15,32)	31 (21,37)

S-139.

EFFECTS OF THE MEDICAL PAYMENT SYSTEM ON JAPANESE SURGEONS' PRODUCTIVITY:A PRELIMINARY REPORT

AUTHORS: Y. Nakata¹, T. Yoshimura², Y. Watanabe¹, H. Otake³

AFFILIATION: ¹Graduate School of Public Health, Teikyo University, Tokyo, Japan, ²Department of Anestheisa, Shin-yurigaoka General Hospital, Kawasaki, Japan, ³Department of Anestheisa, Showa University School of Medicine, Tokyo, Japan

INTRODUCTION: Surgeons' productivity has a great influence on operating room efficiency. Japan has maintained universal health insurance system for more than half a century. Most health care providers are reimbursed on a fee-for-service basis according to the fee schedule that set prices uniformly at the national level. This fee schedule is revised every two years at the Central Social Insurance Medical Council. Malmquist index (MI) represents productivity change of a decision making unit (DMU) between two time periods. The goal of this study is to compute surgeons' productivity before and after the revision of medical payment system, and to evaluate the impact of the revision on their productivity change.

METHODS: We focused on the revision of medical payment system that was implemented on April 1, 2014. We collected data of all the surgical procedures performed from April 1 through June 30, 2013 (period 1) which was before the revision, and those performed from April 1 through June 30, 2014 (period 2) which was after the revision.

We employed Malmquist model under the constant returns-to-scale assumptions. We defined the DMU as a surgeon with the highest academic rank in the surgery. Inputs were defined as (1) the number of medical doctors who assisted surgery, and (2) the time of surgical operation from skin incision to skin closure. The output was defined as the surgical fee for each surgery.

We added all the inputs and outputs of the surgical procedures for each DMU during these study periods, and computed his/her MI, catch-up effect (CU) and frontier-shift effect (FS). The natural logarithms of the MI, CU and FS allow us to interpret these results as percent changes. The natural logarithm of MI > 0 indicates progress in total factor productivity of the DMU from period 1 to 2, while that of MI = 0 and MI < 0 respectively indicate the status quo and deterioration in the productivity. Similarly, a natural logarithm for the CU and the FS measure of greater than 0 implies that there is efficiency progress and frontier technology progress, respectively.

Statistical analysis was conducted on the natural logarithms of these values using student t-test. A p-value < 0.05 was considered statistically significant.

RESULTS: We analyzed 2,549 surgical procedures performed by 93 surgeons during the two study periods.

The percent change of MI was not significantly different from 0 (p = 0.58), which demonstrated that the total factor productivity did not change significantly from period 1 to period 2. However, the percent change of CU was significantly greater than 0 (p = 0.03), which demonstrated the surgeons significantly improved efficiency in period 2. The percent change of FS was significantly smaller than 0 (p < 0.0001), which indicated regress in the frontier technology from period 1 to 2 (Table). This regress is considered to be due to a reduction of surgical fees.

CONCLUSIONS: Surgeons' productivity did not significantly change before and after the revision of medical payment system. This is because surgeons performed surgery more efficiently to compensate for the reduced reimbursement.

Values are expressed as mean ± SD.*The value is significantly different from 0 (p < 0.05).

	Percent change from 2013 to 2014
Productivity	+ 2.9 ± 49.7 %
Catch-up effect	+ 12.4 ± 52.8 % *
Frontier-shift effect	- 9.6 ± 9.1 % *

S-140.

LARYNGOSCOPY SKILL TRANSFER AFTER MANIKIN PRACTICE WITH VARYING ANATOMY AND DIFFICULTY

AUTHORS: S. Seshadri¹, N. Delson², S. Kedarisetty³, R. H. Hastings⁴

AFFILIATION: ¹Anesthesiology, UC San Diego, La Jolla, CA, ²Mechanical & Aerospace Engineering, UC San Diego, La Jolla, CA, ³School of Medicine, UC San Diego, La Jolla, CA, ⁴Anesthesiology, VA San Diego Healthcare System, San Diego, CA

INTRODUCTION: Practicing direct laryngoscopy on airway models allows trainees to gain experience without putting patients at risk, but the acquired skills may not transfer well because most manikins do not model human variability. This study investigated whether skill transfer would be improved by training on adjustable models that could simulate the range of airway anatomies and laryngoscopy difficulty found in patients.

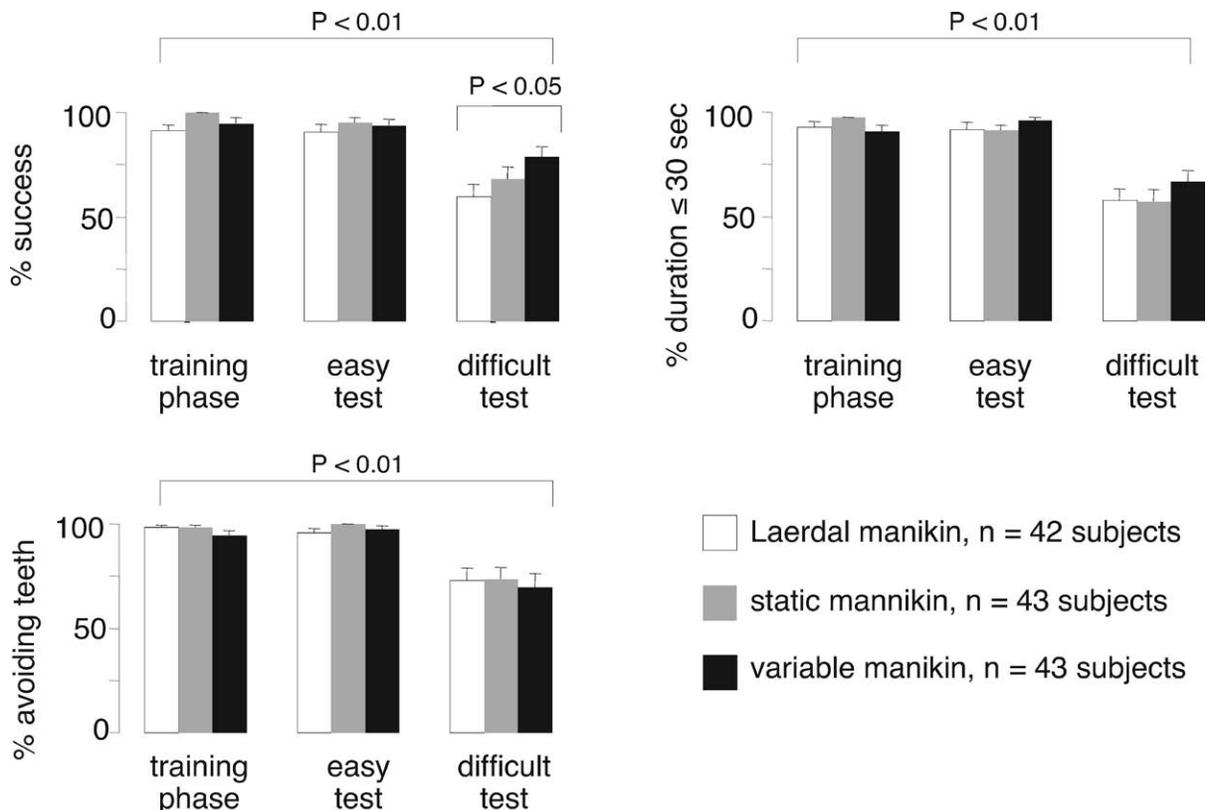
METHODS: Subjects were 129 paramedic and medical students with minimal airway experience who gave informed consent. They were divided randomly among three educational interventions with 12 training trials on either 1) a commercial airway model with one configuration, 2) an adjustable model held static in a single configuration or 3) the adjustable model varied through the standard configuration and three more difficult airway anatomies. Skill transfer was assessed with 3 test laryngoscopies each on two unfamiliar models, a Medical Plastics model that poses significant laryngoscopy difficulty and an easy configuration of the adjustable manikin. A trained observer assessed each procedure for intubation success, duration ≤ 30 sec and laryngoscope blade contact with teeth. Performance was compared for the training phase vs. the two subsequent tests and among the training groups by ANOVA

RESULTS: On the last 3 trials of the training phase, the average rate for intubation success, duration ≤ 30 sec, and no teeth contact was > 90% across subjects in each group (Figure). Performance on the easy test manikin compared favorably with the testing phase. In contrast, the 3 outcome measures deteriorated on the difficult test manikin regardless of group (P < 0.01). Even so, subjects trained with multiple configurations of the adjustable model averaged 80% intubation success on the difficult test manikin, significantly greater than the 60-70% rate for the other groups (P < 0.05).

CONCLUSIONS: Better intubation success on the difficult test manikin indicates that the practice protocol with the adjustable model provided better skill transfer than did the protocols with non-adjusting models. In published work, laryngoscopy skill transfer on airway models has been about 70%^{1,2}, so the result here may represent a small improvement. The previous papers proposed that practicing on more difficult models improves skill transfer. Taken with the current data, the findings suggest that training formats could be designed around airway models with multiple airway anatomy adjustments and increasing procedural difficulty to enable students to transfer laryngoscopy skills to patients. Such a program would reduce the need for practice on live humans.

REFERENCES:

1. Anesth Analg 93:656, 2001;
2. Anesth Analg 113:862, 2011



S-141.

COMPLIANCE WITH SURGICAL CARE IMPROVEMENT PROJECT-INFECTIO-10 AND ITS IMPACT ON THE INCIDENCE OF SURGICAL SITE INFECTION

AUTHORS: M. J. Brown, T. B. Curry, D. J. Kor

AFFILIATION: Department of Anesthesiology, Mayo Clinic, Rochester, MN

INTRODUCTION: Perioperative hypothermia has been identified as a risk factor for Surgical Site Infection (SSI), and its prevention was implemented as a key metric included in the Joint Commission’s Surgical Care Improvement Project (SCIP) in 2009. However, little data existed to support this metric.

METHODS: After IRB approval, patients who underwent surgical intervention in one of five surgical specialties (orthopedic, general, spine, vascular, neurologic) with Type 1 surgical wounds during the time period of January 2003-December 2012 were identified in the Mayo Clinic Division of Infectious Disease SSI database. A total of 1934 patients who were diagnosed with SSI and 5512 age, sex, ASA status, date of surgery and procedure code matched controls were included in analysis. Compliance in composite and individual components of SCIP-Inf-10 was determined in the two cohorts. Components of SCIP-Inf-10 include: (1) Temperature \geq 36

$^{\circ}$ C measured 30 min before or 15 min after the documentation of “Anesthesia End” in the perioperative record and (2) The use of forced-air warming device documented in the perioperative record. Additionally, non-complaint end-of-case temperature was stratified into 5 categories ($< 35^{\circ}$ C, 35.0-35.2 $^{\circ}$ C, 35.2-35.5 $^{\circ}$ C, 35.5-35.7 $^{\circ}$ C, and 35.7-35.9 $^{\circ}$ C) to determine if there is an association between hypothermia and SSI.

RESULTS: Compliance with the SCIP-Inf-10 clinical process of care measure significantly improved after its implementation as a quality metric (98.6 vs. 92.9%, $P < 0.01$). However, in both univariate and multivariate analyses, compliance with composite and individual components of SCIP-Inf-10 was not associated with the avoidance of SSI (Table 3 and 4). Additionally, end of surgical case temperature below 36 $^{\circ}$ C, measured in five distinct categories, was not associated with SSI ($p = 0.39$).

CONCLUSIONS: Although compliance with the SCIP-Inf-10 clinical process of care measure increased significantly after its implementation in 2009, achieving SCIP-10 compliance was not associated with SSI prevention. This suggests that neither end-of-procedure temperature nor the use of a forced-air warming device should be used as a reportable quality metric in the quest to reduce SSIs.

Table 1. Univariate analysis of SCIP-Inf-10 Performance Metrics and the Incidence of SSI

	SSI (n=1934)	Control (n=5512)	p value
SCIP temperature compliance	1431 (74.0)	4106 (74.5)	0.67
Forced-air warming device documented	1682 (87.0)	4747 (86.1)	0.35
Temperature compliance or forced air			
Warming device documented	1836 (94.9)	5228 (94.9)	0.88

Temperature compliance requires a temperature of $\geq 36^{\circ}$ C is recorded within 30 min before or 15 min after documentation of “anesthesia end” in the perioperative record. Data are shown as number (%).

Table 2. Multivariate Analysis of SCIP-Inf-10 Performance Metrics and SSI

	Odds Ratio	95% CI	p value
Composite SCIP-10 compliance	1.01	0.77-1.31	0.99
Temperature compliant	1.02	0.90-1.16	0.75
Forced-air warming device documented	1.02	0.87-1.22	0.74

Adjusted for surgical duration, body mass index (BMI), diabetes, peripheral vascular disease, cerebrovascular disease, cirrhotic liver disease, and plasma transfusion required

S-142.**ARTERIAL CATHETERIZATION: BLIND PALPATION VS
ULTRASOUND GUIDED TECHNIQUE. ON-GOING STUDY****AUTHORS:** J. Lee¹, Y. Yeap²**AFFILIATION:** ¹Dept. of Anesthesiology, Indiana University of School of Medicine, Indianapolis, IN, ²Dep. of Anesthesiology, Indiana University School of Medicine, Indianapolis, IN**INTRODUCTION:** Arterial catheterization has become commonplace in OR to provide convenient and reliable access for frequent blood gas analysis, blood sampling, and real-time hemodynamic monitoring for critically ill patients and major surgeries. Several randomized controlled trials and meta-analyses have shown that use of ultrasound reduces complication and increases first-attempt success rate when compared with blind palpation technique. We hypothesized that ultrasound guidance for artery catheterization will improve placement time for arterial line in the OR.**METHODS:** Following IRB approval, consented adult patients undergoing routine surgery were randomized to the conventional blind palpation or ultrasound guidance technique for artery catheterization. In this study we compared time required for placement of arterial line placement, number of sites, number of catheters used, and number of operators required to insert the arterial line. All catheterizations in both groups is performed by trained anesthesiology residents (CA-2 and CA-3 residents or staff anesthesiologist) who have similar level of experience in radial arterial catheterization with palpation technique and with US guided technique. In both groups, arterial catheterizations were performed after induction of general anesthesia. Start time was defined as the time when the ultrasound machine is turned on before gel is placed on the transducer. In the palpation technique, start time of the procedure is defined as the time when the operator's finger will be placed on the wrist to palpate the radial pulse. End time is recorded after successful arterial cannulation with appropriate pulsatile blood flow return.**RESULTS:** A total of 73 subjects, 42 blind palpation group and 31 ultrasound group are currently enrolled for the study. Total time taken for successful arterial catheterization for blind palpation group vs ultrasound guidance group were 219 seconds and 187 seconds, respectively (p value 0.63). Total number of the attempts, number of sites used, number of the catheter used and total number of operators were consistently higher in blind technique (See Table 2). Ultrasound rescue was required in 4 out of 42 patients in the blind palpation group. In contrast, only 1 out of 31 patient cross over to the palpation technique in ultrasound technique group.**CONCLUSIONS:** Despite the frequency of arterial catheterization done in the OR, blind palpation technique continues to be a clinical challenge even for the most experienced anesthesiologist. At this time, time for successful arterial line placement for both blind and ultrasound guidance technique are similar. However, ultrasound technique added benefit in using less sites and number of catheters used. This could be a potential deduction in complications and costs. Nevertheless, this is still on-going investigation. Our sample size of the study needed to complete the study is at least 210 patients in each group.**REFERENCES:**

1. Crit Care Med .2003; 31 (2): 481 - 484.
2. Acad Emerg Med. 2006; 13 (12): 1275 - 1279.

Table 1: Patient Demographics

	Blind palpation (n=42)	Ultrasound guided (n=31)
Age (yrs)	53.5	54.5
Weight (Kg)	92.1	83.6
Height (cm)	170.8	170.1
ASA class	2.95	3
Baseline SBP (mmHg)	133.7	120.0
Baseline HR (beats/min)	90.8	84.3

Table 2: Time take for Arterial line catheterization

	Blind palpation (n=42)	Ultrasound guided (n=31)	p-value
Time to success, mean (sec)	219	187	0.63
Number of attempts, mean	2.29	1.62	
Number of sites, mean	1.23	1.03	
Number of catheter used, mean	1.74	1.17	
Number of operators, mean	1.14	1.06	
Number of cross over to other technique	4	1	

S-143.

AUTOMATED ONGOING PROFESSIONAL PERFORMANCE EVALUATION (OPPE) AS PART OF A 360° ASSESSMENT OF THE ACGME CORE COMPETENCIES FOR ANESTHESIOLOGY RESIDENTS

AUTHORS: L. Ring, J. D’Armiento

AFFILIATION: ¹Anesthesiology, Vanderbilt University School of Medicine, Nashville, TN, ²Vanderbilt University, Nashville, TN, ³Anesthesiology, Vanderbilt University, Nashville, TN

INTRODUCTION: The ACGME Core Program Requirements state that training programs must provide objective assessments of competence and use multiple evaluators of resident performance, including peer-to-peer evaluation. Manual collection of this data currently involves a significant amount of time and administrative effort, as well as a reported fear of lack of anonymity on the part of the residents. As such, an automated, anonymous Ongoing Professional Practice Evaluation (OPPE) that incorporates the ACGME core competencies and fulfills this requirement would be a programmatic improvement.

METHODS: With IRB exemption, we sent a voluntary survey to residents in our training program concerning their attitudes surrounding peer-to-peer evaluation. They also completed a self-evaluation with the same questions that are asked on the OPPE when they evaluate peers. We then created an automated system that assigns peer-to-peer evaluations and collects and collates the data (See Figure 1) within the existing electronic medical record workflow. See Table 1 for the evaluation assignments generated logic.

RESULTS: Seventy-six percent (46/60) of residents responded to the pre-implementation survey and 75% (45/60) completed the self-evaluation, the results of which are shown in Table 2 and Table 3, respectively. Residents rated themselves most commonly as ‘good’ on all OPPE questions except for professionalism and communication, where the most common rating was ‘excellent’ (see Figure 2). One thousand one hundred and thirty-five evaluations were generated and 518 were completed (46% completion rate) over the six month period after implementation, for an average of 11.5 OPPEs per resident.

CONCLUSIONS: We created an automated, anonymous system for gathering peer-to-peer evaluation that requires no administrative time for evaluation generation or data entry. Furthermore, the system has generated a substantial number of evaluations that were previously difficult to collect and a corpus of data helpful in resident evaluation. The implications for this type of peer-to-peer evaluation system are significant because every ACGME accredited residency program is required to have multiple evaluators that assess resident’s growth and performance within the 6 core competencies area. Furthermore, as the time to complete resident assessments in the Milestones era will be substantial, automated approaches to data collection and reporting will be of great value to the Clinical Competency Committee and Program Director. Future studies will compare resident OPPE to faculty evaluations of residents as well as that of nurses, other care staff, and patients.

Table 1

The hospital wide enterprise data warehouse, which includes data from the electronic medical record and resident scheduling programs, assigns evaluations based on the logic below:

- Create a listing of all resident-to-resident pairings based on current active residents.
- Calculate the number of patient care handoffs that each pair has had over the past 9 months. A handoff is defined as the evaluator’s StopTime is the same as the evaluatee’s StartTime in an anesthetic care record.
- Pairings for each evaluator are ranked by the number of handoffs they have had (highest to lowest) and then alphabetically by evaluatee (alternating A-Z and Z-A every other month).
- The top 5 pairings are selected for each evaluator with the following exclusions:
 - The same person cannot be evaluated twice by the same evaluator within a 3-month period
 - A single person cannot be evaluated by more than 5 people in any given month.

Figure 1: Screenshot of OPPE Form Completed by Residents for Peer to Peer Evaluation

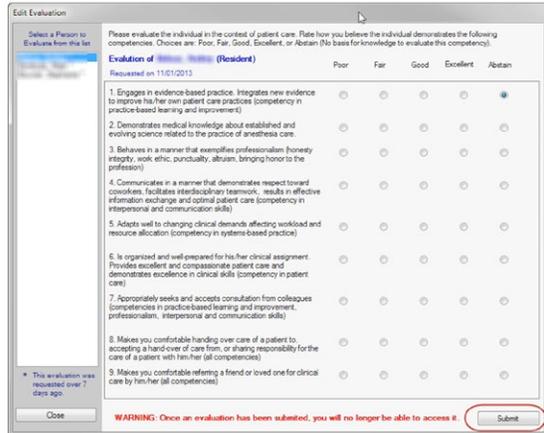
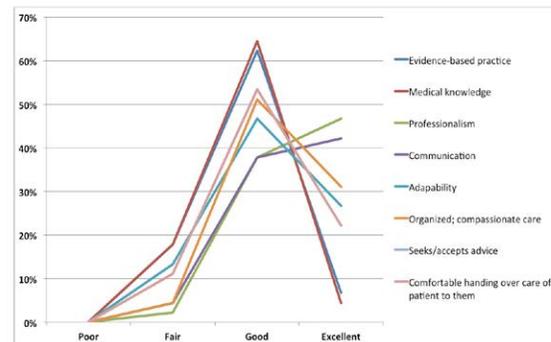


Figure 2: Percentage of Resident Responses by Category for the Pre-Implementation OPPE Self-Evaluation (N=45)



S-143 • continued

Table 2

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am satisfied with the amount of feedback I receive from my peers about my performance.	1	15	16	8	1
I receive timely feedback from my peers about my performance	2	21	9	9	0
I would like to be anonymously evaluated by my peers about my performance.	2	11	10	16	2
I would like to anonymously evaluate my peers concerning their performance.	1	13	9	15	2
I regularly reflect on my own performance in order to set goals for professional growth.	0	0	1	23	17
I think that reflecting on my performance is useful in setting professional goals.	0	0	1	23	17
I think that performing a self-evaluation of my performance is useful.	1	4	2	23	11
I would like to receive summary feedback from peer evaluations about my performance compared to peer evaluations of my residency class and to the residency as a whole.	4	3	10	16	8
I would like to receive summary feedback about my performance showing a comparison of evaluations from my peers and faculty.	4	3	9	18	7
I think that an anonymous peer evaluation system will provide more honest feedback as compared to evaluations where the evaluator is identified.	1	2	5	20	13

Table 3 Self-Evaluation

	Poor	Fair	Good	Very Good	Abstain
Engages in evidence based practice. Integrates new evidence to improve patient care practice	0	8	28	3	1
Demonstrates medical knowledge about established and evolving science related to the practice of anesthesia care.	0	8	29	2	1
Behaves in a manner that exemplifies professionalism (honesty, integrity, work ethic, punctuality, altruism, bringing honor to the profession	0	1	17	21	1
Communicates in a manner that demonstrates respect toward coworkers, facilitates interdisciplinary teamwork, results in effective information exchange and optimal patient care	0	2	17	19	1
Adapts well to changing clinical demands affecting workload and resource allocation	0	6	21	12	1
Organized and well-prepared for clinical assignment. Provides excellent and compassionate patient care and demonstrates excellence in clinical skills	0	2	23	14	1
Appropriately seeks and accepts consultation from colleagues.	0	5	24	10	1
Comfortable handing over care of patient, accepting a hand over of care from, or sharing responsibility for the care of a patient	0	5	24	10	1

S-144.

USE AND EFFECT OF QUANTITATIVE FEEDBACK FOR LEARNING AND QUALITY IMPROVEMENT IN ANESTHESIOLOGY AT TWO ACADEMIC INSTITUTIONS: A COMPARATIVE CASE STUDY

AUTHORS: A. Brovender¹, C. Mc Donnell², G. Baker³

AFFILIATION: ¹Anesthesiology, Vancouver Coastal Health, Vancouver, BC, Canada, ²Anesthesiology, The Hospital for Sick Children, Toronto, ON, Canada, ³Institute for Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada.

INTRODUCTION: Providing quantitative performance feedback to individuals and clinical groups is one strategy to reduce morbidity and mortality within medicine¹ and has been shown to be effective in promoting practice change². Both system design and context may affect effectiveness and usability of quantitative feedback. Contextual features that may affect usability include organizational culture, leadership, communication, and availability of resources. Anesthesiology groups wishing to adopt or institute quantitative feedback programs are hampered by a lack of published accounts for such systems. Through case studies, the following questions were explored: How is quantitative feedback being used to support learning and quality improvement? What design features have been found to be helpful in this regard? How is quantitative performance feedback perceived by providers? What contextual features support or hinder efforts in response to quantitative feedback?

METHODS: Two institutions that provided anesthesiologists with quantitative performance feedback were identified through review of the literature, and word of mouth. Case studies were conducted that consisted of detailed descriptions of the setting, system for collecting and communicating feedback, examples of performance reports and semi-structured interviews with department chiefs,

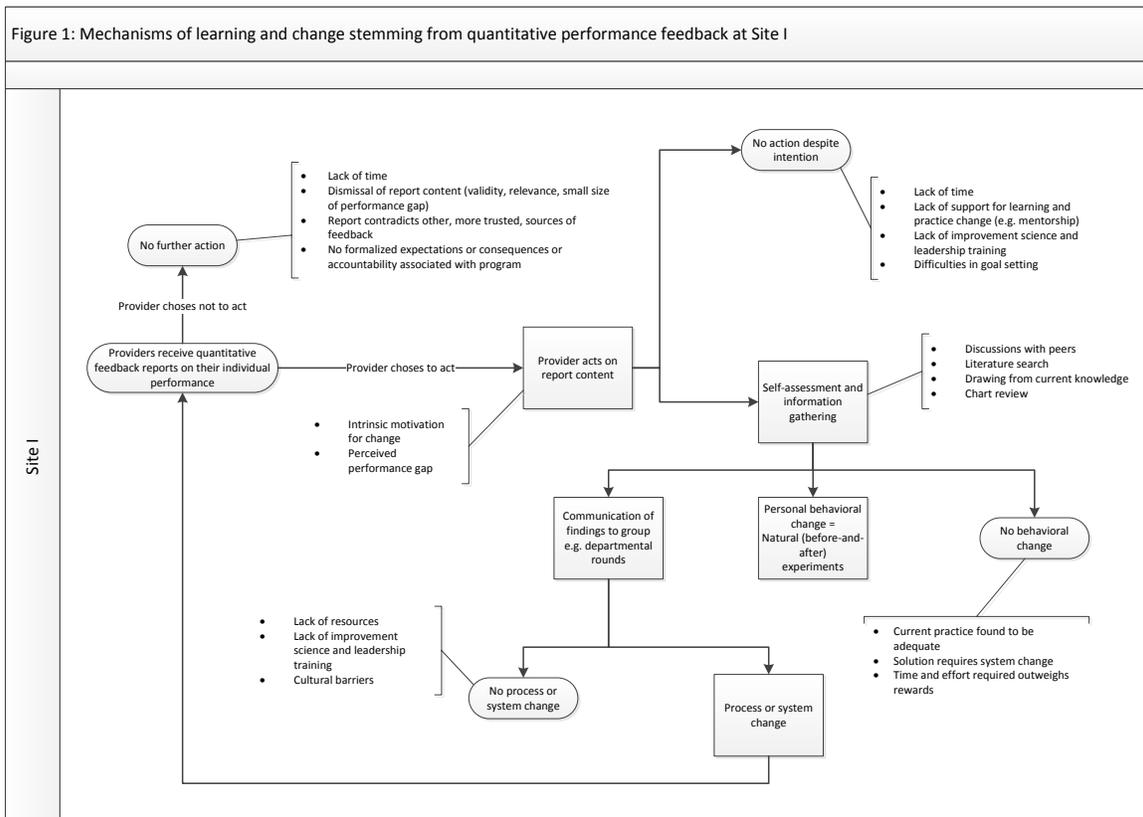
quality leaders and front line workers. Interview transcripts were analyzed using a general inductive approach through coding, then categorization and thematic development.

RESULTS: The characteristics of each site and their feedback program are presented in table 1. The contribution of contextual and design elements to program use was complex (table 2). Providers at both sites had high acceptance of metrics that were salient, representative, actionable, and with transparent collection methodology. Training and orientation to quality science helped providers interpret performance reports. Providers from site I described uncertainty in report interpretation, a lack of timely reports hampering experimentation, and a lack of time and mentorship. Providers from site II were supportive of the program but struggled to comply with quality initiatives and processes when multiple projects caused provider distraction, and, when a loss of appreciation for individual contributions and skills was perceived. Schematics of learning and improvement mechanisms at each site are provided in figures 1 and 2.

CONCLUSIONS: The use of quantitative performance feedback on learning and quality improvement in anesthesiology is a complex process that is influenced by both feedback design and contextual factors. Careful consideration of these factors, in conjunction with an understanding of the theoretical underpinnings of quality improvement science, individual learning, and group learning, during program design will be paramount in maximizing the power of this promising tool.

REFERENCES:

1. Anes Analg 2011; 112:958
2. Cochrane Database Syst Rev. 2012;CD000259



S-144 • CONTINUED ON NEXT PAGE

S-144 • continued

Table 1: Site and program characteristics

Characteristic	Site I	Site II
Health institution type	Private, not-for-profit, academic center.	Private, not-for-profit, academic center.
Location	Canada, city of < 1 million	United States, city of > 2 million
Referral base	Provincial	Global
Case volume and mix represented by the data	~24 000 surgical cases per year 40% ambulatory	~35 000 surgical cases per year 75% ambulatory
Anesthesiologist remuneration	Fee for service	Salary plus variable compensation
Anesthesiologist group size and provider type	30 physicians	50 physicians 40 CRNAs
Data abstraction	Health records analysts from the department of medical records	Trained human data abstractors from the research and quality divisions of the department
Level of measurement	Individuals	Group
Measurement Items	Six quality indicators that describe patient condition in PACU	Quality dashboard modeled on a balanced scorecard Data pertaining to QI projects and safety initiatives
Data reporting frequency	Quarterly (intended) Reports delayed, sometimes cancelled	Weekly and monthly for data related to QI projects and initiatives Quarterly for quality dashboard
Report design	Visual scatterplot: Provider scores indexed to the mean for each indicator No longitudinal information	Run charts and control charts showing longitudinal variation compared to benchmarks or goals
Actions arising from data	Individual reflection and action No expectations for use from departmental or institutional leadership	Group goal setting Group brainstorming of key drivers Formal quality improvement projects aimed at improving particular measures Reporting to hospital executive team and board of trustees Reporting to insurers/ payers Reporting to the public via institution's website

S-144 • continued

Table 2: Design and Contextual factors affecting usability

Dimension	Site I	Site II
Motivation for practice change	Intrinsic: competitiveness, conformity, beneficence	Intrinsic: competitiveness, professionalism, beneficence Extrinsic: variable compensation, career advancement
Communication of quantitative performance feedback	Passive Hard copy report placed in departmental mailbox. No discussion during meetings or appraisals	Passive and active Reports published on website and departmental newsletter Results presented at meetings
Department member orientation to program	None	New members oriented by department and quality chairs and receive basic training in QI methodology
Leadership	Passive and intradepartmental	Active and multilevel
Accountability	Department must demonstrate some QA/QI activity to hospital administration and regional health authority but this does not need to include quantitative performance information	Department expected to collect metrics and engage in downstream action by the board of directors and executive team
Performance measure choice	Metrics on individual performance Outcome measures Limited input from providers No goals or benchmarks	Metrics on group performance Process and outcome measures Input from providers encouraged, metrics undergo testing and pilot phase prior to use Group consensus goal-setting Comparisons to baseline and published benchmarks
Group norms and culture	Individualism Anesthesia providers all autonomous Immature safety culture	Team-based care emphasized Anesthesia providers of different levels of autonomy and responsibility Robust safety and learning culture
Barriers	Culture of individuality Passive leadership Poor availability of resources Low quality improvement capacity Provider resistance to change Stakeholder alignment Distrust of other clinical departments and institution's management	Provider resistance to change Limited availability of resources Improvement project and data fatigue Duplication with other departments and services Stakeholder alignment Multiyear timelines of change

S-145.

WITHDRAWN.

S-146.

ONGOING PROFESSIONAL PRACTICE EVALUATION(OPPE) METRICS IMPROVE COMPLIANCE WITH INTRAOPERATIVE HANDOFF PROCEDURES

AUTHORS:J. Tan¹, J. R. Ruiz¹, J. Roquemore², C. Stevens², T. Rahlfs¹

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, MD Anderson Cancer Center, Houston, TX, ²Office of Performance Improvement/Clinical Operations Informatics, MD Anderson Cancer Center, Houston, TX

INTRODUCTION: In 2006, The Joint Commission’s National Patient Safety Report stipulated that institutions must implement standardized handoff reports when transferring care of patients between health care providers.¹ Intraoperative handoffs between anesthesia providers have been gaining attention² and recent literature suggests that the frequency of intraoperative handoffs is associated with increased patient morbidity and mortality.³

The use of Ongoing Professional Practice Evaluation (OPPE) metrics for the evaluation of medical staff and performance improvement has already been described.⁴ We now present how OPPE has the potential to influence patient safety by improving anesthesia providers’ compliance to an intraoperative handoff protocol.

METHODS: A faculty task force developed an intraoperative handoff protocol which was implemented in September 2013 into PICIS®, the department’s anesthesia information management system (AIMS). Evidence to having completed the protocol was measured by attesting to six items (Fig. 1), agreed by the task force to represent essential components of a proper intraoperative handoff. Under IRB approval, compliance to this attestation was measured at monthly intervals by extracting the metrics from the PICIS® database. Data were gathered from 70 physician anesthesiologists over a one year period. Personal and overall faculty performance was shared with individual faculty at quarterly intervals (Fig 2).

RESULTS:Figure 3 represents the p-chart generated by Statit PPRTM. Average faculty compliance to the protocol, as measured by OPPE metrics, began at 53.25% after the first month of implementation and steadily increased to 87.39% in the most recent month. The overall average compliance for the entire period was 74.9%.

CONCLUSIONS: As seen with efforts to implement changes to clinical practice in other domains,⁵ compliance to this protocol documentation was initially low, possibly due to unfamiliarity with the requirement and/or resistance to change. However, as this data was made transparent through feedback sessions with providers, compliance increased and currently rests at 87%. Further analysis of data indicated that a small number of non-compliant participants (outliers) were able to bias the results and therefore this percentage may represent an underestimation of the faculty’s participation in the protocol as a whole.

We recognize that documentation of completion of the handoff protocol does not guarantee that a proper handoff occurred. However, faculty were required to address all six critical parameters with free text entry which may provide sufficient incentive and prompting to follow the complete handoff procedure.

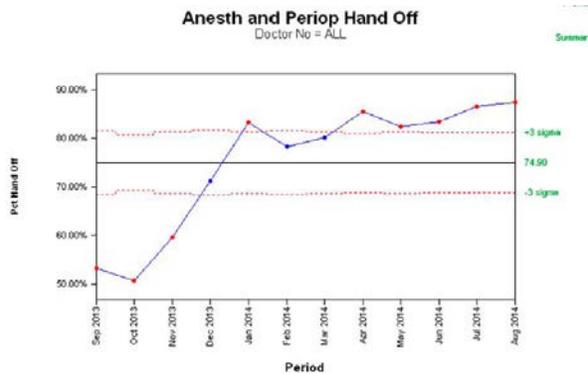
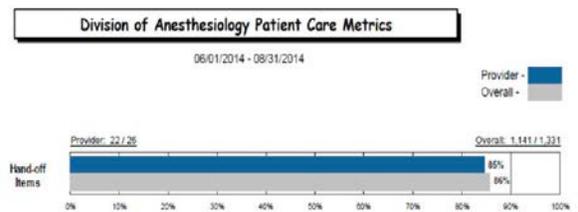
In summary, we have presented an example of how OPPE metrics are able to encourage adherence to an intraoperative handoff protocol. Proper handoffs have the potential to improve patient outcomes.

REFERENCES

1. Joint Commission Resources; 2007
2. International Anesthesiology Clinics. 2013. V.51: 31-42
3. Anesthesiology. 2014 Oct;121(4):695-706
4. Anesthesia & Analgesia. 2006. V.111:515-9
5. Medical Care. 2001. 39(8): 46-54

**Perioperative Anesthesia Hand-Off
Picis AER**

- Hand-Off at the Bedside
- Patient Identified
- Medical Records Reviewed-Clinic Station Open:
- Intraoperative Anesthesia Hand-off Worksheet
- Postop Plan-Disposition
- OR Team Notified of Provider Change



S-147.**GRACE UNDER FIRE: IDENTIFYING PREDICTORS OF SUCCESS IN SIMULATION-BASED EDUCATION****AUTHORS:** S. T. Samuelson, A. Goldberg, S. DeMaria**AFFILIATION:** Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY

INTRODUCTION: With increased utilization of high-fidelity human patient simulation for education and assessment in anesthesiology, it has become apparent that some people engage readily with the simulated environment, while others stubbornly resist. To facilitate learning in this medium, it may be possible to identify characteristics predisposing participants to such behavior. “Mindfulness”, a concept borrowed from the psychology literature, is generally defined as focusing one’s attention in a nonjudgmental manner or accepting the experience occurring in the present moment.¹ Furthermore, willingness to engage in simulation, i.e. suspend one’s disbelief, may confer a more emotionally charged experience and even an enhanced ability to learn from a simulated scenario. In this study we examine whether a measure of Mindfulness can predict emotional impact and improved performance.

METHODS: After IRB approval, PGY-2 Anesthesiology residents were recruited to participate in a 12-week simulation-based didactic curriculum. Prior to beginning, each resident completed the Kentucky Inventory of Mindfulness Scale (KIMS), in which a higher scale indicates increased mindfulness.¹ Residents participated in one or two structured operating room scenarios each week. After 8 weeks, resident performances on four remaining scenarios were objectively rated by blinded attending anesthesiologists using the Anesthesia Non-Technical Skills (ANTS) scale (this validated scale assesses task management, teamworking, situation awareness, and decision making).² At the end of the curriculum, each participant completed an Impact of Events Scale (IES, a measure of psychological response to a stressor in which a higher score indicates higher impact)³ and were asked 1) how helpful and 2) how traumatic they had found the curriculum (1-5, with 5 being highest). Multivariable analysis was carried out to analyze the effect of KIMS score on IES, self report of trauma/helpfulness, and objective performance.

RESULTS: 26 Anesthesiology residents were recruited, all of whom completed the entire 12-week simulation-based curriculum. Higher KIMS score was significantly associated with higher IES score ($p=0.005$) and with greater subjective report of trauma ($p=0.002$). On objective assessment of performance, higher ANTS score was associated with greater self-report of trauma ($p<0.0169$) and of helpfulness ($p<0.0246$).

CONCLUSIONS: In this study, greater mindfulness was associated with increased post-curriculum emotional impact, subjective report of helpfulness/trauma, and enhanced performance in simulated scenarios. As all of these are suggestive of “engaged” participants, it may be that a measure of mindfulness can be employed in the future to help identify those who would benefit most from simulation-based learning.

REFERENCES:

1. Baer, R. A., et al. (2004). The Kentucky inventory of mindfulness skills. *Assessment* 11 (3): 191-206.
2. Fletcher G, et al. (2003). Anaesthetists’ non-technical skills (ANTS). *Br J Anaesth* 90:580-8
3. Horowitz M et al. Impact of Event Scale: a measure of subjective stress. *Psychosom Med.* 1979 May;41(3):209-18.

S-148.

TEN YEARS OF EXPERIENCE OF SYSTEM-BASED PRACTICE PROJECT FOR ANESTHESIOLOGY RESIDENTS

AUTHORS: T. Sakai, T. D. Emerick, R. M. Patel

AFFILIATION: Department of Anesthesiology, University of Pittsburgh School of Medicine, Pittsburgh, PA.

INTRODUCTION: The Accreditation Council for Graduate Medical Education has emphasized in its core competencies and more recently, in its Milestones Project, that residents understand the importance of systems-based practice (SBP). In principle, SBP refers to the use of available resources to manage patients with the highest standards of safety in a cost-effective and efficient manner. All residency programs in the United States have developed specific interventions and curricula to teach SBP and have attempted to evaluate residents in this competency domain. To date, however, no long-term analysis of SBP projects within a residency program has been performed. The purpose of the study is to review a ten-year experience of an anesthesiology residency program where senior residents have completed a mandatory SBP project.

METHODS: Under IRB approval, graduated residents' SBP projects for the last 10 years (2004 - 2013) were reviewed. This SBP project was taken place during the final year of the anesthesiology residency (PGY-4) from September to May. Residents were introduced to the projects in September with benchmarks set such as project identification, data collection, and proposal draft. The draft was reviewed by the program director and completed as the

written proposal. The written proposal was reviewed, evaluated, and graded by two members of the department executive steering committee in March. The SBP projects concluded in May with oral presentations by each resident to the department executive steering committee, who evaluated oral presentation. Each project received scores for clinical significance, proper identification of contributing factors, proposed solution, and presentation technique using a Likert scale (1-9, where 9 is the best). For the analyses, the projects were categorized into seven areas: safety initiatives, economic analysis, process analysis, policy change recommendations, education initiatives, teamwork/communication, and operating room efficiency. Evaluation scores were analyzed. The rate of implementation of project ideas within the department based on the presentations to the executive committee was examined.

RESULTS: A total of 149 projects were completed. Among the seven areas, policy change recommendations was the most frequently chosen category (46 projects, 30.9%), followed by process analysis (36 projects, 24.2%). The overall evaluation score was 7.6 ± 0.6 (mean \pm SD) (Table 1). Among 111 projects presented in 2004-2011, 45 projects (40.5%) were implemented in the department. These projects with implementation received higher evaluation scores in clinical significance (7.9 ± 0.6 vs. 7.6 ± 0.6 ; $p = 0.029$) compared to the projects that were not implemented.

CONCLUSIONS: This SBP project method has given residents the opportunity to participate in improving the efficiency and safety of a hospital system.

Table 1 Representative Systems-Based Practice Projects with Top Scores per Category Presented for the Last 10 Years

CATEGORY	TITLE	SCORE (Overall)
Policy change recommendations	Early Preoperative Type and Screen Analysis of Patients at High Risk for Red Blood Cell Alloimmunization	8.5
	Emergent Airway Management During Codes	8.5
	Proposed Initiative to Reduce Intraoperative Wastage of Blood Products	8.5
Process analysis	An Indirect Laryngoscope: A Cost Effective Adjunct for Difficult Airway Management in Off-Site Locations	8.4
	Preventing Diversion from Automated Drug Dispensing Machines	8.4
	Difficult Intubation: What's the Story?	8.3
Safety initiatives	Painful for the Patient and Anesthesia Provider	8.3
	How Should We Screen for Pregnancy in Our Patients?	8.2
	Improving Safety of Off-Site Procedures on the Weekend	8.2
Teamwork/Communication	Anesthesia Members to Critical Care Medicine Communication	8.5
	Improvement in Communication with Blood Bank	8.3
	Can You Hear Me Now? A Discussion of Communication within an UPMC Affiliated Department of Anesthesiology and Suggestions for Improvement	8.2
Education initiatives	Standardizing Emergency Response Equipment for Anesthesiologists and Providing Training for Usage of All Equipment	8.3
	Increased Education of Radiation Exposure and Safety Procedures for Anesthesia Personnel in the Operating Room	8.0
	The Telephone Game	7.7
Operating room efficiency	Creating User Friendly Summary Cover Sheet	8.7
	ISMETT-UPMC Palermo Operating Room Efficiency	8.0
	Incomplete Cardiac Preoperative Evaluations Causing Cancellation and Delay on the Morning of Surgery	7.4
Economic analysis	The Effectiveness and Economics of the Use of Chlorhexidine-Impregnated Sponges in Central Venous Catheter Dressings	7.4

S-149.**THE INFLUENCE OF DEATH IN SIMULATION-BASED ANESTHESIOLOGY TRAINING: HOW MUCH IS TOO MUCH?****AUTHORS:** S. T. Samuelson, A. Goldberg, S. DeMaria**AFFILIATION:** Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY**INTRODUCTION:** While high-fidelity patient simulation has gained ever-increasing support as a tool for anesthesiology education and assessment,¹ few guidelines have been established to maximize its efficacy. In recent years there has been debate regarding the influence of “failure”, i.e. patient death, on learning and performance, and little data exists to support or oppose its inclusion in anesthesiology training. This study examined whether death of simulated patients could be correlated with objectively-assessed performance in a simulated curriculum.**METHODS:** After IRB approval, PGY-2 Anesthesiology residents from our institution were recruited to participate in a 12-week structured simulation-based didactic curriculum. Each week, residents were presented one or two operating room scenarios in which they had to manage a simulated patient. The residents were divided into three cohorts: 1) patient always dies, 2) patient never dies, and 3) patient dies approximately 50% of the time in an unpredictable fashion. After 8 weeks of the simulation-based curriculum had been completed, residents were then objectively scored on four remaining scenarios by blinded attending anesthesiologists using the validated Anesthesia Non-Technical Skills (ANTS) scale (this scale does not analyze patient outcome, but rather assesses task management, teamworking, situation awareness, and decision making).² Linear regression was carried out to analyze the effect of cohort assignment on objective performance in these selected scenarios.**RESULTS:** 26 Anesthesiology residents were recruited to complete the simulation-based curriculum, of which 9 were assigned to the “patient never dies” cohort, 9 to the “patient always dies” cohort, and 8 to the “patient dies unpredictably” cohort. All participants completed all scenarios. Assignment to the “patient never dies” cohort and the “patient dies unpredictably” cohort were both associated with higher ANTS scores ($p=0.0185$ and $p=0.0054$, respectively). Conversely, assignment to the “patient always dies” cohort was associated with poorer performance as measured by the ANTS ($p=0.0057$).**CONCLUSIONS:** In this study, residents who predictably experienced patient death in the simulated scenarios performed worse in non-technical skills assessments as measured by the ANTS. Residents who never experienced patient death, or who experienced patient death in an unpredictable fashion, did significantly better. While further investigation may clarify this association, it may be that expectation of failure predisposed participants to lackluster performance by undermining confidence or encouraging emotional detachment over time.**REFERENCES:**

1. Naik, Viren N. and Susan E. Brien. “Review article: Simulation: a means to address and improve patient safety.” *Can J Anesth* (2013; 60:2): 192-200.
2. Fletcher G, McGeorge P, Flin R, Glavin R, Maran N (2003) Anaesthetists’ non-technical skills (ANTS). Evaluation of a behavioural marker system. *Br J Anaesth* 90:580-8.

S-150.

VIEWS OF US ANESTHESIOLOGISTS ABOUT HEALTH CARE COSTS AND THE PERIOPERATIVE SURGICAL HOME

AUTHORS: D. R. Raphael, M. Cannesson, J. Rinehart, Z. Kain

AFFILIATION: Department of Anesthesiology and Perioperative Care, University of California, Irvine, Orange, CA

INTRODUCTION: The push to reduce health care costs while improving quality of care and patient experience in the United States (US) has become urgent. In 2013 Tiburt et. al. surveyed the views of US physicians about containing health care costs¹. Physicians expressed enthusiasm for strategies that focus on quality and continuity of care rather than financial reforms. The Perioperative Surgical Home (PSH) is a proposed model that calls for anesthesiologist led coordination of care from decision to operate until 30 days after discharge. Proof of concept has been established², but the question of widespread adoption remains. We used a survey based on the instrument developed by Tiburt et. al. to assess anesthesiologists' views about health care costs and the PSH model.

METHODS: Following IRB approval and instrument development by a taskforce of anesthesiologists, a cross-sectional survey was sent via email to 6,000 randomly chosen American Society of Anesthesiologists (ASA) members. A power analysis assuming a random uniform distribution of responses for each survey question showed that 750 respondents would result in an approximate precision for point estimates of ±3.2% with 99.7% confidence. We assumed a 12.5% response rate, indicating 6,000 surveys would need to be sent. Data was collected in March through May of 2014 using an online survey tool and non-practicing respondents were excluded. Respondents were asked about responsibility for cost reduction, enthusiasm for cost reduction strategies, understanding of the PSH model, and comfort with new practice roles.

RESULTS: A total of 883 anesthesiologists completed the survey (14.7%). Respondents expressed fair or good understanding of the PSH model (75%). They agreed that anesthesiologists should coordinate patient care from scheduling to hospital discharge (60%), and that coordination of pre-operative (81%) and post-operative (64%) care should become standard. Respondents expressed comfort managing preoperative (95%), intraoperative (100%) and postoperative (79%) care. Respondents agreed that coordination of postoperative care would improve outcomes (89%), reduce cost (82%), length of stay (81%) and readmission rate (73%) (Tables 1&2). Anesthesiologists were somewhat or not enthusiastic about Medicare payment cuts (99%), implementing bundled payments (95%), and eliminating fee for service (92%). Anesthesiologists attributed major responsibility for cost reduction to hospitals (57%) and insurance companies (54%) and felt professional societies (21%), trial lawyers (18%), and employers (17%) bare no responsibility for cost reduction.

CONCLUSIONS: US anesthesiologists' perceptions of responsibility for controlling costs and their enthusiasm for cost containment strategies closely reflect those of US physicians reported by Tibbert et. al.

There is broad understanding and support for the PSH model among US anesthesiologists. Notably there is strong agreement that anesthesiologist coordination of post-operative care will improve outcomes and reduce cost.

REFERENCES:

- 1JAMA 2013 Jul 24/31; 310:380.
- 2Anesth Analg. 2014 May;118(5):1081-9.
2. PLoS One, 2012 Sep 7, Poly I:C enhances susceptibility to secondary pulmonary infections by gram-positive bacteria.

Table 1. Characteristics of US Anesthesiologists Responding to Survey

Characteristic	Respondents (n=883)
Age	
<30	22 (2)
30-39	180 (20)
40-49	153 (17)
50-59	340 (39)
60-69	157 (18)
70 or older	31 (4)
Male sex	689 (78)
Region¹	
Midwest	279 (32)
South	246 (28)
Northeast	187 (21)
West	128 (15)
Other	36 (4)
Practice setting type¹	
Community Hospital	433 (49)
Free Standing Surgery Center	312 (36)
University Hospital	254 (29)
Community Hospital (Teaching)	210 (24)
Children's Hospital	91 (10)
Office Based Anesthesia	81 (9)
Other	31 (4)
Political self-characterization²	
Very conservative	113 (13)
Somewhat conservative	275 (31)
Independent / moderate	287 (33)
Somewhat liberal / progressive	157 (18)
Very liberal / progressive	49 (6)

¹ Numbers may not add to total because of missing data for some questions

² Number of responses > number of respondents due to multiple answers allowed

Table 2. Self-reported Responsibility and Enthusiasm for Various Means of Reducing Health Care Costs Among US Anesthesiologist Survey Respondents

	No. (%)		
	Major Responsibility	Some Responsibility	No Responsibility
Entities with potential responsibility to reduce cost of health care (n=875)			
Employers	178 (20)	546 (62)	151 (17)
Government	323 (37)	452 (52)	100 (11)
Hospitals	499 (57)	362 (41)	14 (2)
Insurance Companies	472 (54)	364 (42)	39 (4)
Physicians	332 (38)	506 (58)	37 (4)
Patients	399 (46)	426 (49)	50 (6)
Pharmaceutical Companies	417 (48)	405 (46)	53 (6)
Professional Societies	122 (14)	566 (65)	187 (21)
Technology Companies	229 (26)	526 (60)	120 (14)
Trial Lawyers	419 (48)	295 (34)	161 (18)
	Very Enthusiastic	Somewhat Enthusiastic	Not Enthusiastic
Strategies to reduce cost of health care (n=873)			
Bundled payment model	43 (5)	272 (31)	558 (64)
Eliminate fee-for-service model	67 (8)	211 (24)	595 (68)
Pay for performance	124 (14)	401 (46)	348 (40)
Medicare payment cuts	6 (1)	55 (6)	812 (93)
Compensation reform	167 (19)	387 (44)	319 (37)

S-151.**PRIOR PODCAST EXPERIENCE MODERATES EFFICACY OF ELECTROENCEPHALOGRAPHY**

AUTHORS: T. Vasilopoulos¹, D. F. Chau², M. Bensalem-Owen³, J. E. Cibula⁴, B. G. Fahy¹

AFFILIATION: ¹Anesthesiology, University of Florida, Gainesville, FL, ²Pediatrics, The Children's Hospital of the King's Daughters, Norfolk, VA, ³Neurology, University of Kentucky, Lexington, KY, ⁴Neurology, University of Florida, Gainesville, FL

INTRODUCTION: There is continued interest for using technology to enhance medical education and the variables that may impact its success.

METHODS: Anesthesiology residents and fourth year medical students participated in an electroencephalography (EEG) educational video podcast module. A 25-item evaluation tool was administered before any EEG education was provided (baseline) and the podcast was then viewed. Another 25-item evaluation tool was administered following podcast viewing (after podcast). Ten EEG interpretations were completed with a neurophysiologist with an additional 25-item evaluation tool administered following the interpretations (after 10 EEG interpretations). Participants were surveyed concerning technology and podcasting experience before the educational module and their responses to the podcast educational model. Multiple analyses were performed¹ to evaluate differences in improvement in EEG evaluation scores between the podcast module and the standard didactics (control group); and² to evaluate potential moderation by technology and the podcast experience on the change in mean EEG evaluation scores from after the podcast module to after 10 EEG interpretations.

RESULTS: 21 anesthesiology residents and 12 fourth-year medical students participated. Scores on the 25-item evaluation tool increased with each evaluation time ($P \leq 0.001$, Figure 1). Moderation analyses revealed that individuals with more podcast experience (four or more previous podcasts) had greater increases in scores after a podcast to after 10 EEG compared to individuals with less experience (three or fewer previous podcasts) ($P = 0.027$, Figure 2). Furthermore, as compared to a control group with similar baseline characteristics that received only standard didactics without a podcast, those in the podcast group had greater increases in mean EEG evaluation scores between baseline and after 10 EEG interpretations (Figure 3).

CONCLUSIONS: In reviewing the improvement in EEG evaluation following a podcast education module, those with more podcast experience achieved greater gains in EEG evaluation scores. For EEG education, those receiving the podcast education module showed greater increases in scores compared to those receiving didactic teaching without podcasting, as measured by change in a mean EEG evaluation scores.

S-152.

AN ANALYSIS OF ANESTHETIC INTERVENTIONS AND ANESTHESIA START TIMES

AUTHORS: Jain¹, M. J. Bloom², S. Kendale³, J. Kim⁴, L. Russo⁴, G. Cuff¹, A. D. Rosenberg⁴

AFFILIATION: ¹Anesthesiology, New York University Langone Medical Center, New York, NY, ²Anesthesiology, NYU Langone Medical Center, New York, NY, ³Anesthesiology, NYU, New York, NY, ⁴Anesthesiology, NYU School of Medicine, New York, NY

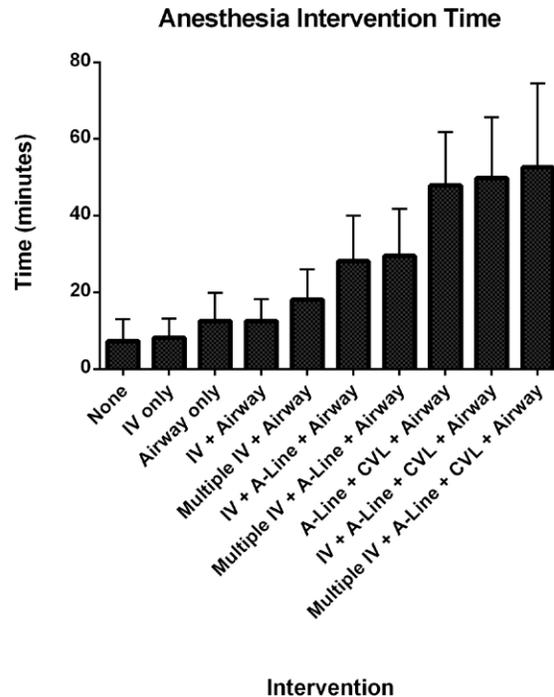
INTRODUCTION: As the healthcare landscape evolves, hospital administrators are requiring healthcare providers, including anesthesiologists, to be more efficient and cost-effective. Currently, no national benchmark exists for intraoperative anesthesia induction and preparation times. Without an existing standard, healthcare administrators may have unrealistic expectations as to what the average “anesthesia induction time” should be. To help establish a baseline, we have provided the average “anesthesia induction” times for 40,120 out of 52,349 cases performed in our institution based upon the number of anesthetic procedures/interventions performed to prepare a patient for surgery.

METHODS: With IRB approval, a retrospective analysis of 52,349 cases was performed from our electronic medical record in a 15-month period. 12,247 anesthetic interventions were excluded for incomplete documentation of data points or for extreme outliers in the data set, considered being five standard deviations away from mean. The average time from “wheels into the operating room” to “ready for surgical preparation and positioning” of 40,102 cases were recorded based upon the number of anesthetic procedures/interventions performed.

RESULTS:

Inserted by Anesthesia	Count	Time to Ready or Prep	StdDev
None	3546	7.53	6.20
IV	5375	8.40	5.74
Airway only	2997	12.68	7.89
IV + airway (either LMA or ETT)	22026	12.78	6.17
Multiple IVs + airway	1796	18.70	9.34
IV + A line + airway	1696	28.64	13.04
Multiple IVs + Aline + airway	1660	30.38	13.80
Aline + CVP + airway	474	48.69	15.37
IV + Aline + CVP + airway	480	50.44	17.31
Multiple IVs + Aline + CVP + airway	52	54.10	24.09
TOTAL	40102		

CONCLUSIONS: Our results reveal the average intraoperative anesthesia ready time based on the number of anesthetic procedures/interventions performed in an academic medical center. This data may help administrators and anesthesiology departments create realistic models toward perioperative efficiency. Further analysis of the data is needed to differentiate the average anesthesia ready time of cases based on staffing (attending alone versus with house staff or nurse anesthetist).



S-153.**12 MONTH MULTINATIONAL EPISODIC DAILY LEARNING ONLINE MOBILE CURRICULUM (STARTPREP) FOR 990 ANESTHESIA RESIDENTS DESIGNED TO PREPARE THEM FOR COMPETENCY IN THE ANESTHESIA BASIC SCIENCES**

AUTHORS: J. T. Chandrasoma¹, L. F. Chu¹, L. Ngai², E. Piehl³, G. McFadyen⁴, A. J. Traynor³

AFFILIATION: ¹Anesthesia, Stanford University Anesthesia Informatics and Media Lab, Stanford, CA, ²Anesthesia, USC, Los Angeles, CA, ³Anesthesia, University of Colorado Denver, Denver, CO, ⁴Anesthesia, Stanford University, Stanford, CA

INTRODUCTION: Episodic daily learning reduces cognitive load by promoting the assimilation of concepts with prior knowledge. This interim study assessed a 12-month multi-institutional online course called STARTprep that delivers basic science curriculum to anesthesia residents in daily modules to prepare them for competency in the anesthesia basic sciences. The program uses open-source learning management system (LMS) tools to deploy individualized learning. The authors hypothesized that a structured daily course delivered in a mobile format would lead to feelings of greater preparedness for high stakes educational milestone testing, and increased mastery of basic science concepts assessed on high stakes educational testing milestones.

METHODS: A human subjects protocol (#27444) was obtained through the IRB to enroll learners. 992 post-graduate year (PGY)-2 residents from 36 institutions in the U.S., 1 in Australia and 1 in South Africa were invited and enrolled. Enrollment was voluntary, and performance was blinded to home institutions.

Students logged onto the course for daily lessons that consisted of a pre-test, a brief teaching text complemented by interactive components, and a post-test. Discussion forums, flashcard topical review, audio podcasts, in addition to an online question bank of

4000 questions were additional program components. Monthly comprehensive assessments (MCA's) were administered and qualitative feedback was solicited daily. The Moodle LMS was used to build the online course. Data were analyzed using SPSS 22 (IBM, Armonk, NY).

RESULTS: Demographics of Learners

52% of participants were male and 48% female. The largest program had 28 CA-1 residents and the smallest program 5 CA-1 residents. 38 participating institutions from across the US, Australia and South Africa. 99% used learning technologies in college/ medical school and 59% had completed a previous online course.

Course Performance and Participation

81% of residents who used STARTprep for at least 3 months say that STARTprep is more engaging than traditional study methods, and 86% of residents say it is more engaging than traditional lectures. 92% of learners say that STARTprep helps them make better clinical decisions and 94% say it helps them feel more prepared for daily cases. 100% of students who used STARTprep received a pass score on the ABA Part 1 2014 examination.

After completing STARTprep, a majority of learners felt moderately or strongly prepared to pass a high stakes educational testing milestone.

Qualitative analysis revealed a strong preference for modules that situated concepts in clinical context enabling assimilation with prior schema. Learners used the flashcards and individualized study tools at a far greater rate than the discussion forums.

CONCLUSIONS: This interim study suggests that a daily online curriculum makes them feel more prepared for high stakes educational milestones, engages learners more than traditional lectures and study methods, allows them to learn at times that are convenient to their needs and lifestyles and reveals their strengths and gaps in knowledge of the anesthesia basic sciences.

Subspecialty Abstracts

Liver

S-154.**PROPOFOL POSTCONDITIONING CONFERS HEPATIC PROTECTION VIA ACTIVATING NRF2 IN THE EARLY MINUTES OF REPERFUSION WHICH REQUIRES ADIPONECTIN IN MICE****AUTHORS:** . H. Li, W. Yao, M. Irwin, Z. Xia**AFFILIATION:** Department of Anaesthesiology, The University of Hong Kong, Hong Kong, Hong Kong**INTRODUCTION:** Propofol, an anaesthetic agent, given during early reperfusion (propofol postconditioning, PPC) attenuates hepatic ischemia reperfusion (HIR) injury. However, the underlying mechanism of PPC hepatic protection is unclear. We and others showed that nuclear factor-like 2 (Nrf2)/heme oxygenase-1 (HO-1) pathway activation^{1,2} and the accumulation of adiponectin (APN, a molecule with cytoprotection)³ in response to HIR injury are cytoprotective against HIR. The aims of this study were to examine whether the activation of Nrf2 in the early minutes of reperfusion is critical in PPC hepatic protection, and whether this activation of Nrf2/HO-1 in PPC is mediated by APN.**METHODS:** Wild-type(WT) or APN knock-out(KO) mice were subjected to seventy percent partial hepatic warm ischemia for 60 min followed by various durations (0, 0.5, 1, 2, 4, 24hr) of reperfusion in the absence or presence of PPC achieved by intravenously injection of propofol (30 mg/kg body weight per hour) for 30 min at the onset of reperfusion. Some of the WT mice were treated with selective Nrf2 inhibitor, luetolin (20µM), 5 minutes before inducing HIR. Cultured mouse hepatocytes (AML12) were subjected to 12 hours hypoxia and 6 hours reoxygenation (H/R) without or with PPC, some of the sub-groups were infected with Nrf2 or APN siRNAs to knock down Nrf2 or APN gene, respectively.**RESULTS:** HIR significantly increased hepatic injury manifested as evaluated serum aspartate aminotransferase (AST), alanine aminotransferase (ALT), and evaluated suzike's injury score that were associated with increased hepatic 15-F2t-isoprostane and reduced superoxide dismutase(SOD) from 4hr to 24hr after the induction of reperfusion (Rep) in WT mice (P<0.05 vs. Sham-operated control). And these changes were further aggravated in APN KO mice (P<0.05 vs. WT). HIR-induced Nrf2 activation (translocation into the nucleus) was detected from 1 hour after Rep while HO-1 expression was increased from 4 hours after Rep in WT but not in KO mice (P<0.05 vs. sham-operated control). PPC significantly enhanced Nrf2 activation as early as 0.5 hours and increased HO-1 protein expression at 2 hours after Rep, which was accompanied with reduced AST, ALT, 15-F2t-isoprostane and elevated SOD. All these protective effects of PPC were cancelled in WT mice treated with leotulin or in KO mice. Similarly, PPC significantly reduced post-hypoxic lactate dehydrogenase release and apoptotic cells, accompanied with increased Nrf2 activation and HO-1 protein expression in cultured AML12 cells, where these cellular protection of PPC were cancelled by either Nrf2 or APN gene knock-down.**CONCLUSIONS:** PPC confers hepatic protective effects against HIR by reducing oxidative stress via activating Nrf2 in the early minutes of reperfusion, and subsequently enhanced HO-1 induction, and this process is mediated by APN.**REFERENCES:**

1. Oxid Med Cell Longev, 2014: 258567
2. Ann Surg, 2014, 260(1):118-27
3. J Hepatol, 2014, 61(4):825-31

S-155.

MILRINONE-INDUCED LOW CENTRAL VENOUS PRESSURE IN LIVE LIVER DONORS: CENTRAL VENOUS PRESSURE-GUIDED VS STROKE VOLUME VARIATION-GUIDED TECHNIQUES

AUTHORS: J. Lee¹, M. Hur¹, J. Lee², D. KIM³, C. Jung⁴

AFFILIATION: ¹Anesthesiology and pain medicine, Seoul National University Hospital, Seoul, Korea, Republic of, ²Anesthesiology and Pain Medicine, Seoul Metropolitan Government Boramae Medical Cent, Seoul, Korea, Republic of, ³Anesthesiology and Pain Medicine, Seoul National University College of Medicine, Seoul, Korea, Republic of, ⁴Anesthesiology and Pain Medicine, Seoul National University Hospital, Seoul, Korea, Republic of.

INTRODUCTION: Low central venous pressure (CVP) is known to improve surgical environment during hepatectomy. However, disadvantages associated with the central venous catheterization claimed less invasive CVP monitoring tool. Arterial pressure-derived stroke volume variation (SVV) is a useful alternative considering its close relationship with the CVP during hepatectomy¹. However, this relationship has never been confirmed in low CVP made with vasodilator, which was essential for donor hepatectomy². We tested the feasibility of SVV monitoring to guide milrinone-induced low CVP during live liver donor hepatectomy.

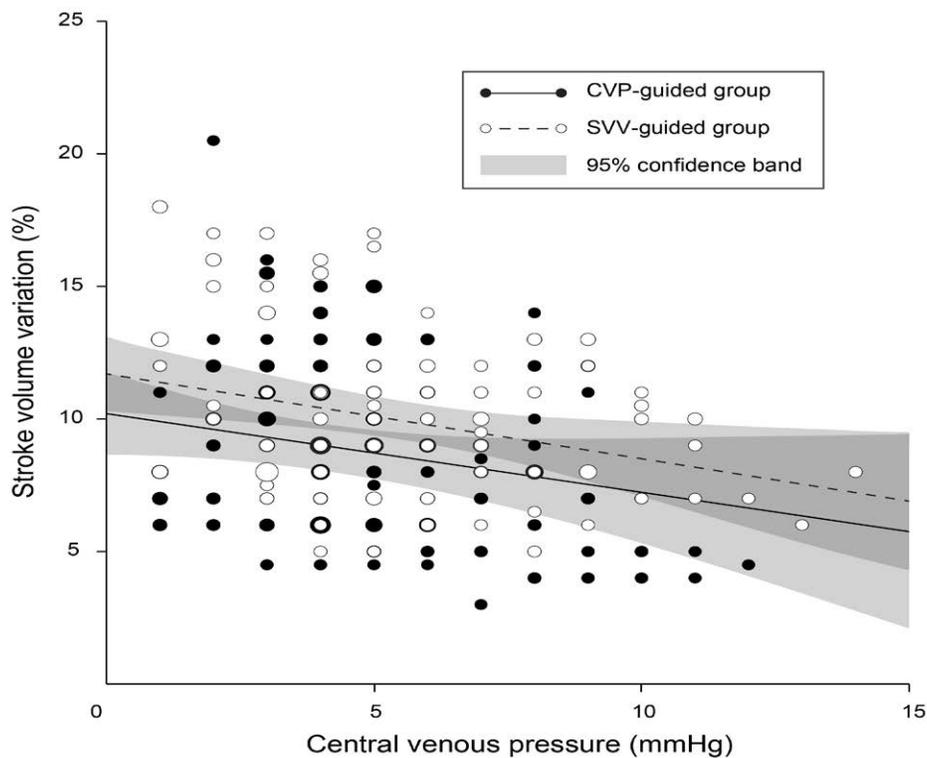
METHODS: The target SVV value corresponding to target CVP, 5 mmHg, was sought while CVP-guided low CVP was applied to 19 donor hepatectomies. Then the target SVV value was used for the SVV-guided method in next 19 donors. Characteristic features of the CVP- and the SVV-guided groups were compared, and factors contributing to the best outcome were analyzed.

RESULTS: The target SVV identified by regression analysis was 9%. Surgical field grade and intraoperative bleeding were comparable between the two groups. The ratio of achieving target values was significantly higher in the CVP-guided group than the SVV-guided group (99% vs 79%, P = 0.005). Multivariate logistic regression analysis revealed younger age and lower CVP during hepatectomy were independent predictors of better surgical field. The CVP during hepatectomy was best predicted by linear mixed effect model including baseline CVP, groups and their interactions with milrinone infusion time.

CONCLUSIONS: The SVV is as effective a guide as the CVP to provide milrinone-induced low CVP during live donor hepatectomy. However, CVP is a more useful guide because it is easily managed and significantly related with surgical field enhancement. Clinicians should consider advantages and disadvantages of CVP or SVV monitoring during donor hepatectomy.

REFERENCES:

1. Dunki-Jacobs EM, Philips P, Scoggins CR, McMasters KM, Martin RC, 2nd. Stroke volume variation in hepatic resection: a replacement for standard central venous pressure monitoring. *Annals of surgical oncology.* 2014;21(2):473-8.
2. Ryu HG, Nahm FS, Sohn HM, Jeong EJ, Jung CW. Low central venous pressure with milrinone during living donor hepatectomy. *American journal of transplantation : official journal of the American Society of Transplantation and the American Society of Transplant Surgeons.* 2010;10(4):877-82.



S-156.**SEVOFLURANE PRECONDITIONING AND POSTCONDITIONING AT CLINICALLY RELEVANT DOSES INDUCE PROTECTIVE EFFECTS ON HEPATIC ISCHEMIA REPERFUSION IN RATS**

AUTHORS: S. Shiraishi¹, S. Cho², I. Shibata¹, O. Yoshitomi³, T. Maekawa¹, T. HARA⁴

AFFILIATION: ¹Anesthesiology, Nagasaki University Hospital, Nagasaki, Japan, ²Anesthesiology, Japanese Red Cross Society, Nagasaki Atomic Bomb H, Nagasaki, Japan, ³Anesthesiology, Nagasaki University School of Medicine, Nagasaki, Japan, ⁴Anesthesiology, Nagasaki University, Nagasaki, Japan

INTRODUCTION: Hepatic ischemia-reperfusion (IR) injury caused by Pringle maneuver to prevent blood loss during liver resection still remains a factor that contributes to postoperative morbidity and mortality. This study investigated whether the clinic relevant doses of sevoflurane has the properties of preconditioning (PreC) and postconditioning (PostC) against hepatic IR injury.

METHODS: All experimental procedures and protocols described in this study were approved by the local institutional committee. Male SD rats were divided into three groups: rats in group PF (n = 8) received propofol at 39 mg/kg/h and fentanyl at 30 µg/kg/h from 60 min before ischemia until the end of the experimental procedure, rats in groups SPreC (n = 8) and SPostC (n = 7) received propofol and fentanyl, and propofol was replaced by 2.5% sevoflurane for 30 min from 35min before ischemia in SPreC group and for 30 min from 5min before reperfusion in SPostC group. All groups underwent 1 h of warm ischemia of median and left lateral lobes, followed by 3 h of reperfusion. Serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and lactic dehydrogenase (LDH) levels were determined. The results are expressed as mean ± standard deviation. Statistical analysis was performed by analysis of variance for repeated measures followed by Dunnett's test and one-way analysis of variance followed by the Tukey-Kramer test.

RESULTS: There were no significant differences in blood pressure, body temperature, heart rate among groups. Compared with those in group PF, the serum ALT, ASL, and LDH levels at 3 hours after reperfusion significantly decreased in groups SPreC and SPosC. There were no significant differences in the serum ALT, ASL, and LDH levels between groups SPreC and SPosC.

CONCLUSIONS: The clinic relevant doses of sevoflurane-induced PreC and PostC could effectively attenuate hepatic IR injury as compared with propofol and fentanyl anesthesia. Thus, the application of sevoflurane PreC and PostC might be more beneficial for postoperative liver function than propofol and fentanyl in patients receiving hepatectomy under inflow occlusion.

S-157.

COMPARISON OF THE EFFECT OF PREOPERATIVE MELD AND MELD-NA SCORES ON OUTCOME AFTER LIVER TRANSPLANTATION

AUTHORS: T. Lai, G. Wagener

AFFILIATION: Anesthesiology, Columbia University, New York, NY

INTRODUCTION: The United Network for Organ Sharing (UNOS) and the Organ Procurement and Transplantation Network (OPTN) recently changed the criteria for allocation of liver transplant graft from the MELD score to the MELD-Na score¹. The MELD-Na score is a modification of the MELD score that includes sodium levels and correlates better with waitlist mortality than the traditional MELD score¹. Little is known about the effect of preoperative MELD-Na score on outcome after liver transplantation.

METHODS: We retrospectively compared the effect of MELD and MELD-Na scores on 90-day and 1-year mortality/graft failure after liver transplantation. MELD-Na was calculated as per UNOS policy: MELD-Na = MELD + 1.32 x (137-Na) - [0.033 x MELD*(137-Na)] for any MELD score >11.

RESULTS: 610 patients undergoing liver transplant from xx to xx were included in this study. The MELD-Na scores were significantly higher than the MELD scores (22.6 +/-12.1 vs. 21.21 +/-10.5, p<0.0001). In 91 patients MELD-Na was -1.5 +/- 0.8 points lower than MELD score and in 285 patients MELD-Na was 2.8 +/- 2.1 points higher than the MELD score (see figure).

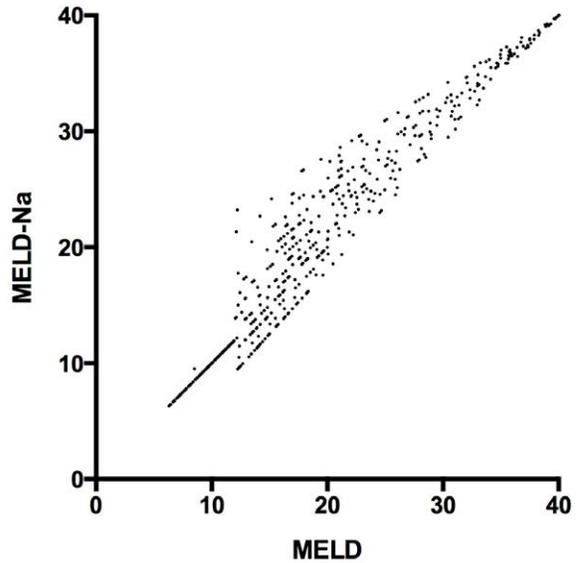
MELD-Na and MELD scores were higher in patients who died or required re-transplantation within 90 days (n=41) and 1 year (n=95). The areas under the curve of the receiver operator characteristics curves of MELD and MELD-Na to predict 90-day and 1-year mortality/graft failure were not different (see table).

CONCLUSIONS: MELD-Na scores were higher than MELD scores. This may impact the availability of grafts, especially for patients who receive exception points for cancer, for example.

The preoperative MELD-Na score did not improve the predictive power of MELD score on post-liver transplant outcome. The definitive impact of MELD-Na on waitlist mortality and outcome after liver transplantation will only be obvious after the introduction of the UNOS rule change.

REFERENCES:

1. http://optn.transplant.hrsa.gov/ContentDocuments/OPTN_Policy_Notice_07-24-2014.pdf
2. Kim WR, Biggins SW, Kremers WK, et al. Hyponatremia and mortality among patients on the liver-transplant waiting list. N Engl J Med 2008;359:1018-26.



AUC (95% CI) of the ROC curves to predict 90-day and 1-year mortality/graft failure

	MELD	MELD-Na
90-day Mortality/graft failure	0.671 (0.581 to 0.761)	0.677 (0.590 to 0.765)
1 year Mortality/graft failure	0.615 (0.55- to 0.679)	0.615 (0.551 to 0.680)

Subspecialty Abstracts

Neuroscience in
Anesthesiology and
Perioperative Medicine

S-158.

IMPACT OF INTRAVENOUS ACETAMINOPHEN ON EARLY POSTOPERATIVE PERIOD AFTER AWAKE CRANIOTOMY

AUTHORS: K. Kamata¹, N. Morioka¹, T. Maruyama², K. Hirooka¹, N. Komayama¹, Y. Muragaki², M. Ozaki¹

AFFILIATION: Anesthesiology, Tokyo Women’s Medical University, Tokyo, Japan, 2Neurosurgery, Tokyo Women’s Medical University, Tokyo, Japan

INTRODUCTION: Multimodal analgesia with intravenous (IV) acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs) has been widespread because it reduces opioid-related adverse effects. Both postoperative nausea and vomiting (PONV) and pain are recognized to deteriorate the clinical course of patients. Particularly in the neurosurgical field, PONV and postcraniotomy headache should be calmed to distinguish the incidence of lethal complications such as intracranial hemorrhage. The aim of this study is to evaluate efficacy of intraoperatively administrated IV acetaminophen and NSAIDs during the early postoperative period following elective craniotomy.

METHODS: Anesthetic charts and clinical records in the intensive care unit (ICU) of 19 awake craniotomies for glioma resection under “asleep-awake-asleep” technique were reviewed. All participants received 50 mg of diclofenac suppository until the beginning of awake phase, and either IV acetaminophen (2000 mg) or flurbiprofen axetil (1 mg/kg) were supplementary given until the end of operation. Incidences of complications during awake phase of operation as well as during ICU stay were analyzed.

RESULTS: Ten patients received acetaminophen (Group A) and 9 patients received flurbiprofen axetil (Group F) intraoperatively. Demographics and operative backgrounds of the patients were not significantly different between each group. All patients discharged from ICU the morning after surgery. At the beginning of operation, scalp blocks with lidocaine and ropivacaine were applied to every patient. Total dose of ropivacaine was significantly higher in Group F (p=0.01). General anesthesia was provided with propofol/remifentanyl/fentanyl during first asleep phase. Propofol and fentanyl consumption were comparable. A greater amount of remifentanyl was given for the patients in Group A (p=0.03), although none of the patients received remifentanyl infusion from the beginning of awake phase. The number of patients who complained of headache, nausea, vomiting, and shivering during operation was not significantly different between the study groups. Postcraniotomy headache was more frequent in Group F (8 patients) than in Group A (4 patients; p=0.03) in ICU. However, time to first rescue pain medication (p=0.91) and its requirement (p=0.11) were comparable. Incidence of postoperative nausea was not significantly different (1 patient in Group A, 4 patients in Group F; p=0.09). All 4 patients who complained of nausea developed vomiting in Group F, whereas no one vomited in Group A (p=0.02). Sleep disturbance was recorded in 2 patients in Group A and 4 patients in Group F, respectively (p=0.26). Fluctuation of body temperature in ICU was comparable. Characteristics of the patients are shown in the Table.

CONCLUSIONS: Compared with flurbiprofen axetil, prophylactically administrated 2000 mg of acetaminophen reduces the incidence of PONV after awake craniotomy, mainly mediated through superior pain control.

Characteristics of the patients.

	Acetaminophen (A, n=10)	Flurbiprofen axetil (F, n=9)
Age (yr)	40 (9)	39 (11)
Gender [M/F]	6/4	5/4
Height (cm)	169 (13)	169 (11)
Weight (kg)	63 (10)	67 (14)
ASA-PS [1/2/3]	5/4/1	6/3/0
Operative time (min)	417 (65)	412 (104)
Anesthesia time (min)	500 (64)	492 (104)
Tumor location [frontal/temporal/parietal]	8/1/1	9/0/0
Side of hemisphere [left/right]	6/4	7/2

S-159.

PROPOFOL ANESTHESIA SHOWED NO EFFECT ON THE DOPAMINERGIC ACCELERATION INDUCED BY METHAMPHETAMINE AND NOMIFENSINE IN RAT STRIATUM - IN VIVO MICRODIALYSIS STUDY

AUTHORS: Y. U. Adachi

AFFILIATION: Department of Emergency Medicine, Nagoya University Hospital, Nagoya, Japan

INTRODUCTION: Previously, we demonstrated that inhalational anesthesia markedly enhanced the increase of the extracellular concentration of dopamine (DA) induced by administration of methamphetamine (Met) and nomifensine (Nom) using in vivo microdialysis experiments. Met reverses DA transporter (DAT) and Nom inhibits DAT, and both increase the DA concentration in the brain. The effect of propofol anesthesia on DA regulation modified by psychotic drugs was not fully investigated. In the current investigation, we studied the effect of propofol and sevoflurane anesthesia on the extracellular concentration of DA and metabolites with a treatment of Met and Nom in rat striatum.

METHODS: Male adult Sprague-Dawley rats were used. Microdialysis probe was inserted into the right striatum and perfused with modified Ringer solution (2 µl/min). Samples were collected every 20 min and the concentrations of DA, 3,4-dihydroxyphenylacetic acid (DOPAC), 3-methoxytyramine (3-MT) and homovanillic acid (HVA) in each dialysate were determined by HPLC.

Rats were administered saline, same volume of 2 mg/kg Met or 10 mg/kg Nom, with or without 1-hr propofol anesthesia (20 mg/kg bolus administration followed by 25 or 50 mg/kg/h infusion). Another group of rats were anesthetized with sevoflurane (2.5%). All data were presented as percent changes from the baseline and expressed as mean ± SE.

RESULTS: Propofol showed no effect on the extracellular concentration of DA during anesthesia, however, propofol decreased DA concentration after anesthesia in high dose group (Fig. 1). Sevoflurane anesthesia increased the concentration of metabolites (Fig. 1). Systemic administration of Met and Nom increased the extracellular concentration of DA (Fig. 2,3). Sevoflurane anesthesia significantly enhanced the increase of DA induced by both Met and Nom (Fig. 4), whereas, propofol anesthesia showed no effect on the Met- and Nom-induced DA increase throughout the anesthesia (Fig. 2, 3).

CONCLUSIONS: The results of current investigation demonstrated that propofol showed smaller interactions on DA release and metabolism than sevoflurane in the animals treated with psychotropic agents.

Recently, a plenty of harmful effects of volatile anesthetics on central nervous system have been reported. The issue is known as a term of “developing brain” in neonates and “postoperative cognitive dysfunction” in geriatric patients. Another group of patients addicted in psychotropic drugs are in focus. Concerning to these patients who might be vulnerable to the toxicity of volatile anesthetics, propofol anesthesia has a possibility not to exacerbate the brain function by smaller effect on central dopaminergic system comparing to inhalational anesthesia.

REFERENCES:

1. Adachi YU, et al. Halothane enhances dopamine metabolism at presynaptic sites in a calcium-independent manner in rat striatum. *Br J Anaesth* 2005; 95: 485-94.
2. Grasshoff C, et al. Modulation of ventral pallidal dopamine and glutamate release by the intravenous anesthetic propofol studied by in vivo microdialysis. *Amino Acids* 2005; 28: 145-8.

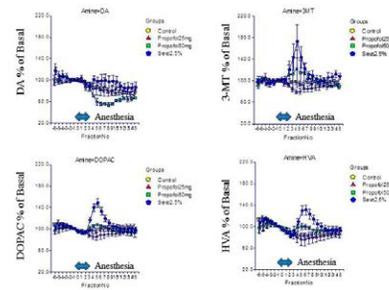


Fig. 1. Effect of propofol and sevoflurane anesthesia on extracellular concentration of dopamine and metabolites. Control no anesthesia, Propofol25mg or Propofol50mg: propofol 20 mg/kg bolus administration followed by 25 or 50 mg/kg/h infusion. Sevoflurane: sevoflurane inhalation at 2.5%. DA: dopamine, DOPAC: 3,4-dihydroxyphenylacetic acid, 3-MT: 3-methoxytyramine and HVA: homovanillic acid. Significant differences were visible and asterisks were omitted in the current figures for avoiding busy presentation.

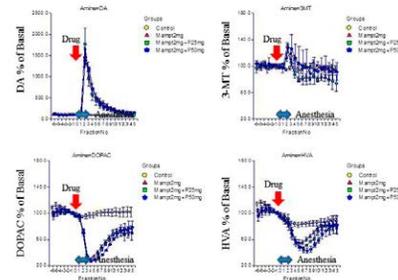


Fig. 2. Effect of methamphetamine and propofol anesthesia on extracellular concentration of dopamine and metabolites. Control no anesthesia and drug, Met2mg: methamphetamine 2 mg i.p., Met5mg: P25mg or +50mg: Methamphetamine 2 mg i.p. and propofol 20 mg/kg bolus administration followed by 25 or 50 mg/kg/h infusion. DA: dopamine, DOPAC: 3,4-dihydroxyphenylacetic acid, 3-MT: 3-methoxytyramine and HVA: homovanillic acid. Significant differences were visible and asterisks were omitted in the current figures for avoiding busy presentation.

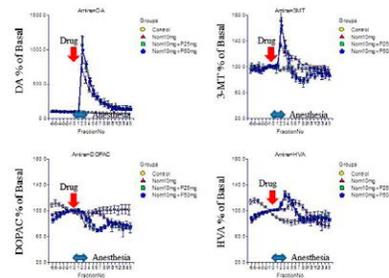


Fig. 3. Effect of nomifensine and propofol anesthesia on extracellular concentration of dopamine and metabolites. Control no anesthesia and drug, Nom10mg: nomifensine 10 mg i.p., Nom25mg: P25mg or +50mg: nomifensine 10 mg i.p. and propofol 20 mg/kg bolus administration followed by 25 or 50 mg/kg/h infusion. DA: dopamine, DOPAC: 3,4-dihydroxyphenylacetic acid, 3-MT: 3-methoxytyramine and HVA: homovanillic acid. Significant differences were visible and asterisks were omitted in the current figures for avoiding busy presentation.

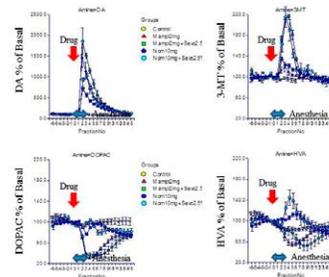


Fig. 4. Effect of sevoflurane anesthesia on extracellular concentration of dopamine and metabolites with the treatment of methamphetamine or nomifensine. Control no anesthesia and drug, Met2mg: methamphetamine 2 mg i.p., Nom10mg: nomifensine 10 mg i.p., Sevoflurane: sevoflurane inhalation at 2.5%. DA: dopamine, DOPAC: 3,4-dihydroxyphenylacetic acid, 3-MT: 3-methoxytyramine and HVA: homovanillic acid. Significant differences were visible and asterisks were omitted in the current figures for avoiding busy presentation.

S-160.**PROPOFOL INDUCES DEATH OF HUMAN OLIGODENDROCYTES DIFFERENTIATED FROM STEM CELLS**

AUTHORS: Y. Inagaki¹, Y. Liu¹, Y. Yan², D. Twaroski¹, Z. J. Bosnjak¹, X. Bai¹

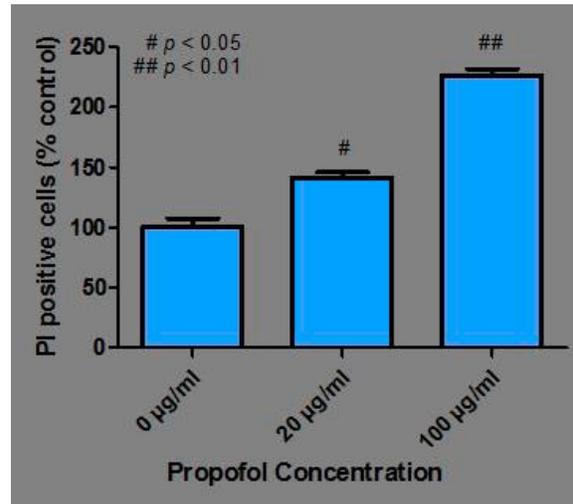
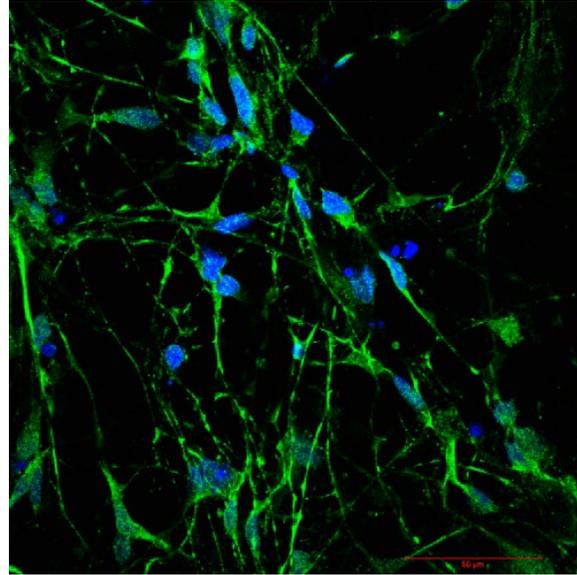
AFFILIATION: ¹Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, ²Anesthesiology, Medical College of Wisconsin, Milwaukee, WI

INTRODUCTION: Propofol induces oligodendrocytes (OLs) death in fetal and neonatal non-human primate brain. However, no studies show the toxic effect of propofol on human oligodendrocytes. The aim of this study is to investigate whether propofol can cause the death of human OLs differentiated from OL precursor cells.

METHODS: OLs were differentiated from human embryonic stem cell-derived OL precursor cells by culturing the cells in chemically defined induction medium. The success of OL differentiation was confirmed by the expression of OL-specific marker (myelin basic protein; MBP) using immunofluorescence staining. The 2-week old OLs were then exposed to 0, 5, 20 or 100 µg/ml propofol. The exposure duration was 6 hours or 24 hours. The frequency of exposure varied from 1 to 3 times. Cell death was assessed by propidium iodide (PI) staining.

RESULTS: Immunostaining showed that OL differentiation efficiency was over 73% (Image 1). There was a significant number of PI-positive dead cells in OL culture exposed to the clinically relevant dose of propofol (20 µg/ml) for 24 hours (Image 2). Additionally, significant cell death was observed in OL culture when exposed to 100 µg/ml of propofol, a supra-clinical dose, for either 24 hours or three individual 6 hour exposures.

CONCLUSIONS: This study demonstrates for the first time that propofol dose, time, and frequency-dependently induces human OL death. Further experimentation will be done to determine the underlying mechanism (i.e. reactive oxygen species) of propofol-induced OL death.



S-161.

THE INFLUENCE OF VENTILATION STRATEGIES AND ANESTHETIC TECHNIQUES ON CEREBRAL OXYGENATION IN THE BEACH CHAIR POSITION: A PROSPECTIVE INTERVENTIONAL STUDY WITH A RANDOMIZED COMPARISON OF TWO ANESTHETIC REGIMENS

AUTHORS: Picton¹, A. Dering¹, M. Neff¹, B. Miller², A. Shanks¹, M. Housey¹, G. A. Mashour¹

AFFILIATION: ¹Anesthesiology, University of Michigan, Ann Arbor, MI, ²Orthopedic Surgery, University of Michigan, Ann Arbor, MI

INTRODUCTION: Beach chair positioning during general anesthesia is associated with marked cerebral desaturation¹; severe neurological injury in otherwise healthy patients has been reported². Changes in cerebral oxygenation resultant upon the interaction between inspired oxygen fraction, end-tidal carbon dioxide and anesthetic choice have not been fully evaluated in patients anesthetized in the beach chair position. Here, we test the hypothesis that changes in inspired oxygen fraction or end-tidal carbon dioxide correlate to a significant change in regional cerebral oxygenation in anesthetized patients in the beach chair position and also compare the effects that inhaled and intravenous anesthetics have on this process.

METHODS: A detailed description of the study protocol (ClinicalTrials.gov No. NCT01535274) is available in the published literature³. This is a prospective within-group time-series study, approved by the IRB, which incorporates a randomized comparison between two anesthetics, of patients undergoing shoulder surgery in the beach chair position. Following informed consent, 56 patients were randomized to receive desflurane or total intravenous anesthesia

(TIVA) with propofol adjusted to Bispectral Index for maintenance of anesthesia. Following induction of anesthesia intubation and positioning, inspired oxygen fraction and minute ventilation were sequentially adjusted. Regional cerebral oxygenation (INVOS 5100C, Covidien, Boulder, CO) was recorded at each of 5 set points. The primary outcome measure was the change in regional cerebral oxygenation subsequent upon sequential changes in oxygenation and ventilation. The effect of anesthetic choice on cerebral desaturation in the beach chair position and response to changes in ventilation strategy was evaluated as a secondary outcome. Statistical analysis was a repeated measures analysis of variance with Tukey’s HSD procedure for post hoc contrasts.

RESULTS: The combined interventions of increasing FIO₂ and PETCO₂ result in a 14% point improvement in rSO₂ (FIO₂ 30%, PETCO₂ 30mmHg - mean 61%, SD 12 vs. FIO₂ 100%, PETCO₂ 45mmHg - mean 75%, SD 12) for patients anesthetized in the beach chair position, p <0.001. There was no significant interaction effect of the anesthetic as a between subject factor at the study intervention points. Regional cerebral oxygenation (rSO₂) values at the set ventilation points are represented in table 1 and figure 1.

CONCLUSIONS: Increasing inspired oxygen fraction and end tidal carbon dioxide result in a reliable increase in cerebral oxygenation in patients anesthetized in the beach chair position. When both interventions are combined the magnitude of improvement overcomes cerebral desaturation associated with beach chair positioning. There was no significant difference between anesthetics.

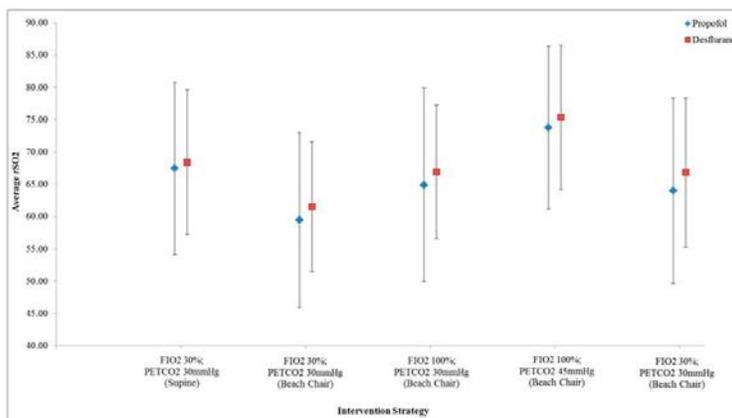
REFERENCES:

1. Anesth Analg 2010, 111(2):496-505.
2. J Clin Anesth 2005, 17(6):463-469.
3. BMC Anesthesiol. 2012 Sep 20;12:23.

	Supine	Beach Chair				
	T1	T2	T3	T4	T5	
	FIO ₂ 0.3, PETCO ₂ 30	FIO ₂ 0.3, PETCO ₂ 30	FIO ₂ 1.0, PETCO ₂ 30	FIO ₂ 1.0, PETCO ₂ 45	FIO ₂ 0.3, PETCO ₂ 30	
Complete	68 ± 12	61 ± 12(p<0.001)	66 ± 13(p<0.001)	75 ± 12(p<0.001)	65 ± 13 (p<0.001)	
Propofol	67 ± 13	59 ± 14(p<0.001)	65 ± 15(p<0.001)	74 ± 13(p<0.001)	64 ± 14 (p<0.001)	
Desflurane	68 ± 11	62 ± 10(p<0.001)	67 ± 10(p<0.001)	75 ± 11(p<0.001)	67 ± 12 (p<0.001)	

Table 1. Regional cerebral oxygenation (rSO₂) values (mean ± standard deviation) at the set ventilation points for the complete study group and for each anesthetic choice. PETCO₂ is presented in mmHg. P values represented for successive within group time point comparisons.

Figure 1. Absolute (mean and standard deviation) regional cerebral oximetry (rSO₂) at each study point for propofol and desflurane groups.



S-162.

ORAL REHYDRATION IMPROVES THIRST AND SATISFACTION AND HEALED PAIN-EVOKED ACTIVATION IN THE HUMAN BRAIN.

AUTHORS: Y. Ogino¹, K. Nakamura², S. Saito¹

AFFILIATION: ¹Anesthesiology, Gunma University Graduate School of Medicine, Maebashi, Japan, ²Anesthesiology, Saiseikai-Hita Hospital, Hita, Japan

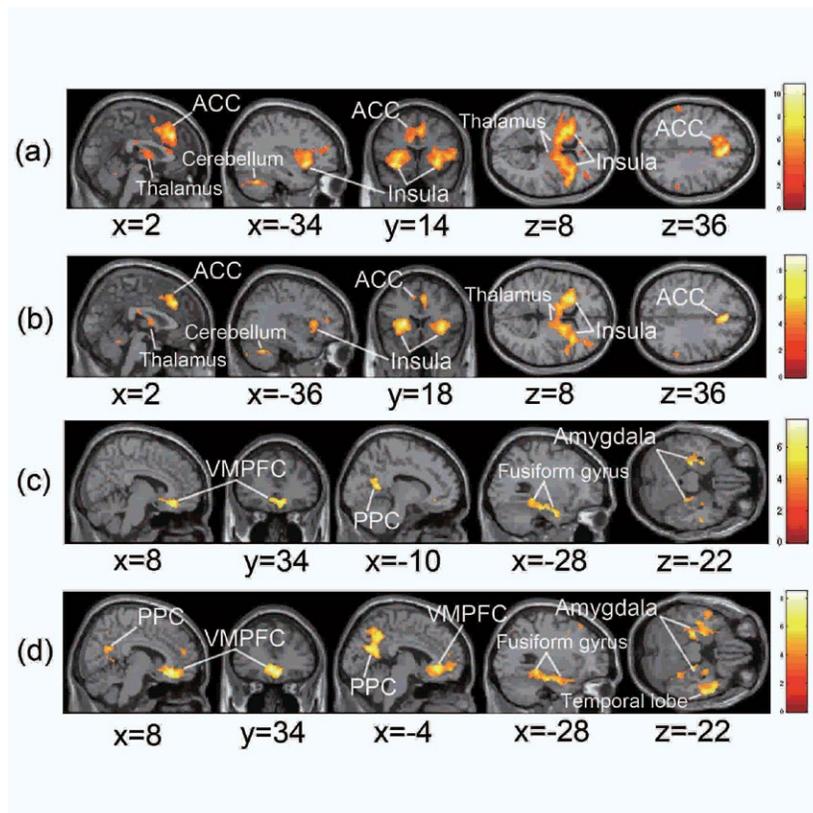
INTRODUCTION: Oral rehydration therapy (ORT) is rapidly introduced in many clinical practices.

We surveyed patients' subjective changes toward four items in a questionnaire (Activity, Satisfaction, Hunger, and Thirst before and after preoperative ORT induction. In addition, we examine the effects of rehydration with an oral rehydration solution (ORS) on pain thresholds and cortical activations in response to pain by functional magnetic resonance imaging (fMRI) in five healthy men.

In clinical use, preoperative ORT using these two ORSs significantly improved the satisfaction and thirst scores, although activity and hunger scores did not significantly differ before and after preoperative ORT induction. In healthy men, pain stimulus robustly activated the pain-related neural network, notably the anterior cingulate cortex, insula, and thalamus. Such activations in the dehydrated subjects were greater than those in the rehydrated subjects in terms of peak and cluster.

Our findings suggest that preoperative ORT improves patients' thirst and satisfaction and rehydration with ORS alleviates thirst and decreases brain activities related to painful stimuli.

Figure legend: Brain activities in each contrast: (a) Pain stimulus (dehydration), (b) Pain stimulus (rehydration), (c) Touch stimulus (dehydration), and (d) Touch stimulus (rehydration)



S-163.**THE RELATIONSHIP BETWEEN AWAKE BISPECTRAL INDEX AND RECALL OF TRAVEL TO THE OPERATING ROOM**

AUTHORS: D. J. Blech¹, R. L. Wagner¹, M. D. Allain¹, X. Zheng¹, A. Evans², M. O'Connor², D. Glick²

AFFILIATION: ¹Pritzker School of Medicine, University of Chicago, Chicago, IL, ²Anesthesia and Critical Care, University of Chicago, Chicago, IL

INTRODUCTION: Awareness with recall (AWR) is an uncommon but potentially dangerous occurrence in anesthetic practice.¹ To guard against instances of AWR, clinicians may use awareness monitors like the BIS Vista (Covidien), which processes EEG information and outputs a single dimensionless integer that indicates the patient's level of wakefulness. The BIS monitor was initially shown to be more effective than other monitoring techniques in preventing AWR,² but more recent studies have called this into question.³ The present study was designed to assess if BIS values are correlated with memory formation, a fundamental component of AWR that can be studied outside the operating room.

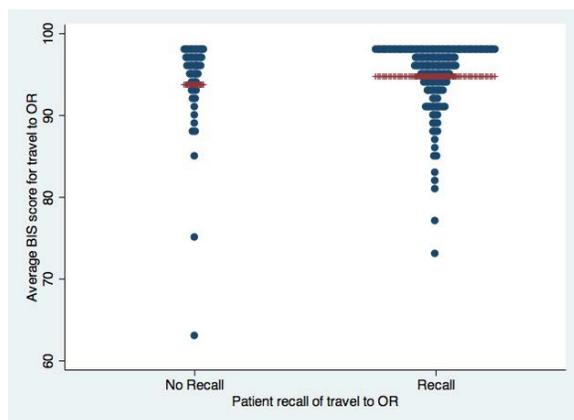
METHODS: 258 subjects were enrolled in the study. All were adult surgical patients who received preoperative midazolam and general anesthesia. Each subject was fitted with a BIS Vista monitor in the preoperative area. A BIS reading was recorded during travel to the operating room, and all enrolled subjects were able to communicate with the researchers during this time. On the day following surgery, subjects were asked if they recalled traveling to the OR. A Wilcoxon rank-sum test was used to analyze the relationship between subject recall of OR travel and corresponding BIS score.

RESULTS: 77% of subjects reported a memory of travel to the operating room. The mean BIS score for these subjects was 94.6. The mean score for those who did not remember was 93.6. This difference was not found to be statistically significant.

CONCLUSIONS: It appears to be common for patients to forget their trip to the operating room. This effect could be due to midazolam, or perhaps to a retrograde effect of one or more drugs given in the OR. Additionally, our results suggest that BIS monitors cannot help clinicians to ascertain if an awake patient is actively forming memories of the transit from the preoperative holding area to the operating room.

REFERENCES:

1. Anesth Analg 2004; 99(3):833-9
2. NEJM 2008; 358(11):1097-108
3. NEJM 2011; 365(7):591-600

**S-164.****IMPACT OF SPINAL ANESTHESIA ON POSTOPERATIVE COGNITIVE DYSFUNCTION**

AUTHORS: R. Yasumura, H. Yoshioka, T. Sugiura, H. Yamazaki, K. Wada, Y. Kobayashi

AFFILIATION: Anesthesiology, National Hospital Organization Tokyo Medical Center, Tokyo, Japan

INTRODUCTION: Postoperative cognitive dysfunction (POCD) is a common and well-known complication among elderly surgical patients. While several reports have stated that there is no significant difference in POCD incidence after anesthesia, either general or regional, little is known about the incidence of POCD after spinal anesthesia without sedation.

We aimed to evaluate the impact of spinal anesthesia on POCD.

METHODS: After the approval of the IRB, we enrolled patients over 65 years of age whose ASA Physical Status was 1-3 and had planned to undergo elective surgery under spinal anesthesia. Patients with a known history of allergy to local anesthetics were excluded.

The patients' preoperative and postoperative cognitive functions were compared using the postoperative quality of recovery scale (PQRS).

The PQRS cognition testing performed preoperatively as the baseline. The test was repeated on postoperative days 1 and 3. We assessed the cognitive function on the basis of the following 5 parameters: orientation to name, place, and date of birth; digits forward; digits backward; word recall; and word generation.

The change scores to determine recovery were ≥ 0 for orientation, ≥ 2 for digits forward, ≥ -1 for digits backward, ≥ -3 for word recall, and ≥ -3 for word generation.

The mean and standard deviation values of each item of the PQRS were used for statistical examination.

RESULTS: Seventeen patients (14 men and 3 women; age, 77.5 ± 6.81 years) participated in this study. Baseline values for the PQRS testing were as follows: orientation, 3 ± 0 ; digits forward, 4.25 ± 0.93 ; digits backward, 2.44 ± 0.96 ; word recall, 3.69 ± 1.92 ; and word generation, 6.69 ± 2.39 . The respective change scores at day 1 were 0 ± 0 , 0.15 ± 0.69 , 0.08 ± 0.86 , 0.85 ± 2.08 , and -1.46 ± 2.26 . The respective change scores at day 3 were 0 ± 0 , 0.5 ± 1.17 , 0.33 ± 0.89 , 0.58 ± 1.56 , and -1.33 ± 2.06 . The postoperative cognitive recovery rates at day 1 and day 3 were 88.2% and 82.3%, respectively. The diagnostic factor for POCD was the change score for word generation.

CONCLUSIONS: We presented POCD incidence after the spinal anesthesia using PQRS. Further clinical studies are required.

S-165.**THE EFFECT OF PROPOFOL VERSUS ISOFLURANE ANESTHESIA ON HUMAN CSF MARKERS OF ALZHEIMER'S DISEASE AND INFLAMMATION: RESULTS OF A RANDOMIZED CONTROLLED TRIAL**

AUTHORS: M. Berger¹, J. Nadler², W. D. White¹, D. McDonagh¹, V. Ponnusamy³, M. L. James¹, J. Mathew¹

AFFILIATION: ¹Anesthesiology, Duke University Medical Center, Durham, NC, ²Anesthesiology, University of Rochester, Rochester, NY, ³Trinity College, Trinity College of Arts and Sciences, Duke University, Durham, NC

INTRODUCTION: Although anesthesia and surgery are clearly associated with post-operative delirium and cognitive deficits that may last for up to several weeks, it remains controversial whether anesthesia and/or surgery are associated with long-term cognitive decline or dementia¹⁻⁵. Nonetheless, a large number of animal studies and in vitro studies show that inhaled anesthetics like isoflurane and intravenous anesthetics like propofol both have effects on the Alzheimer's disease associated protein markers amyloid beta and tau⁶⁻⁸. Further, some laboratory studies suggest that isoflurane may promote Alzheimer's disease pathogenesis and neuroinflammation to a greater degree than propofol⁹, and propofol may even block some of the effects of isoflurane on Alzheimer's disease pathogenesis^{10,11}. However, it is unclear whether isoflurane and propofol exert differential effects on Alzheimer's disease markers or neuroinflammation in humans.

METHODS: Thirty-nine patients undergoing neurosurgical or otolaryngology procedures that required placement of a lumbar CSF drain were prospectively enrolled in this IRB-approved study. Lumbar CSF drains were placed after the induction of anesthesia and before the start of surgery. Patients were randomized to receive isoflurane or propofol for anesthetic maintenance; all patients received propofol for anesthetic induction. CSF samples were taken at the time of drain placement (0 h), 10 h, and 24 h later.

RESULTS: CSF tau levels increased in all patients at 10 and 24 h ($p < 0.0001$), but there was no change in amyloid beta or phospho-tau levels after anesthesia or surgery. There was no significant difference in the CSF tau elevations seen between patients who received propofol versus isoflurane. There were large increases in CSF IL-6, IL-8, and IL-10 levels at 24 h ($p < 0.00001$ for each), but these increases did not significantly differ between patients who received propofol versus isoflurane. CSF MCP-1 levels rose significantly at 24 h, and the magnitude of this increase was higher in patients treated with isoflurane ($p < 0.01$) than those treated with propofol.

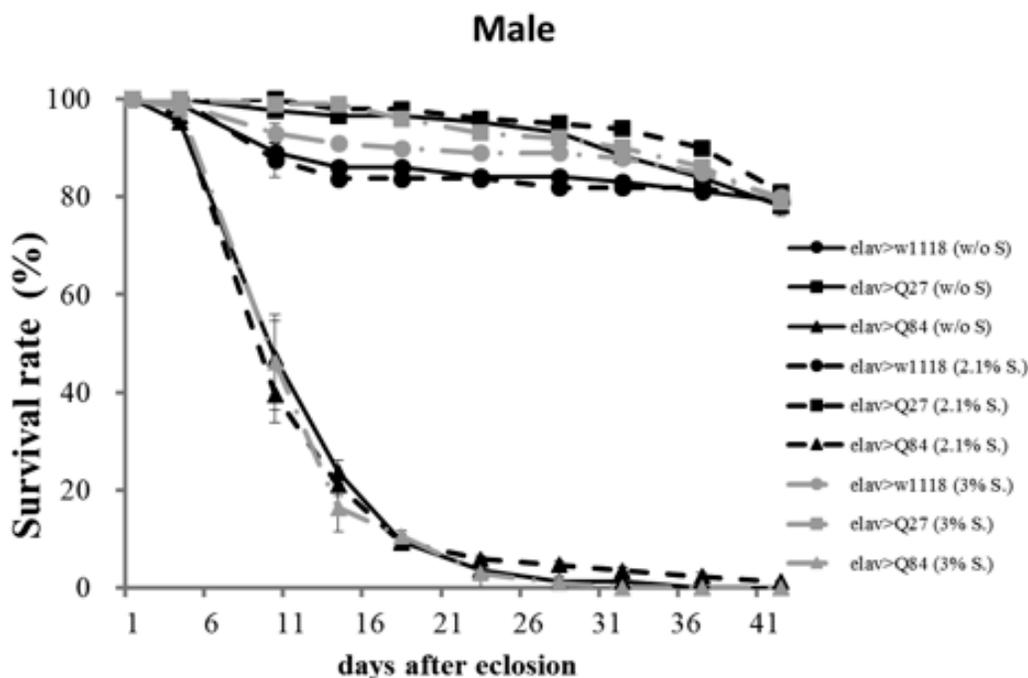
CONCLUSIONS: These data demonstrate that neurosurgery and otolaryngology procedures are associated with a significant increase in CSF tau levels and neuroinflammation at 24 h, but these increases are largely independent of anesthetic type. Future studies will determine the prognostic significance of these perioperative CSF marker elevations.

REFERENCES:

1. Avidan MS, Searleman AC, Storandt M, Barnett K, Vannucci A, Saager L, Xiong C, Grant EA, Kaiser D, Morris JC, Evers AS. Long-term cognitive decline in older subjects was not attributable to noncardiac surgery or major illness. *Anesthesiology* 2009;111:964-70.
2. Chen CW, Lin CC, Chen KB, Kuo YC, Li CY, Chung CJ. Increased risk of dementia in people with previous exposure to general anesthesia: A nationwide population-based case-control study. *Alzheimers Dement* 2013.
3. Chen PL, Yang CW, Tseng YK, Sun WZ, Wang JL, Wang SJ, Oyang YJ, Fuh JL. Risk of dementia after anaesthesia and surgery. *Br J Psychiatry* 2013.
4. Berger M, Burke J, Eckenhoff R, Mathew J. Alzheimer's Disease, Anesthesia, and Surgery: A Clinically Focused Review. *J Cardiothorac Vasc Anesth* 2014;28:1609-23.
5. Seitz DP, Shah PS, Herrmann N, Beyene J, Siddiqui N. Exposure to general anesthesia and risk of Alzheimer's disease: a systematic review and meta-analysis. *BMC Geriatr* 2011;11:83.
6. Eckenhoff RG, Johansson JS, Wei H, Carnini A, Kang B, Wei W, Pidikiti R, Keller JM, Eckenhoff MF. Inhaled anesthetic enhancement of amyloid-beta oligomerization and cytotoxicity. *Anesthesiology* 2004;101:703-9.
7. Tang JX, Mardini F, Janik LS, Garrity ST, Li RQ, Bachlani G, Eckenhoff RG, Eckenhoff MF. Modulation of murine Alzheimer pathogenesis and behavior by surgery. *Ann Surg* 2013;257:439-48.
8. Xie Z, Culley DJ, Dong Y, Zhang G, Zhang B, Moir RD, Frosch MP, Crosby G, Tanzi RE. The common inhalation anesthetic isoflurane induces caspase activation and increases amyloid beta-protein level in vivo. *Ann Neurol* 2008;64:618-27.
9. Ye X, Lian Q, Eckenhoff MF, Eckenhoff RG, Pan JZ. Differential general anesthetic effects on microglial cytokine expression. *PLoS One* 2013;8:e52887.
10. Zhang Y, Zhen Y, Dong Y, Xu Z, Yue Y, Golde TE, Tanzi RE, Moir RD, Xie Z. Anesthetic propofol attenuates the isoflurane-induced caspase-3 activation and Aβ oligomerization. *PLoS One* 2011;6:e27019.
11. Zhang Y, Dong Y, Xu Z, Xie Z. Propofol and magnesium attenuate isoflurane-induced caspase-3 activation via inhibiting mitochondrial permeability transition pore. *Med Gas Res* 2012;2:20.

S-166.**SEVOFLURANE MAY NOT INDUCE LONG-TERM TOXICITY ON SPINOCEREBELLAR ATAXIA TYPE 3 TRANSGENIC DROSOPHILA MODEL****AUTHORS:** C. Chen¹, W. Lin², K. Chen³, Y. Kuo⁴, H. Liu⁵, C. Li¹**AFFILIATION:** ¹Graduate Institute of Clinical Medical Science, China Medical University, Taichung, Taiwan, ²Institute of Integrated Medicine, China Medical University, Taichung, Taiwan, ³Department of Anesthesiology, China Medical University Hospital, Taichung, Taiwan, ⁴Department of Biomedical Imaging and Radiological Science, China Medical University, Taichung, Taiwan, ⁵Graduate Institute of Acupuncture Science, China Medical University, Taichung, Taiwan.**INTRODUCTION:** Spinocerebellar ataxia type 3 (SCA3) is a rare inherited neurodegenerative disease and it is incurable. Sevoflurane is one of the most commonly used volatile anesthetics for general anesthesia during surgery. Sevoflurane has previously been shown to be toxic effects on some neurodegenerative diseases, but the neurologic relationship with sevoflurane and SCA3 was still unknown. However, there is no study for the effects of inhalational anesthetics on long-term outcome. One of the advantages of *Drosophila* model in researches is more than 77% of known human genes are recognizably matched in the genome of *Drosophila*^{1,2}. Therefore, we investigate the long-term effects of sevoflurane, currently the most commonly used inhalational anesthetic, on the overall survival in SCA3 transgenic *Drosophila*.**METHODS:** We used five strains of *Drosophila*: *elav>Gal4*, *w1118*; *P{UAS-SCA3.fl-Q84.myc}7.2/MKRS* (*UAS-Q84*), *w1118*; *P{UAS-SCA3.fl-Q27.myc}46.2* (*UAS-Q27*), and *w1118* (wild type). All flies were obtained from Bloomington *Drosophila* Stock Center. Virgin female flies carrying the driver *elav>Gal4* on X chromosome were crossed to males carrying the *UAS-Q27* or *UAS-Q84*. All F1 offspring expressed Q27 or Q84 separately in the nervous system, giving us a model for SCA3. The virgin female flies carrying the driver *elav>Gal4* were crosses to *w1118* male fliesand their F1 offspring were used as control. SCA3-transgenic and control flies were exposed to sevoflurane with 2.1% or 3.0% plus 100% oxygen for 4 times (1 hour per time per day) and observed survival rate of flies. Flies were exposed to sevoflurane at 6th days after eclosion and anesthetic and oxygen concentrations were measured continuously (Dräger Medical AG & Co., Germany). The flies were maintained at a density of 35 per vial, at 25°C in 50 to 60% relative humidity under a 12-h light:12-h dark (LD) cycle, and transferred to new food every 3 or 4 days until all SCA3 transgenic flies dead³.**RESULTS:** The survival rate of anesthetized SCA3-transgenic flies (2.1% or 3.0% sevoflurane) had no significant difference compared with control. The survival curves of SCA3 disease male flies, which were exposed to different concentration of sevoflurane (2.1% or 3.0%) were similarity with SCA3-transgenic flies which were not exposed (Figure 1).**CONCLUSIONS:** This finding indicated that sevoflurane might not attenuate the neurologic abnormality in SCA3 transgenic *Drosophila* Model. We found that sevoflurane in clinically relevant concentrations might not affect the overall survival of control and SCA3-transgenic flies. This suggests that sevoflurane might not have long-term neurotoxic effects and general anesthesia with sevoflurane might be still effective and safe in clinical practices including the elderly and patients with SCA3. Future studies are necessary to determine whether inhalational anesthetics may induce neurotoxic or neuroprotective effects, which may eventually lead to safer anesthesia care for patients.**REFERENCES:**

1. *Neurobiol Dis* 40:29-39 (2010)
2. *Exp Gerontol* 46:335-9 (2011)
3. *J Nutr Biochem* 19:376-83 (2008)



S-167.**THE EFFECT OF LIDOCAINE ON APOPTOTIC NEURODEGENERATION IN THE DEVELOPING MOUSE BRAIN**

AUTHORS: J. KIM, J. Lee

AFFILIATION: Anesthesiology and Pain Medicine, Seoul National University Hospital, Seoul, Korea, Republic Of

INTRODUCTION: General anesthetics induce the neuronal apoptosis in the immature brain. Regional anesthesia using local anesthetics can be an alternative to general anesthesia. Therefore, this study investigated the possible effect of lidocaine on neuronal apoptosis.

METHODS: Fifty-one 7-day-old C57BL6 mice were allocated into control (group C), lidocaine (group L), lidocaine plus midazolam (group LM) and isoflurane (group I) groups. Group C received normal saline administration. Groups L and LM were injected with lidocaine (4 mg/kg, subcutaneously) only and the same dose of lidocaine plus midazolam (9 mg/kg, subcutaneously). Group I was exposed to 0.75 vol% isoflurane for 6 h. After 6 h, apoptotic neurodegeneration was assessed using caspase-3 immunostaining and TUNEL staining.

RESULTS: For the entire brain section, neuronal cells exhibiting caspase-3 activation were observed more frequently in group I than C ($P < 0.001$). In the thalamus, apoptosis of group L was more than that of group C ($P < 0.001$), but less than group LM and I ($P = 0.0075$ and $P < 0.001$, respectively). In the cortex, group I experienced more apoptosis than group L and C (all $P < 0.001$). On TUNEL staining, the difference in apoptosis between lidocaine and control groups was marginal ($P = 0.05$).

CONCLUSIONS: Lidocaine induced minimal apoptosis in the developing brain compared with isoflurane and lidocaine plus midazolam. However, we cannot fully exclude the possible adverse effect of subcutaneously administered lidocaine on the developing brain.

S-168.**THE CEREBRAL BLOOD FLOW THRESHOLD FOR MEMBRANE REPOLARIZATION IS NOT ASSOCIATED WITH RESIDUAL CEREBRAL BLOOD FLOW DURING ISCHEMIC DEPOLARIZATION IN RATS**

AUTHORS: H. Kawase, Y. Takeda, R. Mizoue, S. Sato, H. Morimatsu

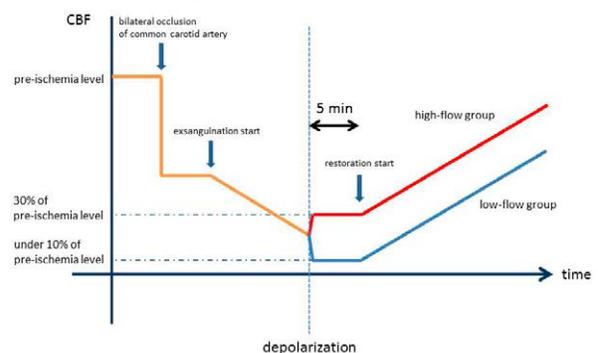
AFFILIATION: Anesthesiology and Resuscitology, Okayama University, Okayama, Japan

INTRODUCTION: Cerebral blood flow (CBF) supplied by chest compression represents 20-40% of pre-ischemia levels. We found that the CBF threshold for membrane repolarization was significantly higher than that for membrane depolarization. However, it is not known whether the residual CBF during depolarization has an impact on the CBF threshold for membrane repolarization. In the present study, we compared the CBF threshold for repolarization between 2 groups that had different residual CBF values during ischemic depolarization.

METHODS: Ten rats in each group were anesthetized with isoflurane. CBF was measured by placing a laser-Doppler flow probe adjacent to a direct current (DC) potential electrode in the parietal cerebral cortex. After bilateral occlusion of the common carotid artery, CBF was decreased continuously by exsanguination at a speed of 2.5% of the baseline level every 1 min until a sudden negative DC shift was observed. After depolarization was observed, residual CBF was controlled at 30% of the pre-ischemia level in the high-flow group, and at under 10% of the pre-ischemia level in the low-flow group. After 5 min of ischemic depolarization, the CBF was restored at the same rate by returning blood until a positive DC shift was observed.

RESULTS: The threshold for depolarization in the high-flow group was $22.2 \pm 5.8\%$, and that in the low-flow group was $20.6 \pm 9.7\%$. There was no significant difference in the threshold for membrane depolarization between the 2 groups ($p = 0.67$). After the onset of depolarization, the mean CBF during depolarization increased to $26.9 \pm 2.1\%$ of the pre-ischemia level in the high-flow group, targeted to 30% of the pre-ischemia level, and decreased to $9.3 \pm 2.8\%$ of the pre-ischemia level in the low-flow group targeted to $<10\%$ of the pre-ischemia level. The mean CBF during depolarization was controlled at a significantly higher level in the high-flow group than in the low-flow group ($p < 0.00001$). The threshold for repolarization in the high-flow group was $45.2 \pm 7.9\%$, and that in the low-flow group was $45.0 \pm 10.6\%$. The threshold for repolarization in the high-flow group was not significantly different compared to that in the low-flow group ($p = 0.95$).

CONCLUSIONS: The thresholds for repolarization were not significantly different between the high-flow and low-flow residual CBF groups during ischemic depolarization. CBF during ischemic depolarization does not have an impact on the thresholds for membrane repolarization.

Time course of CBF

S-169.

EFFECTS OF ANESTHESIA, SURGERY, AND APOE4 IN THE ELDERLY

AUTHORS: K. J. Schenning¹, C. F. Murchison², N. C. Mattek², J. A. Kaye², J. F. Quinn²

AFFILIATION: ¹Anesthesiology & Perioperative Medicine, Oregon Health & Science University, Portland, OR, ²Neurology, Oregon Health & Science University, Portland, OR

INTRODUCTION: Preclinical studies have shown that surgery and anesthesia contribute to cognitive decline and enhance neuropathologic changes that underlie Alzheimer’s disease (AD).¹⁻³ Human investigations have identified biomarker changes following anesthesia and surgery that may represent an increased risk of AD.⁴ Nevertheless, the link between anesthesia, surgery, and AD remains unclear. While presence of an apolipoprotein E ε4 (APOE4) allele increases the risk of developing AD, an association between APOE4 and postoperative dementia is not established. We hypothesized that exposure to general anesthesia (GA) and surgery in the elderly is associated with an accelerated deterioration of cognition, function, and brain volumes, and that this decline is more rapid in those with an APOE4 allele.

METHODS: We performed a retrospective cohort analysis of two natural history studies of aging. After controlling for age, gender, years of education, and Cumulative Illness Rating Scale, we used mixed-effects models to assess the relationship between exposure to GA/surgery and longitudinal change in measures of cognition, function, and brain volumes (Table 1). Using this data, we examined whether the presence of APOE4 was associated with a more rapid rate of decline following GA/surgery.

RESULTS: Descriptive statistics of the cohort are listed in Table 2. Of a total of 527 participants, 182 underwent a total of 331 procedures under GA after enrollment in the study. Mean length of follow-up was 7 years (SD=4.6). There was a wide range in the types of procedures.(Figure 1) The “exposed” group experienced a significantly more rapid rate of deterioration compared to the “unexposed” group in the following outcomes: Mini-Mental State

Examination (MMSE) (p<0.001), Clinical Dementia Rating (CDR) (p<0.001), CDR sum of boxes (p<0.001), Activities of Daily Living (ADL) (p<0.001), Instrumental Activities of Daily Living (IADL) (p=0.002), Delayed Logical Memory (p=0.011), and ventricular volume (p=0.03). Among exposed participants, those with at least one APOE4 allele (n=41) experienced a faster rate of deterioration than those without an APOE4 allele (n=141) in the following: MMSE (p<0.01), CDR (p=0.018), CDR sum of boxes (p<0.001), ADL (p<0.001), IADL (p<0.001), and ventricular volume (p=0.017). No significant differences were observed in measures of executive function, attention, or concentration.

CONCLUSIONS: Elderly participants with an exposure to GA/surgery had a more rapid rate of decline in dementia scores, functional status, and memory, and increase in ventricular volumes when compared to participants who did not undergo GA/surgery. Further, among the “exposed” participants, APOE4 carriers had significant exacerbations in the rate of deterioration in cognition, function, and ventricular volumes when compared to participants without an APOE4 allele.

REFERENCES:

1. Anesthesiology 2004;101:703-9
2. Ann Neurol 2011;70:986-95
3. J Neurosci 2007;27:3090-7
4. J Alzheimers Dis 2010;21:1153-64

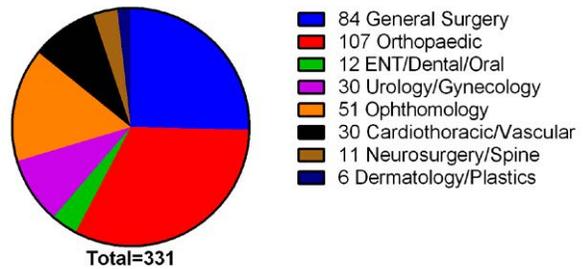


Table 1. Outcome Measures

Cognitive outcome measures	Mini-Mental State Examination (MMSE), Clinical Dementia Rating (CDR), CDR sum of boxes, Consortium to Establish a Registry for AD (CERAD) Word List Delayed Recall, Animal Fluency, Trail Making Test B, Digit Symbol Test, Logical Memory Delayed Recall
Functional outcome measures	Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Functional Activities Questionnaire (FAQ)
Neuroimaging outcome measures	Total brain volume, hippocampal volume, ventricular volume, white matter hyperintensity volume

Table 2. Baseline Characteristics of Exposed and Unexposed

	Exposed (n=182)	Unexposed (n=345)	p-value
Mean Age (years)	80.0 (SD=7.4)	83.9 (SD=7.0)	<0.0001
Female (%)	61%	68%	0.10
Mean Education (years)	15.1 (SD=2.7)	14.8 (SD=2.7)	0.33
Cumulative Illness Rating Scale	20.2 (SD=3.3)	20.5 (SD=3.5)	0.56
Presence of an APOE4 allele (%)	23%	22%	0.68

S-170.**ANESTHETIC TOXICITY IN RATS: RHOGTPASES, GROWTH CONE COLLAPSE, AND AXONAL TRANSPORT****AUTHORS:** M. L. Pearn, M. Kodama, P. Patel, B. Head**AFFILIATION:** Anesthesiology, UCSD, San Diego, CA

INTRODUCTION: A wide body of evidence indicates that anesthetic exposure during synaptogenesis in the developing brain causes widespread neurodegeneration, electrophysiologic abnormalities and long term cognitive deficits. Although the mechanism by which anesthetics injure the neonatal brain is not known, GABA-A mediated excitation, NMDAR antagonism mediated excitotoxicity, aberrant cell cycle entry, mitochondrial injury and free radical mediated toxicity play a role. Work from our laboratory has demonstrated that preferential signaling of proBDNF via p75NTR leads to activation of RhoA, actin dysregulation, loss of dendritic spines and loss of synapses. That inhibition of RhoA attenuates these adverse effects suggests that agents that inhibit RhoA might prevent cognitive deficits attendant with neonatal anesthetic exposure.

The means by which anesthetic induced actin dysregulation leads to neurotoxicity is not clear. Development of neuronal networks requires active axonal growth with appropriate targeting and formation of synapses. In addition, both retrograde and anterograde transport of material is critical to axonal growth. The axonal growth cone at the tip of the axon is required for growth and proper pathfinding. A dynamically regulated actin cytoskeleton is essential for normal growth cone morphology. Indeed, dysregulation of actin leads to growth cone collapse and aberrant synaptic connections. RhoGTPases, which include RhoA, Rac1 and Cdc42, are key regulators of the actin cytoskeleton. Moreover, these RhoGTPases are required for proper axonal transport of signaling endosomes.

We hypothesize that during the vulnerable period of DIV5-7, anesthetic exposure leads to increased RhoA activation, disruption of normal actin cytoskeleton dynamics, growth cone collapse, and impaired retrograde axonal transport. RhoA inhibition prior to anesthetic exposure will rescue neurons from anesthetic mediated growth cone collapse and retrograde axonal transport impairments.

METHODS: Primary rat embryonic neurons (E18) were cultured for 5 days in vitro (DIV5-7) and exposed to propofol (PPF). A subset of neurons were pretreated with C3 toxin (RhoA inhibitor) prior to PPF exposure. Growth cones were stained for F-actin to assess growth cone area. Retrograde axonal transport was assayed by live cell imaging of quantum dot labeled BDNF (BDNF-QD).

RESULTS: PPF exposure at DIV5-7 results in increased RhoA activation, dysregulation of actin dynamics, growth cone collapse, and impaired retrograde axonal transport of QD-BDNF; these deleterious effects are attenuated by RhoA inhibition prior to PPF exposure.

CONCLUSIONS: These results demonstrate that PPF exposure in developing neurons results in increased RhoA signaling, growth cone collapse and impaired retrograde axonal transport of QD-BDNF. Propofol mediated growth cone collapse and impaired axonal transport are attenuated by RhoA inhibition. These findings expand our knowledge of anesthetic mediated neurotoxicity in developing neurons and identify novel targets for therapeutic intervention in the event that toxicity is demonstrated in humans.

S-171.**EFFECT OF ACUTE POST-CRANIOTOMY HEADACHE ON LONG-TERM QUALITY OF LIFE AND THE DEVELOPMENT OF NEUROPATHIC PAIN****AUTHORS:** A. Morad, C. Miller, E. White, M. Yaster, A. Gottschalk**AFFILIATION:** Anesthesiology and Critical Care Medicine, Johns Hopkins School of Medicine, Baltimore, MD

INTRODUCTION: Pain following craniotomy is common and often undertreated.^{1,2,3} However, little is known about how long the pain lasts or whether acute analgesic therapy might impact the development of chronic headache. Therefore, the primary aim of the present study was to determine the duration of pain following craniotomy, its effects on quality of life, and the incidence of any neuropathic pain after discharge. We hypothesized that aggressive postoperative pain management with IVPCA would reduce the incidence of chronic post-craniotomy headache.

METHODS: After obtaining IRB approval, 110 adult patients scheduled for supratentorial craniotomy for tumor were consented preoperatively. Brief pain, quality of life and neuropathic pain surveys were administered prior to OR entry. Following a standardized course of general anesthesia, patients were randomized in the neurosciences critical care unit to receive either PRN fentanyl 25-50 µg IV every 20 minutes or PCA fentanyl 20 µg IV every 8 minutes (up to a maximum of 7.5 doses/hour) in addition to receiving usual ICU care. After discharge from the hospital, all patients received a brief telephone survey to assess for chronic pain, neuropathic pain, and quality of life 1,2,3, and 6 months postoperatively.

RESULTS: One hundred ten subjects (M/F=56/54) mean age (SD) 49.3 (14.0) were enrolled in the study. Over half of all subjects (56.1%) reported pain at any time after discharge but never greater than 2/10. Despite the generally low postoperative pain scores, pain was associated with decreased activities on the quality of life survey (p=0.008). Preoperative pain was associated with incidence and magnitude of pain after discharge (p=0.001) and anxiety/depression (p=0.002), but not gender, age, or PCA use (p>0.41). In those patients without preoperative pain, 64.3% were without pain at any time postoperatively. Neuropathic symptoms were reported by 84% of subjects. These were associated with female gender and postoperative pain (p<=0.001), but not age, preoperative pain, or PCA use (P>0.20).

CONCLUSIONS: Post-craniotomy pain appears to persist beyond the immediate postoperative period and often develops into neuropathic sensitization while affecting quality of life. There does not appear to be an association between modality of postoperative opioid administration on long-term outcomes, although the present study was not powered to determine such effect. Future studies will be necessary to further understand effects of acute pain and its management on the development of chronic pain.

REFERENCES:

1. J Neurosurg. 106(2):210-6. 2007.
2. J Neurosurg. 111(2):343-50. 2009.
3. Anesth Analg. 114(2):416-23. 2012.

S-172.

THE RELATIONSHIP BETWEEN PREOPERATIVE MEMORY FORMATION AND AWAKE BISPECTRAL INDEX READINGS

AUTHORS: D. J. Blech¹, R. L. Wagner¹, M. D. Allain¹, X. Zheng¹, P. O'Connor², M. O'Connor², D. Glick²

AFFILIATION: ¹Pritzker School of Medicine, University of Chicago, Chicago, IL, ²Anesthesia and Critical Care, University of Chicago, Chicago, IL

INTRODUCTION: Awareness with recall (AWR) is an uncommon but potentially dangerous occurrence in anesthetic practice.¹ To guard against instances of AWR, clinicians may use awareness monitors like the BIS Vista (Covidien), which processes EEG information and outputs a single dimensionless integer that indicates the patient's level of wakefulness. The BIS monitor was initially shown to be more effective than other monitoring techniques in preventing AWR,² but more recent studies have called this into question.³ The present study was designed to assess if BIS values are correlated with memory formation, a fundamental component of AWR that can be studied outside the operating room.

METHODS: 258 subjects were enrolled in the study. All were adult surgical patients who received preoperative midazolam and general anesthesia. Each subject was fitted with a BIS Vista monitor in the preoperative area. BIS values were recorded five, three and one minutes pre-midazolam, at the time of midazolam administration,

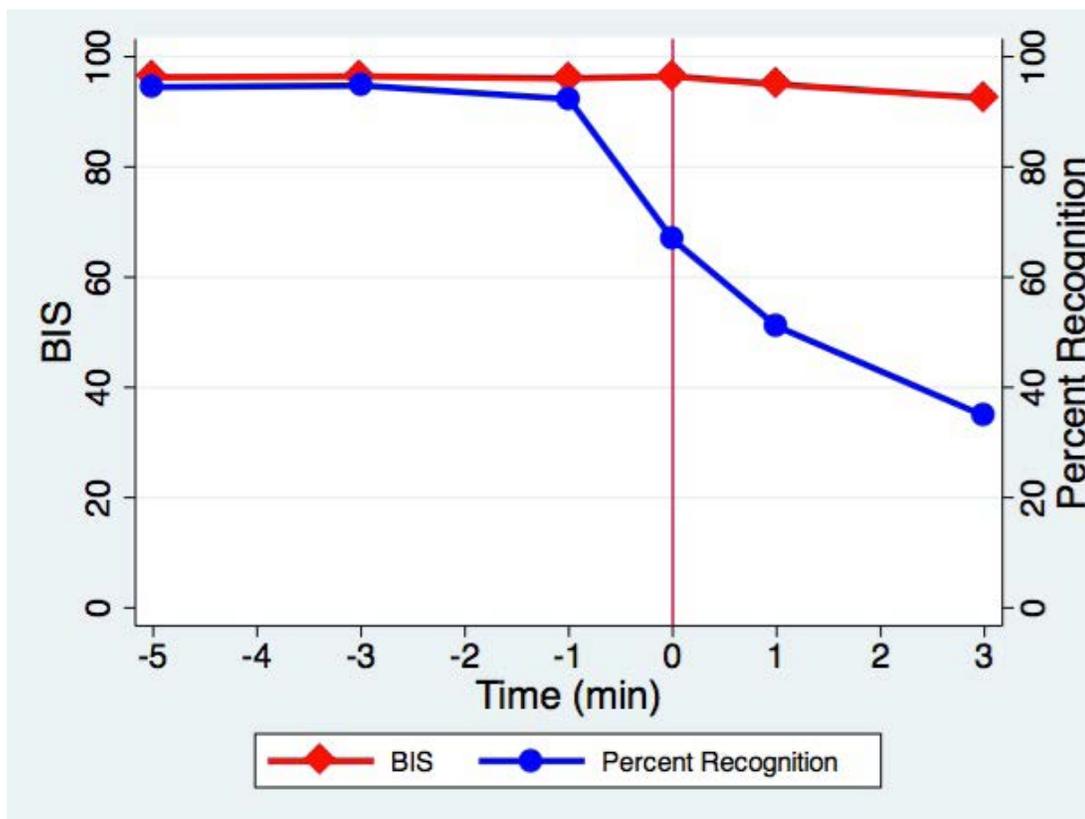
and one and three minutes afterwards. At each of these times, a unique word was given for the subject to remember. On the day following the operation, subjects were invited to select the words they could remember from a list containing the six given words and 18 others. A Wilcoxon rank-sum test was used to investigate the correlation between BIS scores and word recognition.

RESULTS: For the word given one minute after midazolam administration, the mean BIS scores for those who did and did not recognize the word were 95.9 and 94.2, respectively (p = .002). Of the five other words subjected to analysis, none yielded a statistically significant difference between BIS scores of subjects who recognized the words and those who did not.

CONCLUSIONS: Although one significant difference was found, the discrepancy in BIS scores is too small to permit prediction of memory formation in the clinical setting. The dataset as a whole suggests that a relationship between BIS and memory formation cannot be established. It is notable that the downward trend in subject word recognition precedes midazolam administration, suggesting a possible retrograde amnesic effect.

REFERENCES:

1. Anesth Analg 2004; 99(3):833-9
2. NEJM 2008; 358(11):1097-108
3. NEJM 2011; 365(7):591-600



S-173.**A MODEL OF ANESTHESIA: METASTABLE BRAIN STATES DIMINISH WITH A REDUCTION OF CORTICAL AROUSAL****AUTHORS:** A. Hudetz¹, C. Humphries², J. Binder²**AFFILIATION:** ¹Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, ²Neurology, Medical College of Wisconsin, Milwaukee, WI

INTRODUCTION: Understanding how anesthetic agents suppress cognition and consciousness has been a central but elusive problem for neuroscience. Subtle but specific changes in functional integration in the brain are currently considered as candidate mechanisms for explaining the anesthetic effects. Cognition is thought to depend on the dynamic formation of a repertoire of large-scale connectivity patterns that represent fundamental modes of information processing. The degree of diversity of these connectivity patterns reflects the information capacity of the brain and determines the state of consciousness. It is hypothesized that a disruption of the dynamics of large-scale (global) brain states may account for the anesthetic suppression of consciousness. In this work, we examined how a reduction in cortical arousal or activation level would interfere with the ongoing dynamics of global brain states. A computer model was used to simulate brain states as a function of cortical activation level. The modified spin-glass model describes stochastic UP/DOWN state transitions of local neuronal populations as a function of their interactions. The interacting sites were constrained by resting-state functional magnetic resonance imaging (fMRI) data recorded in 20 participants and mapped to 10,000 small (~20mm²) cortical regions (sites) defined on a group-aligned cortical surface map. Cross-correlation matrices of the mapped BOLD time courses of all sites were calculated and averaged across subjects. All sites stochastically transitioned between UP and DOWN states under the net influence of 16 other sites with the highest pair-wise correlation. The probability of transitions was controlled by the level of cortical activation, T . We ran iterative simulations consisting of 10,000 time steps at several values of T . At intermediate T , global state patterns were highly dynamic, i.e., metastable, suggesting critical behavior and high information processing capacity. At critical T , the diversity of global brain states reached maximum, suggesting maximum information capacity. Reduced T (representing “anesthesia”) and increased T (“seizure”) moved the system away from equilibrium, reducing the number of metastable states. The results suggest a specific mechanism by which a reduction in cortical arousal could disrupt the dynamics of large-scale brain states underlying the stream of consciousness.

S-174.

SEARCH FOR COGNITIVE DYSFUNCTION PLASMA AND ANATOMICAL BIOMARKERS FROM ADNI ALZHEIMER'S DATABASE

AUTHORS: R. P. Kline, F. F. Cuadrado

AFFILIATION: Anesthesiology, NYU Langone Medical Center, New York, NY

INTRODUCTION: Numerous reports link surgery with cognitive (cog) problems¹. Since surgery is associated with cortical atrophy² and cytokine elevation³, also reported during Alzheimer's disease (AD), identifying useable AD risk factors could be enlightening in terms of predicting POCD (post operative cognitive dysfunction). The Alzheimer's Disease Neuroimaging database (ADNI) has over a hundred each of plasma analytes and MRI derived cortical dimensions available as biomarkers (BM). With so many values, correlations can be detected occurring only by chance or due to unique cases. Therefore, we analyzed data by compressing groups of similarly behaving BM into derived single variables (eigenvectors) using principal component analysis. These eigenvectors (EV) can be examined along with cog scores showing time progression of effects on memory (Mem) & executive function (ExFn) (fig 1; stable MCI/4 vs unstable MCI/5).

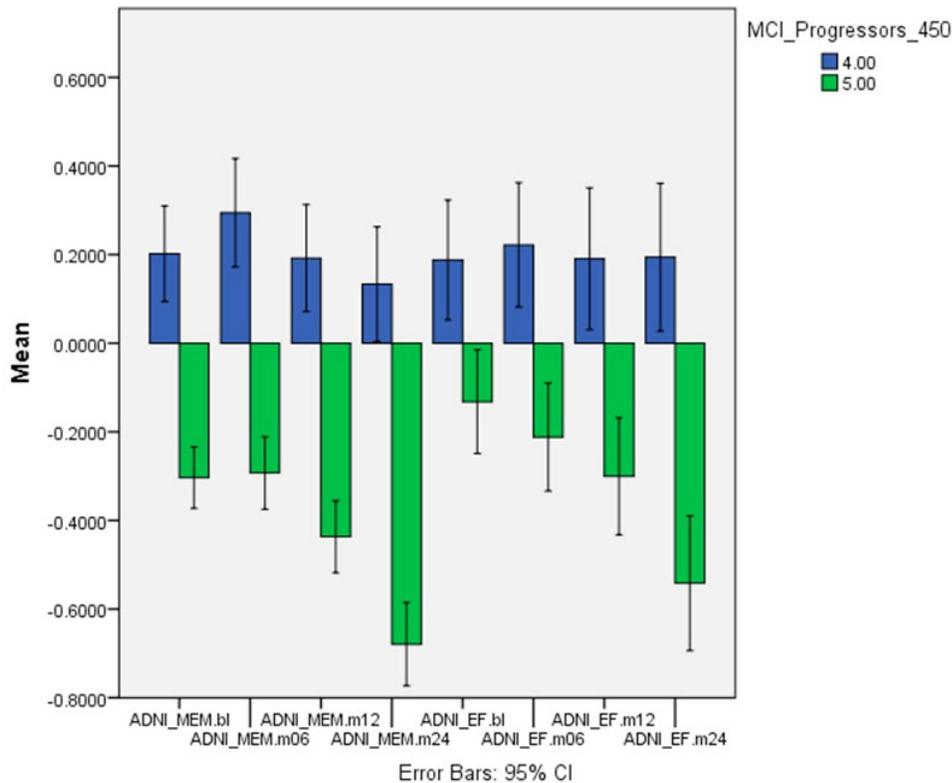
METHODS: We compressed 75 plasma analytes into 5 orthogonal EVs, and 42 MRI BM into 5 additional EVs. The 42 variables were previously chosen for significance (sig) at predicting progression of MCI to AD⁴. Only baseline EV were used. The ADNI database has pre-analyzed cognition, combining over a dozen cog tests into a composite Mem test and a composite ExFn test calculated at baseline, 6, 12 and 24 months (mos). To examine the impact of these EVs on cog function, we used the spearman rho correlation (corr) function, adding linear regression and repeat measures ANOVA (version 21,SPSS) to confirm relationships with memory. Reported values for MCI subjects only.

RESULTS: We found good corr between cog scores and 3 of the 5 anatomical MRI EVs (p=0.000) at all time points. For 1 analyte EV (ExFn), the corr occurred initially (p = 0.002), but was lost at 24 mos; the other EV did not correlate at baseline, but showed increasing sig until a good correlation at 12 & 24 mos (p<0.01; both Mem & ExFn). The forward improvement pattern also was found for 2 of 5 individual analytes comprising the EV, e.g. Apolipoprotein Ai & Ci. These showed no corr at baseline (p = 0.12-0.72) but improved (p<0.06 at 12 & 24 mos). We used linear regression to model the 24 month Mem or ExFn scores with the 10 EVs plus baseline cog scores. At least 5 of the BMs plus the baseline cog score produced a highly sig model (F= 139 [421,11], p = 0.000), including plasma EVs 1 & 5 (p<0.001) and MRI EV1 (p=0.000; ~ temporal lobe) and EV4 (p=0.013; ~Amygdala, ERC, Hip). Individual analytes sampled from analyte EVs also showed sig using repeat measures (ApoCi, p=0.001; ApoAi & Eotaxin3, p <0.05). Two of these MRI & one analyte EV corr (p<0.01) with the well known CSF BM- the tau/ amyloid beta ratio.

CONCLUSIONS: Cog changes can be predicted using combinations of anatomical & plasma analyte values. We are currently working with machine learning techniques to develop a quantitative risk index based on a flexible combination of BMs, robust statistical confidence, but concentrating on plasma BMs as the initial screen.

REFERENCES:

1. Anesthes, 108(1): 18, 2008;
2. Anesthes, 116(3): 603, 2012;
3. J Gerontol A Biol Sci Med Sci, 62(4): 420, 2007;
4. Curr Alzheimer Res, 6(4):347,2009



S-175.**ASTROCYTES ATTENUATE PROPOFOL-INDUCED TOXICITY IN DEVELOPING RAT HIPPOCAMPAL NEURONS VIA BDNF- AND VEGF-DEPENDENT PATHWAYS**

AUTHORS: Y. Liu¹, X. Bai², Y. Yan³, D. Twaroski², Z. Ge¹, Z. J. Bosnjak²

AFFILIATION: ¹Anesthesiology, Medical College of Wisconsin, Milwaukee, WI, ²Anesthesiology & Physiology, Medical College of Wisconsin, Milwaukee, WI, ³Anesthesiology, Medical college of wisconsin, Milwaukee, WI

INTRODUCTION: Emerging evidence suggests that propofol, a widely used intravenous anesthetic agent, induces neuronal death in developing animal brains^{1,2}. However, how astrocytes, the most abundant glial cells, respond to propofol and contribute to neurotoxicity remains unclear. Previous studies have shown that increasing vulnerability of neurons to anesthetics occurs during the brain growth spurt when astrocytes are less developed than that in adults^{3,4}. In this study, we hypothesized that insufficient number of astrocytes may contribute to the increase in neuronal vulnerability to propofol.

METHODS: Hippocampal astrocytes and neurons isolated from neonatal Sprague Dawley rats were exposed to varying clinically relevant doses of propofol for 6 h or dimethyl sulfoxide (DMSO) as control. Neurons were co-cultured with astrocytes at 1:9 and 1:1 ratios of astrocytes/neurons in transwell system in the presence or absence of propofol (30 μ M). Brain derived neurotrophic factor (BDNF) or vascular endothelial growth factor (VEGF)-C was added into 1:9 co-cultures in the presence or absence of LY294002, an inhibitor of PI3K/Akt survival pathway. The 1:1 co-cultures were exposed to propofol in the presence or absence of LY294002. Cell death was measured 12 h following propofol exposure by double staining with propidium iodide and Hoechst 33342. Astrocyte-derived growth factors in conditioned medium from cultured astrocytes for 12 h following propofol exposure were analyzed using rat protein array through dot blot analysis.

RESULTS: Propofol induced cell death in a dose-dependent manner in neurons ($P < 0.05$, $n = 3$), but did not cause cell death in astrocytes ($P > 0.05$, $n = 3$). The detrimental effect of propofol at 30 μ M was significantly blocked by addition of astrocytes to neurons at a ratio of 1:1 ($P < 0.05$, $n = 5$), but not at a ratio of 1:9 ($P > 0.05$, $n = 3$) compared to DMSO control. Rat protein array revealed that BDNF and VEGF-C are two most abundant growth factors released from astrocyte conditioned medium. Addition of BDNF and VEGF-C significantly reduced cell death of the neurons in 1:9 co-cultures ($P < 0.05$, $n = 3-5$) while LY294002 blocked BDNF- or VEGF-C-induced neuronal protection ($P < 0.05$, $n = 3$). In 1:1 co-cultures, the additional astrocyte-induced neuronal protection from propofol-induced toxicity was abolished by LY294002 ($P < 0.05$, $n = 3$).

CONCLUSIONS: Hippocampal developing astrocytes are more tolerant to propofol than neurons. Astrocytes protect neurons against propofol-induced injury through BDNF- and VEGF-dependent pathways. Propofol-induced toxicity in developing hippocampal neurons is related to insufficient paracrine protection from astrocytes.

REFERENCES:

1. Neurosci Lett, 2013. 534: p. 41-6.
2. Br J Anaesth, 2013. 110 Suppl 1: p. i29-38.
3. Proc Natl Acad Sci U S A, 2009. 106(33): p. 14108-13.
4. Genes Dev, 2012. 26(9): p. 891-907.

S-176.**WITHDRAWN.**

S-177.**GENETIC MOUSE TOOLS FOR THE ANALYSIS OF INHIBITORY NEURONS IN ANESTHESIOLOGY AND PAIN RESEARCH****AUTHORS:** S. Hulsmann¹, S. Besser², J. Hirrlinger³**AFFILIATION:** ¹Anesthesiology, University Medical Center Gottingen, Gottingen, Germany, ²Carl-Ludwig-Institut für Physiologie, University Leipzig, Leipzig, Germany, ³Carl-Ludwig-Institute for Physiology, University Leipzig, Leipzig, Germany.**INTRODUCTION:** Inhibitory neurons play an important role in neuronal networks that are relevant for the anesthesiologist e.g. in the respiratory network, in the thalamic circuitry for temperature regulation as well as for pain-pathways and spinal regulation of nociception. Since GABA and glycine can be released from the same synaptic vesicle the range of synaptic function can be increased and, interestingly, such dual transmission is the default mode in the immature nervous system.**METHODS:** To functionally and developmentally analyze these neurons, we generated BAC-transgenic mouse lines that express fluorescent proteins and / or fragments of the Cre-recombinase under the control of promoters that are specific for GABAergic and glycinergic neurons, respectively.**RESULTS:** To label neurons for the periods they are actually capable to release GABA and glycine we generated GAD65-tdtomato mice and crossbred them with GlyT2-EGFP mice. Histological analysis revealed still dual transmitting neurons in adult brain. In a second step we employed the technique of temporal control of DNA recombination mediated by split-Cre protein fragment complementation to permanently label dual transmitting neurons and to follow-up their fate during postnatal development. We have confirmed successful complementation and recombination in vivo in the brainstem.**CONCLUSIONS:** Taken together our technique provides an unprecedented tool to study development and function of inhibitory neurons.

S-178.

PROTECTIVE EFFECT OF HUMAN MESENCHYMAL STEM CELLS AGAINST INTRACRANIAL ANEURYSM RUPTURE IN MICE

AUTHORS: A. Kuwabara, J. Liu, J. W. Lee, T. Hashimoto

AFFILIATION: Anesthesia, University of California, San Francisco, San Francisco, CA

INTRODUCTION: Mesenchymal stem cells (MSCs) are multipotent adult stem cells found in the bone marrow. They can differentiate into a variety of cell types including: osteoblasts, chondrocytes, and adipocytes. In addition, MSCs can modulate inflammation by affecting various inflammatory cell types. Therefore, the administration of MSCs has been proposed as a potential therapy for inflammation associated disorders such as sepsis in mice.

Inflammation is a key component of pathophysiology of intracranial aneurysm. We have demonstrated that mast cell can play a key role in intracranial aneurysm rupture. In addition, it has been reported that MSCs suppress mast cell activity via cyclooxygenase 2 (COX2) dependent mechanisms.

Therefore, we hypothesized that MSCs can reduce the rupture rate of intracranial aneurysm through a COX2 dependent mechanism.

METHODS: We used 8-week-old C57BL/6J male mice. Intracranial aneurysms were induced using a combination of a single injection of elastase into the cerebrospinal fluid and deoxycorticosterone acetate (DOCA) salt hypertension. We administered 1.0×10^6 allogeneic bone marrow-derived human MSCs or vehicle 6 days and 9 days after aneurysm induction into the jugular veins.

To investigate the mechanisms underlying the protective effects of MSCs against aneurysmal rupture, MSCs were pretreated with COX2 selective inhibitor (NS-398).

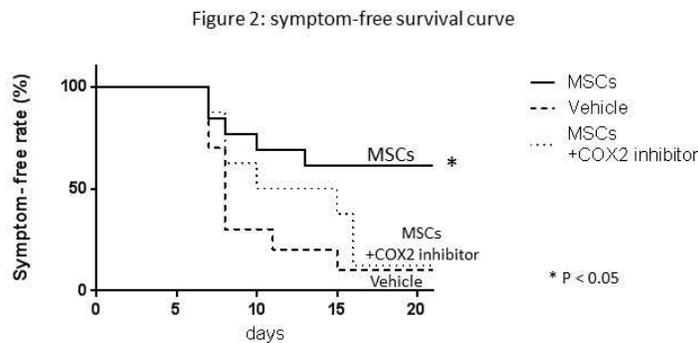
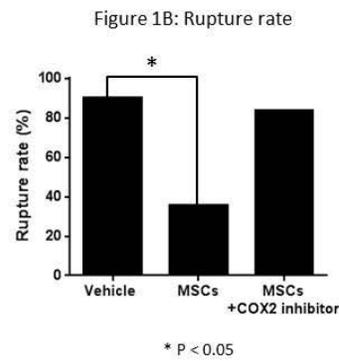
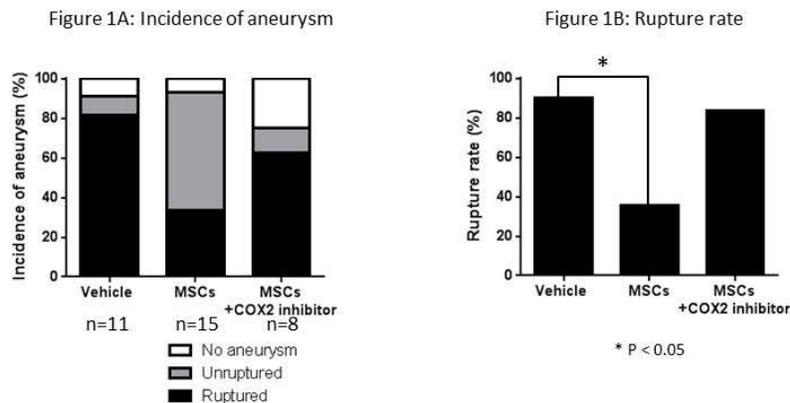
We performed daily neurological exam to detect aneurysmal rupture. When mice developed neurological symptoms, mice were sacrificed and we confirmed the presence of subarachnoid hemorrhage with intracranial aneurysms. Asymptomatic mice were sacrificed 21 days after aneurysm induction.

RESULTS: Incidence of aneurysm was similar in all 3 groups (Figure 1A). However, the rupture rate in the MSCs treatment group (n=15) was significantly lower than the vehicle treatment group (n=11) (36% in MSCs group, 90% in Vehicle group, $p < 0.05$, Figure 1B). The protective effect of MSCs against aneurysmal rupture was abolished by the pretreatment of MSCs with COX2 inhibitor (rupture rate: 83%). Symptom free survival curves were plotted after excluding mice that did not have any aneurysms. The symptom free survival curve of the MSCs group was significantly higher than the Vehicle Group ($p < 0.05$, Figure 2).

CONCLUSIONS: Intravenous administration of human MSCs may prevent aneurysmal rupture in a COX2 dependent fashion.

REFERENCES:

1. A mouse model of intracranial aneurysm: technical consideration. *Acta Neurochir Suppl.* 2011;111:31-5
2. Critical Roles of Macrophages in the Formation of Intracranial Aneurysm. *Stroke.* 2011;42:173-8
3. Concise review: Mesenchymal stem cells for acute lung injury: role of paracrine soluble factors. *Stem Cells* 2011;29:913-919
4. Bone marrow stromal cells inhibit mast cell function via a COX2-dependent mechanism. *Clin Exp Allergy* 2011;4:526-534



S-179.**SEVOFLURANE AND DESFLURANE INHIBIT SYNAPTIC STRENGTH OF NEWLY DEVELOPED SYNAPSES BETWEEN LYMNAEA NEURONS**

AUTHORS: R. Armstrong¹, F. Xu¹, D. Urrego¹, M. Qazzaz¹, M. Pehar², J. N. Armstrong², N. I. Syed¹

AFFILIATION: ¹Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada, ²Department of Anesthesia, University of Calgary, Calgary, AB, Canada

INTRODUCTION: Recent studies have called into question the safety of inhalational anesthetics on developing nervous systems. Inhalational anesthetics have been shown to result in cognitive defects in exposed children.¹ However, the mechanism underlying these cognitive effects is still relatively unknown at the level of the cell and of the synapse due partly to the complexity of the nervous system in mammalian models. In this study, we used the freshwater pond snail *Lymnaea*, which easily allows for the analysis of single synapses, to determine whether two common modern inhalational anesthetics, sevoflurane and desflurane, could negatively impact the formation and function of new synapses.

METHODS: Individual *Lymnaea* neurons were isolated and maintained in *Lymnaea* brain conditioned medium. Cholinergic synapse-forming neurons were plated in a soma-soma configuration. (Fig. 1A) Cells were allowed to rest for one hour after culture, and were then placed in a Billups-Rothenburg Modular Incubation Chamber and exposed to anesthetic overnight. Anesthetic was delivered with a Datex-Ohmeda Aestiva/5 anesthetic machine. Anesthetic concentrations were chosen to be roughly equipotent based on clinical MAC equivalency, and were verified with a Datex-Ohmeda gas analyzer. Synaptic responses were verified the following day by recording the post-synaptic potential (PSP) in response to current injection-elicited single action potentials in the presynaptic neuron. (Fig. 1B) To examine acute effects of sevoflurane and desflurane they were bubbled in *Lymnaea* saline for 20 minutes and immediately perfused through the dishes. Intracellular calcium levels were quantified with Fura-2 AM fluorescence.

RESULTS: Overnight exposure to either desflurane (4.3%) or sevoflurane (1.3%) did not significantly impact the percentage of paired cells that had formed a chemical synapse. (Fig 1C) However, in neuron pairs that form a chemical synapse, the strength of the excitatory post-synaptic potential was significantly reduced (***) $p < 0.001$ in neuron pairs exposed to both sevoflurane and desflurane. (Fig. 1D)

We further demonstrate that this effect is not due to an acute inhibition of pre-synaptic calcium channels, which is required for synaptic transmission. After 5 minutes of perfusion with anesthetic saline, calcium rise in response to current-injection induced action potentials did not change. (Fig. 2A) However, post-synaptic responses to exogenously applied acetylcholine, mimicking the response to pre-synaptic release of neurotransmitter, were inhibited in the presence of desflurane. (Fig. 2B)

CONCLUSIONS: Using a unique *Lymnaea* model, we demonstrate that both sevoflurane and desflurane inhibited the formation of synapses, as measured by post-synaptic potential amplitudes. Desflurane lead to a more severe reduction in synaptic strength as compared to sevoflurane. This is not likely due to an inhibition of neurotransmitter release mechanisms, but may involve other post-synaptic responses.

REFERENCES:

1. Flick, R. P. et al. Pediatrics 128, 1053-1061, (2011).

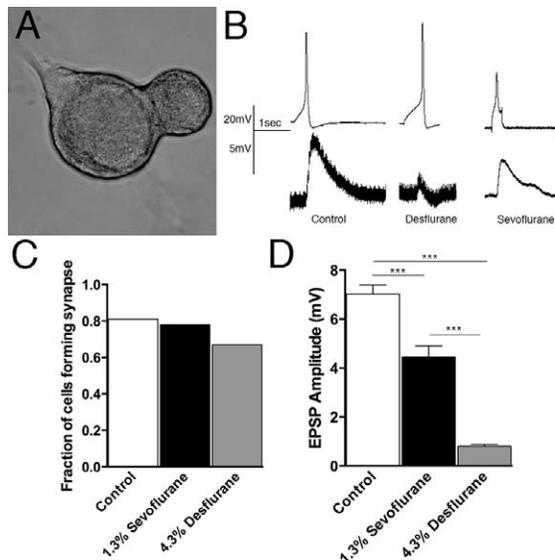


Figure 1

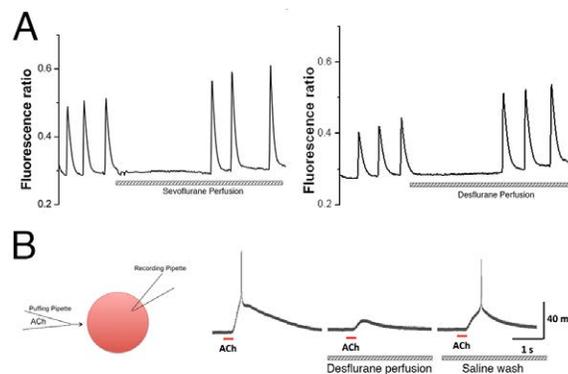


Figure 2

S-180.**ISOFLURANE INDUCED PATHWAY-SPECIFIC
SUPPRESSION OF CORTICAL SYNAPTIC RESPONSES
IN MICE****AUTHORS:** A. Raz, B. M. Krause, S. Grady, M. Banks**AFFILIATION:** Anesthesiology, University of Wisconsin
Madison, Madison, WI**INTRODUCTION:** The mechanisms underlying Loss of Consciousness (LOC) under anesthesia remain largely unknown. We have previously demonstrated that cortico-cortical (CC; “top-down”) extracellular synaptic responses are preferentially suppressed by isoflurane (ISO) compared to thalamo-cortical (TC; “bottom-up”) responses. This result is consistent with a model in which anesthetic-induced LOC depends on selective inhibition of top-down connections. Here, we investigate the mechanism underlying this differential sensitivity by measuring the effect of ISO in clinically relevant concentrations on the post-synaptic responses of cortical pyramidal neurons to TC and CC stimuli.**METHODS:** The study was approved by the institutional animal care and use committee. Acute auditory TC brain slices were prepared from 4-8 week-old mice. Afferent stimuli were applied using bipolar tungsten electrodes either at the superior thalamic radiation, just rostral to the hippocampus or in layer 1 or 2 (L1/L2) of neocortex, 0.5 - 1 mm rostral to the recording site in auditory cortex. Pyramidal cortical neurons, mostly from layer 5, were identified visually and whole cell current clamp recordings obtained of short latency (presumably monosynaptic) synaptic responses to TC and CC stimuli and of responses to polarizing current pulses. ISO (1%) was dissolved in the aCSF and bath applied to the slice. We compared the resting membrane potential, membrane resistance and EPSPs to the two stimuli with and without ISO using paired t-test.**RESULTS:** Following ISO administration, the cells' resting membrane potential was depolarized (Baseline: -74mV, ISO: -69mV, $p=0.04$, $n=10$), but input resistance did not significantly change (Baseline: 137.6 Mohm, ISO: 120.7 Mohm, $p=0.10$, $n=10$). Under ISO, TC responses were increased by 11.4% whereas CC responses were decreased by 51.4% ($p=0.008$, $n = 10$ cells). There was no correlation between the change in TC or CC response and the change in input resistance.**CONCLUSIONS:** We have demonstrated that the previously reported preferential effect of isoflurane on the top-down projections is a result of a direct effect on CC versus TC EPSPs in auditory cortical pyramidal cells. Further investigation is needed to elucidate the mechanism underlying this differential effect.

S-181.

KETAMINE INDUCES OLIGODENDROGLIA APOPTOSIS IN ADDITION TO NEURONAL LOSS IN DEVELOPING NON-HUMAN PRIMATE BRAIN

AUTHORS: A. M. Brambrink¹, L. D. Martin², G. A. Dissen³, S. Johnson⁴, E. A. Olsen⁵, K. K. Noguchi⁶, J. Olney⁷

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, OHSU, Portland, OR, ²Oregon National Primate Research Center, Oregon Health & Sci Univ, Portland, OR, OHSU, Portland, OR, ³Oregon National Primate Research Center, Oregon Health & Sci Univ, Portland, OR, OHSU-ONPRC, Beaverton, OR, ⁴Department of Psychiatry, Washington University in St. Louis, Saint Louis, MO, ⁵Anesthesiology and Perioperative Medicine, OHSU, OHSU, Portland, OR, ⁶Department of Psychiatry, Washington University in St. Louis, St Louis, MO, ⁷Department of Psychiatry, Washington Univ St. Louis, MO, St. Louis, MO

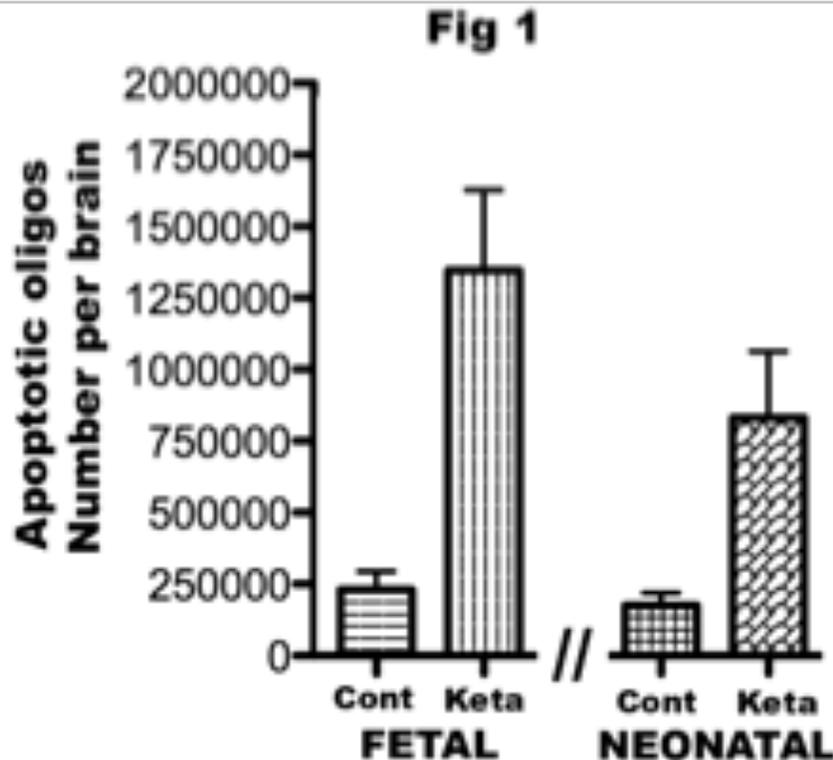
INTRODUCTION: Exposure of fetal or infant animals, including non-human primates (NHPs), to anesthetic drugs, at clinically relevant doses, causes brain injury and results in long-term neurodevelopmental impairment (NDI). The injury in fetal or infant macaques brains was originally described as apoptotic death of neurons, and was documented following exposure to ketamine, isoflurane or propofol^{1,2,3}. Subsequent reports demonstrated that the cell death response following isoflurane or propofol is more complicated and includes apoptotic death of both neurons and oligodendrocytes (oligos)^{3,4}. The present study was undertaken to determine whether ketamine-induced neuronal apoptosis in the developing NHP brain is also accompanied by apoptosis of oligos.

METHODS: With institutional approval, neonatal (postnatal day 6; P6) and pregnant (gestation day 120; G120; full term 165 days) macaques were exposed for 5 h to ketamine (intubation, ventilation, vital signs controlled) or no anesthesia (controls). Ketamine was

infused IV to maintain a surgical plane of anesthesia (no movement / no >10% raise in heart rate or systolic blood pressure to mosquito-clamp pinch; all extremities; q 30 min). Animals were then extubated and observed for 3 h. Control animals received baseline measurements, IV saline and returned to their dams/cages. At 8 h of time zero, neonatal and fetal (following caesarean section) brains were perfusion fixed and analyzed, using markers of apoptosis (activated caspase 3; AC3) and cell death (silver stain). Quantitative evaluation included counting all apoptosis-positive oligo profiles in serial sections at 2 mm intervals across the brain.

RESULTS: Fetal brains (G120) after ketamine-exposure (n=4) had a 4.13-fold higher number of apoptotic (AC3-positive) oligos compared to controls (n=4; Fig 1). Neonatal brains (P6) after ketamine-exposure (n=4) had a 4.03-fold greater number of apoptotic oligos compared to controls (n=5; Fig 1). The oligo apoptosis response reported here is approximately of the same magnitude as the neuronal apoptosis response to ketamine reported previously¹. Oligo-apoptosis in both fetal and neonatal brains was distributed throughout the white matter, but tended to be more heavily concentrated caudally in the fetus and rostrally in the neonate, which is consistent with the caudal to rostral progression of myelinogenesis during early development.

CONCLUSIONS: Exposure of infant or fetal macaques to a surgical plane of ketamine anesthesia for 5 hours triggers a robust apoptosis response affecting two cell types - neurons and oligodendrocytes. These findings clarify that following ketamine exposure, just as has been described following isoflurane or propofol^{3,4}, the cell death response impinges on both neurons and oligos in approximately equal numbers. Oligos are responsible for generating and maintaining the myelin sheath, which is essential for normal neuronal function. Developmental loss of neurons, compounded by simultaneous loss of oligos, is a type of brain injury that potentially could contribute to long-term neurobehavioral impairment.



S-182.

WITHDRAWN.

S-183.

WITHDRAWN.

S-184.**ISOFLURANE BUT NOT SEVOFLURANE RESTORED
ENDOTOXIN-INDUCED IMPAIRED HYPOCAPNIC
CEREBRAL BLOOD FLOW RESPONSE IN RATS****AUTHORS:** H. - Okamoto**AFFILIATION:** Anesthesiology, Kitasato University School of Medicine, Sagamihara, Japan

INTRODUCTION: Cerebrovascular responsiveness to hypocapnia is well known under both physiological and anesthetic conditions. However, little is known about the impact of brain inflammation on this hypocapnia-induced cerebral blood flow response during anesthesia. Therefore, the current study was designed to investigate whether or not central administration of endotoxin may alter the hypocapnic cerebral blood flow responsiveness during isoflurane and sevoflurane anesthesia in rats. **Methods:** Under IRB approval, thirty Male Sprague-Dawley rats were used. Under pentobarbital anesthesia, rats were mechanically ventilated. Arterial blood gases, blood glucose, brain temperature were maintained within the normal range. Regional cerebral blood flow (rCBF) was measured using laser Doppler flowmetry through the cranial window created at the parietal cortex. Mean arterial blood pressure, heart rate, and end-tidal carbon dioxide tension were also monitored. Hypocapnia was induced by the stepwise increase in the respiratory rate from 50 to 100 cycles per minute. Rats were randomly assigned into four groups. In group 1 rats, hypocapnia was induced with or without 1% isoflurane. In group 2 rats, hypocapnia was induced with or without 1.7% sevoflurane (in the equivalent concentration of 1% isoflurane). In group 3 and group 4 rats, endotoxin (lipopolysaccharide, E coli 055-B5; 1 mg/kg) was pre-administered into the brain via Cisterna magna, and followed by the induction of hypocapnia with or without 1% isoflurane (group 3), or 1.7% sevoflurane (group 4). All data were expressed mean \pm SD. Repeated measures ANOVA followed by the SNK test was used for statistics. $P < 0.05$ was considered significant. **Results:** In group 1 and 2 rats (no endotoxin), end tidal carbon dioxide tension was reduced down to 15 mmHg at the lowest level by the hyperventilation. In association with this hypocapnia, rCBF was significantly reduced by approximately 25% of control at the lowest. This hypocapnia-induced reduction of rCBF was eliminated by the centrally administered endotoxin (Group 3 and 4). During isoflurane anesthesia, this blunted rCBF response to hypocapnia by endotoxin was significantly restored ($12 \pm 9\%$ reduction; $P < 0.01$) whereas this hypocapnia-induced rCBF reduction was still blunted ($5 \pm 9\%$ reduction; n.s) by the central endotoxin during sevoflurane anesthesia. **Conclusions:** The present study demonstrates two major findings. Firstly, brain inflammation by the central administration of endotoxin eliminated the hypocapnia-induced cerebral blood flow response. Secondly, isoflurane but not sevoflurane restored this cerebral blood flow responsiveness to hypocapnia. These two findings may provide new clinical insights as follows. At first, it is suggested that hyperventilation therapy in order to reduce cerebral blood flow may not be guaranteed in case of brain inflammation. In addition, isoflurane could be used during surgery in patient with hyperemic brain inflammation whereas sevoflurane could be applicable in patient with ischemic brain inflammation. **References:** Stroke. 29:1209,1998. Anesth Analg. 91:896,2000.

S-185.**SEVOFLURANE ALTERS MATURATION IN MOUSE HIPPOCAMPAL DENDRITIC SPINES VIA EFFECTS ON F-ACTIN POLYMERIZATION****AUTHORS:** J. H. Zimering¹, Y. Dong², Y. Zhang³, Z. Xie⁴**AFFILIATION:** ¹University of Rochester School of Medicine and Dentistry, Rochester, NY, Howard Hughes Medical Institute/Harvard Medical School, Boston, MA, ²Dept. of Anesthesia, Critical Care and Pain Medicine, Mass General Hospital, Boston, MA, ³Dept. of Anesthesia, Critical Care and Pain Medicine, Mass General Hospital and Harvard Medical School, Boston, MA, ⁴Dept. of Anesthesia, Critical Care and Pain Medicine, Mass General Hospital, Boston, MA, Howard Hughes Medical Institute/Harvard Medical School, Boston, MA**INTRODUCTION:** Early postnatal anesthesia causes long-lasting learning and memory impairment in rodents¹. It poses an unknown safety risk for the millions of infants and children who undergo major surgery each year. However, the underlying mechanisms remain largely unknown. The actin cytoskeleton in dendritic spines undergoes dynamic rearrangement in response to excitatory synaptic activity underlying learning² and is a target for anesthesia³. Thus, we set out to test a hypothesis that exposure in neurons to clinically relevant concentrations of sevoflurane alters maturation in mouse hippocampal neuron dendritic spines.**METHODS:** The study was approved by the local Institutional Animal Care and Use Committee. Mouse embryonic day 15 hippocampal neurons were cultured in Neurobasal medium for 7 days in vitro (DIV) prior to a single (4 hour) exposure to 3% sevoflurane in 95% air/5% CO₂ or control condition (95% air/5% CO₂). Control or sevoflurane-treated DIV 7 neuronal cultures were either immediately fixed in 4% paraformaldehyde or maintained for up to 7 additional days in culture prior to staining with Alexa Fluor555-Phalloidin (5 units/mL), specific for filamentous (F)-actin. Distally-located, dendritic segments (2-5 per neuron) were randomly selected for analysis. Fluorescence images were acquired using a 100x NA 1.40 oil immersion objective and laser scanning microscope.**RESULTS:** Sevoflurane induced acute significant decreases in mean dendritic filopodial length (n=41) compared to control (n=39; P < 0.00001, n= 3 experiments). Sevoflurane induced significant decreases in mean thin spine length (n=6) compared to control (n=9; P = 0.002). Two days later, on DIV9, mean thin spine length in sevoflurane-treated neurons had fully recovered to levels (1.67 μm) significantly exceeding mean level in control DIV9 neurons (1.15 μm; P =0.01). Sevoflurane caused a 56% increase in mean head diameter (0.93 μm) in a subset (10/15) of maturing spines compared to control (n=2; 0.56 μm; P=0.03) or unaffected stubby or mushroom spines (n=5, 0.6 μm; P = 0.003). On DIV14, mean head diameter in sevoflurane-treated maturing spines still significantly exceeded control neurons (0.74 μm vs 0.48 μm, P< 0.0001, n= 73). Finally, sevoflurane significantly impaired early actin-clustering in filopodia as evidenced that the ratio of actin cluster- type: diffusely staining filopodia was 5% vs 40%; P < 0.01, in the sevoflurane-treated vs control DIV9 neurons. There was no significant difference in mean mushroom spine density at DIV14 between sevoflurane and control condition (0.51 vs 0.42 spines/μm, P=0.44).**CONCLUSIONS:** Our data demonstrate that sevoflurane may differentially affect dendritic spine head vs neck structure. The underlying mechanisms of such effects are under ongoing investigation.**REFERENCES:**

1. PLoS One 9(8):e105340; 2014.
2. Science 290: 754-758; 2000.
3. PLoS One 9(7):e102978; 2014.

S-186.

A NOVEL ELECTROPHYSIOLOGICAL MEASURE FOR FAST GABA-MEDIATED INHIBITION IN INTACT CIRCUITS OF RAT HIPPOCAMPAL BRAIN SLICES

AUTHORS: B. D. Heifets¹, J. Nie¹, B. Sharma², B. MacIver¹

AFFILIATION: ¹Anesthesiology, Stanford University, Stanford, CA, ²Medical School, Louisiana State University, Kenner, LA

INTRODUCTION: The GABA_A receptor (GABA_AR) is an attractive, tractable drug discovery target¹. It remains unclear how native neural circuits of the hippocampus respond to drugs in this highly clinically relevant class. The CA1 region of the hippocampus is crucial for learning, memory and cognition, thus a key brain region to screen GABAergic compounds that may influence these processes. We developed a novel screen for GABA_AR ligands, including general anesthetics, by measuring field inhibitory postsynaptic potentials (fIPSPs) in the CA1 area. While allowing many of the advantages of an in vitro preparation, field recordings mirror their in vivo counterparts, and unlike intracellular recordings, are minimally invasive to the neuron, typically remaining stable for many hours.

METHODS: 24-28 day old Sprague Dawley rats were anesthetized and decapitated. Brains were dissected and submerged in chilled artificial cerebrospinal fluid (ACSF). 400 μm thick coronal slices were cut and maintained in ACSF bubbled with 95% O₂ and 5% CO₂. fIPSPs were evoked through a bipolar tungsten stimulating electrode placed in the stratum pyramidale (SP) of the CA1 region and recorded by microelectrode 150 μm away in the SP of CA1. GABAergic fIPSPs were isolated with NMDA and AMPA receptor antagonists (d-APV, NBQX, kynurenic acid). fIPSP dependence on GABA_AR was confirmed by blockade in high dose GABA_AR antagonist, picrotoxin (PTX). GABAergic ligands were applied to slices, and their effects on magnitude and decay kinetics of the fIPSP were measured. Ligands tested include: propofol, isoflurane, midazolam, diazepam, flumazenil and furosemide (FUR) and PTX.

RESULTS: Hippocampal GABAergic inhibition can be classified by its duration and sensitivity to allosteric modulators like benzodiazepines (BZPs). We characterized the CA1 fIPSP with compounds known to affect these parameters; a subset of our data is summarized here. FUR, a selective antagonist of GABA_A-fast, dose-dependently reduces fIPSP amplitude and prolongs its decay, suggesting that the fIPSP is largely mediated by GABA_A-fast synapses². In comparison, PTX, a non-selective GABA_AR antagonist, depressed evoked fIPSP amplitude without modifying the fIPSP decay (Fig. 1). fIPSPs are also sensitive to BZPs, including midazolam and diazepam, both of which enhanced fIPSP amplitude, and prolonged decay time. Flumazenil, a BZP antagonist, blocked these effects (Fig. 2).

CONCLUSIONS: This method for studying synaptic inhibition has major advantages over conventional electrophysiological techniques: 1) it is extracellular, so key intracellular signaling molecules remain intact, 2) it detects changes in both tonic and phasic GABA_AR mediated signaling, and finally 3) it is more stable and technically easier than whole-cell recording. Combining this fast, minimally cell invasive, neural population based approach affords a unique opportunity to assay multiple lead compounds for anesthetic efficacy in an intact, well characterized neural circuit with clear relevance to learning, memory and cognition.

REFERENCES:

1. Nat Rev Neurosci. 2008. 9:370.
2. BMC Neurosci. 2008. 9:1471.

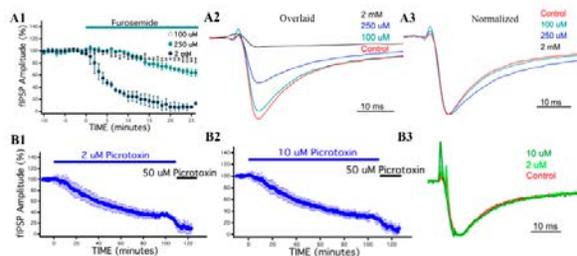


Figure 1. Furosemide and picrotoxin differentially affect pharmacologically isolated GABA_AR-mediated fIPSPs in CA1. **A1.** Furosemide (100 μM, 250 μM, 500 μM), a selective GABA_A-fast antagonist dose dependently reduced fIPSP amplitude. **A2.** Overlaid averaged traces from the same recordings as in **A1**. **A3.** Traces in **A2** normalized for kinetic comparison show furosemide prolongs fIPSP. **B1.** Picrotoxin (2 μM), a non-selective GABA_AR antagonist, depressed evoked fIPSP amplitude. 10 μM picrotoxin shown separately in **B2** for clarity. **B3.** Traces in **B1** and **B2** overlaid and normalized for kinetic comparison show that picrotoxin does not modify the decay of the fIPSP. All residual fIPSPs were confirmed to be GABA_AR mediated by >95% blockade in 50 μM picrotoxin.

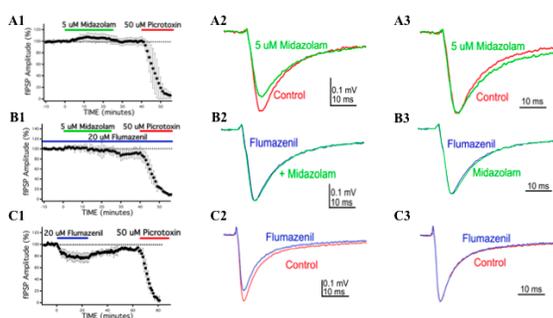


Figure 2. Midazolam enhances fIPSP amplitude and duration. **A1.** Midazolam (5μM), a positive allosteric modulator of GABA_AR, enhances fIPSP amplitude. **A2.** Overlaid averaged traces from recordings in **A1**. **A3.** Traces in **A2** normalized for kinetic comparison show midazolam prolongs fIPSP. **B1.** Flumazenil (20μM), a selective benzodiazepine (BZP) antagonist, blocks the enhancement of fIPSP amplitude by midazolam. **B2** illustrated in overlaid averaged traces, and **B3** blocks the kinetic effect of midazolam, illustrated by their overlapping decay phase. **C1.** Flumazenil on its own reduces amplitude of the fIPSP (overlaid traces in **C2**), but does not change the decay (overlaid, normalized traces in **C3**), suggesting a non-BZP mediated alternate effect of the drug. All residual fIPSPs were confirmed to be GABA_AR mediated by >95% blockade in 50 μM picrotoxin.

S-187.

WITHDRAWN.

S-188.**RAT CORTICAL NEURONS EXPOSED TO SEVOFLURANE AND DESFLURANE EXHIBIT DECREASED SYNAPTIC DEVELOPMENT**

AUTHORS: F. Xu¹, R. Armstrong¹, D. Urrego¹, M. Qazzaz¹, M. Pehar², J. N. Armstrong², N. I. Syed¹

AFFILIATION: ¹Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada, ²Department of Anesthesia, University of Calgary, Calgary, AB, Canada

INTRODUCTION: Recent research has raised concerns about the potential side effects of exposure to inhalational anesthetics on cognitive function in children or animal models^{1,2}. To date, the underlying mechanisms are yet to be identified. In this study, we examined whether two commonly used inhalational anesthetics, sevoflurane and desflurane, affect the architectural and functional development of rat cortical networks.

METHODS: All animal procedures were in accordance with the relevant Institutional Animal Care and Use Policy. Sprague-Dawley rat frontal cortices were removed from post-natal day 0 pups and enzymatically dissociated. Cortical neurons were allowed to settle for one hour prior to be placed in a Billups-Rothenburg Modular Incubation Chamber. The cells were then exposed to anesthetics in conjunction with medical air for one hour. Roughly equipotent concentrations of sevoflurane (1.3%) and desflurane (4.3%) were used. Control cells were exposed to medical air only. Post-anesthetic exposure, the cells were maintained at 37°C in an incubator at 5% CO₂ until use. Immunostaining of synaptic proteins was performed on fixed cells. Whole-cell patch clamping was done to measure synaptic currents. Mitochondria were visualized with MitoTracker Red. Fluorescence images were acquired with a confocal microscope.

RESULTS: Phase contrast visualization of premature cells (day 3) showed that both sevoflurane and desflurane reduced neurite density (circles) and damaged cell bodies (asterisks) (Fig.1). Immunostaining of mature cells (day 10-14) with the pre-synaptic marker synaptophysin (green) and the post-synaptic marker PSD-95 (red) (Fig.2) revealed that sevoflurane and desflurane caused significant reduction in the punctate expression of synaptophysin. To determine the functional impact on the synapse of the reduction of synaptophysin, we performed whole-cell patch clamping recording of the synaptic currents of mature cells (day 10-14). Both sevoflurane and desflurane treated cells exhibited a reduction in spontaneous synaptic currents, indicating a reduction in the expression of functional synapse (Fig.3A). Our data further showed that desflurane and sevoflurane may impact these developing neurons by impacting mitochondrial integrity and function (Fig.3B).

CONCLUSIONS: Our study suggests that exposure of sevoflurane and desflurane to developing neuronal cultures reduces neurite outgrowth and synaptic protein expression. These architectural changes may account for the functional changes observed during electrophysiological studies of synaptic currents. Our study also suggests that sevoflurane and desflurane impact mitochondrial morphology and function. Future studies of mitochondrial protective agents might help reduce the detrimental effects induced by inhalational anesthetics on developing neurons. Our preliminary data show that application of a mitochondrial division inhibitor (mdivi-1) inhibited anesthetic-induced changes in mitochondria.

REFERENCES:

1. Ing, C. et al 130: e476-485, 2012
2. Loepeke, A. W., Soriano, S. G. 106: 1681-1707, 2008

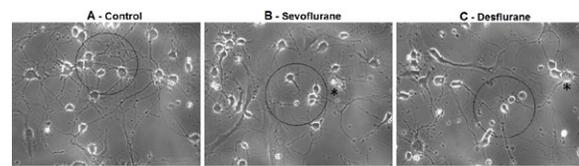


Figure 1

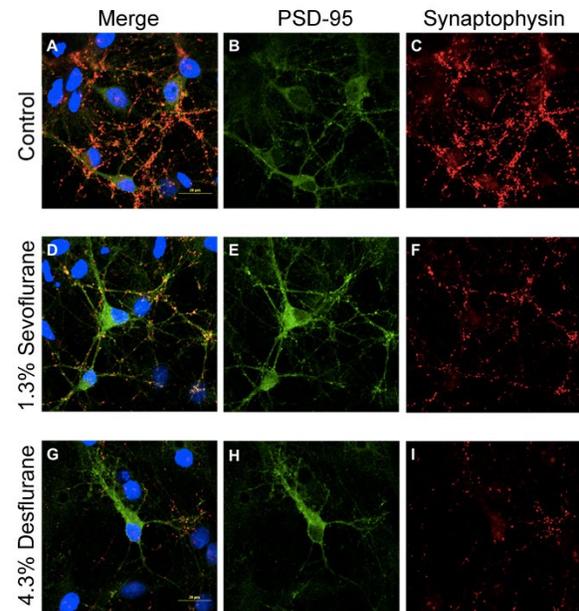


Figure 2

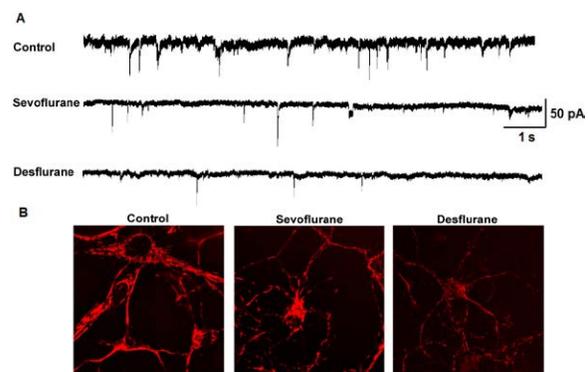


Figure 3

S-189.

LIVE IMAGING OF APOPTOGENIC CHANGE INDUCED BY GENERAL ANESTHETIC NEUROTOXICITY IN DEVELOPING MOUSE

AUTHORS: A. Konno¹, A. Nishimura¹, S. Nakamura², A. Yamada³, R. Kamijo³, T. Inoue², T. Iijima¹

AFFILIATION: ¹Department of Perioperative Medicine Division of Anesthesiology, Showa University School of Dentistry, Tokyo, Japan, ²Department of Physiology, Showa University School of Dentistry, Tokyo, Japan, ³Department of Biochemistry, Showa University School of Dentistry, Tokyo, Japan

INTRODUCTION: Anesthetic neurotoxicity in the developing brain has been investigated in animals and humans and has become a major health issue of interest to both the medical community and the public. Accumulating evidence suggests that exposure to general anesthetics at clinically effective concentrations induces widespread increases in neuronal apoptosis in the developing brains of a variety of animals ranging from rodents to rhesus monkeys. However, these former studies have shown the consequences of the apoptotic cascade at one time point, and temporal changes have not been confirmed. Additionally, a causal relationship cannot be determined. The present study examined temporal apoptotic changes induced by propofol over time in neonatal mouse brain by visualizing the activity of caspase3.

METHODS: Transgenic mice carrying a genetically encoded fluorescence resonance energy transfer (FRET)-based fluorescent reporter for caspase activation, known as SCAT3 mice, were used. Brain stem slices from neonatal mice (0-4 days postnatal) at the level of hippocampal CA1 neurons were prepared for imaging. The reporter enabled simultaneous Z stack (5 μm) and time-lapse

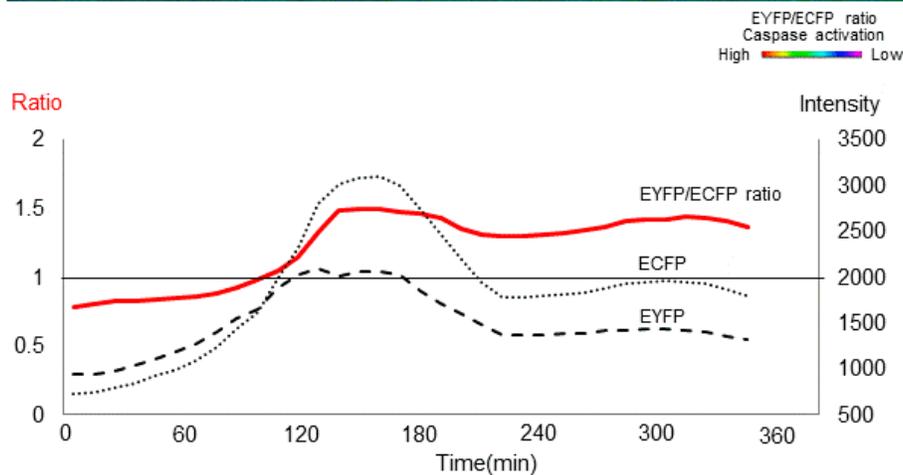
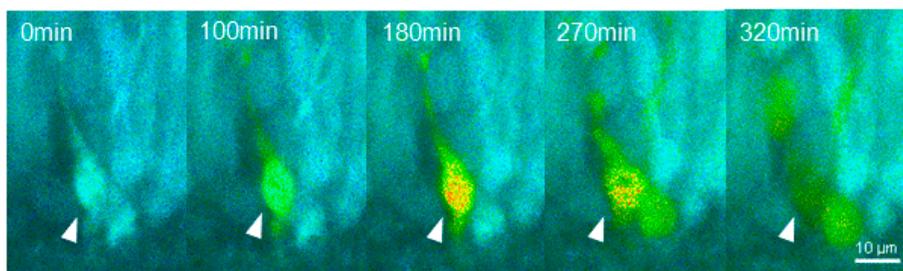
imaging of apoptosis every ten minutes. The Z stack images enabled us to correct the focus and to obtain clear images. The dissociation between ECFP and EYFP upon cleavage of the linker lowers the EYFP/ECFP ratio (Y/C; the FRET signal), indicating caspase activation. The brain slices were processed for confocal laser scanning 5 hours after exposure to 1 mM of 2,6-diisopropylphenol (propofol) added to oxygenated artificial cerebrospinal fluid using a peristaltic pump.

RESULTS: Live FRET conversion was clearly observed in our system. Light bleaching was minimum, thus, the images were repeatedly obtained. We have recorded that some inert cells commenced caspase3 activation, then, collapsed into death. It looked triggered by propofol, however, the same images were obtained even in the control group. The frequency of this caspase3 activation did not differ between groups. No further activation of caspase3 was confirmed in propofol group.

CONCLUSIONS: We have succeeded in observing the time-course of activation of caspases3 induced by propofol in hippocampal CA1 sector. Since there was no significant difference of the frequency of caspase3 activation between control and propofol, propofol may not be a potent inducer of apoptosis.

REFERENCES:

1. Aesthesiology; 118:516-526
2. Aesthesiology; 120:392-402
3. British J. Anesthesia; 110:129-138
4. J. Cell Biology; 195:6:1047-1060
5. Neuroscience Letter; 311:177-180



S-190.**SEVOFLURANE POSTCONDITIONING IMPROVES
IMPAIRED ENDOTHELIAL BRAIN BARRIER FUNCTION
IN A RAT IN VITRO MODEL**

AUTHORS: T. Restin¹, M. Kajdi², M. Schläpfer²,
B. Beck-Schimmer²

AFFILIATION: ¹Institute of Physiology, University Zurich, Zurich, Switzerland, ²Institute of Anesthesiology, University Hospital Zurich, Zurich, Switzerland

INTRODUCTION: Sevoflurane is a volatile anesthetic which attenuates the inflammatory response after hypoxic injury of the heart, liver and lung¹⁻³. Animal models provide evidence that sevoflurane reduces brain injury and cerebral infarct size after ischemia, impacting on the blood brain barrier (BBB)⁴. The grade of brain edema as the clinical equivalent of the disrupted BBB is an independent predictor of unfavorable outcome after brain injury^{5,6}. The mechanism, however, how sevoflurane interacts with injured endothelial cells still has to be elucidated. We therefore tried to determine the effects of sevoflurane on rat brain endothelial cells (RBE4) after hypoxic injury.

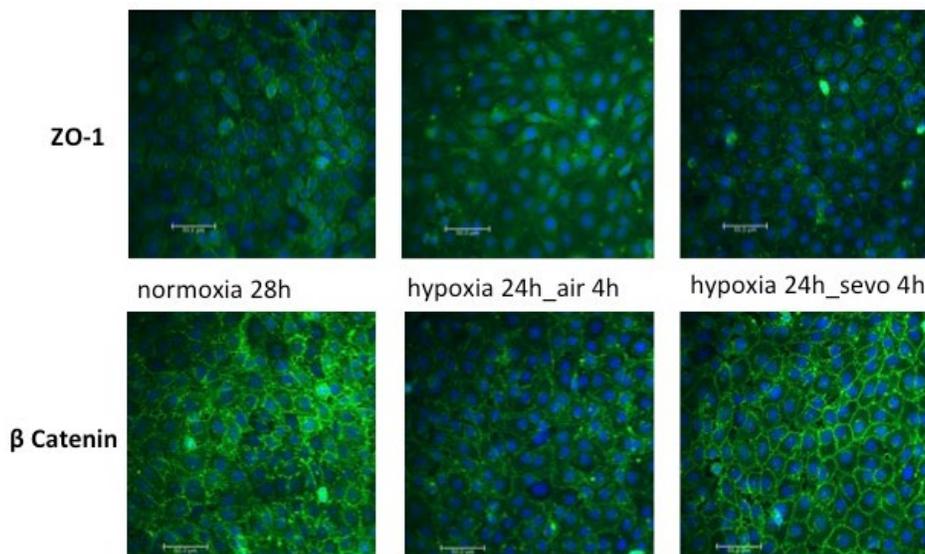
METHODS: RBE4 cells were exposed for 24 hours to hypoxia 0.2% O₂, followed by a 4 hour reoxygenation with 21% O₂ with or without the presence of 2.2% sevoflurane. Cellular DNA content (bisbenzimidazole) was measured. In order to assess permeability of the monolayer, RBE4 cells were cultured in Boyden chambers for 2-3 days and permeation of 40kD FITC dextran was determined. Immunostaining was performed using monoclonal mouse anti ZO-1 and anti-beta-Catenin antibodies to identify tight and adhesion junctions.

RESULTS: Hypoxia of 24 hours followed by a 4-hour reoxygenation significantly reduced DNA content of RBE4 cells by 20% (p<0.0001), sevoflurane had no effect. Barrier function, determined by dextran permeability, was significantly impaired after hypoxia-reoxygenation (increased permeability of 2.5, p<0.0001), while it partially recovered with sevoflurane postconditioning (increased permeability of 1.6, p<0.001). Tight junction organization was altered by sevoflurane treatment. Both ZO-1 and beta-Catenin were translocated to the nucleus after reoxygenation with 21% O₂, while both junction proteins were better maintained in the cellular membrane under sevoflurane reoxygenation (Figure 1).

CONCLUSIONS: These data provide for the first time evidence that sevoflurane positively impacts on impaired endothelial barrier function. A possible mechanism might be stabilization of junction proteins through sevoflurane. Further studies are needed to test the effects of sevoflurane on the blood brain barrier in vivo and to assess safety of volatiles.

REFERENCES:

1. Anesthesiology, 2004. 101(2): p. 299-310.
2. Ann Surg, 2008. 248(6): p. 909-18.
3. Anesthesiology, 2009. 111(6): p. 1238-48.
4. Anesth Analg, 2006. 103(1): p. 173-9, table of contents.
5. Curr Opin Neurol, 2010. 23(3): p. 293-9.
6. Stroke, 2002. 33(5): p. 1225-32.



S-191.**GABA(A) RECEPTOR ANTAGONISM BY THE MACROLIDE ANTIBIOTIC, CLARITHROMYCIN MEDIATES EXCITATION OF THE HIPPOCAMPUS, BUT DOES NOT HASTEN EMERGENCE IN A RODENT MODEL OF EMERGENCE FROM GENERAL ANESTHESIA**

AUTHORS: P. S. Garcia¹, J. A. Fidler¹, E. B. Murlin¹, A. Nash², L. M. Trotti³, D. B. Rye³, A. Jenkins⁴

AFFILIATION: ¹Anesthesiology, Emory University / Atlanta VA Medical Center, Atlanta, GA, ²Psychiatry, Emory University School of Medicine, Atlanta, GA, ³Neurology, Emory University School of Medicine, Atlanta, GA, ⁴Anesthesiology, Emory University School of Medicine, Atlanta, GA

INTRODUCTION: Recently, a macrolide antibiotic, clarithromycin (CLR), has been shown to promote vigilance in patients suffering from excessive sleepiness related to abnormal enhancement of GABA(A) receptor function¹. Although case reports of insomnia and mania due in part to CLR administration exist, seizures are rare². This evidence combined with recent interest in accelerating emergence via monoaminergic excitation of brain stem nuclei³ has motivated us to investigate macrolides as potential inhibitors of the anesthetized state.

METHODS: Inhibition of GABA-mediated current by macrolides was measured in vitro using transient expression of common GABA(A) receptors in HEK293 cells. Hippocampal slices were acutely prepared from rats (16-21 days old) anesthetized with isoflurane prior to brain removal and sectioning into 350 μ m slices. After > 60 minutes of incubation in ACSF, the slices were transferred to a heated recording chamber. Excitability characteristics were measured in the presence and in the absence of 300 μ M CLR via patch-clamp recordings from CA1 pyramidal cells in the whole-cell configuration. Isolation of GABA-ergic activity was achieved using pharmacologic blockade of glutamate: CNQX (20 μ M), D-AP5 (50 μ M). Adult male rats (250 - 350 g) were the subject of our in vivo model of emergence. In brief, the animals were anesthetized with inhaled isoflurane, placed supine on a heated pad, and monitored. At the end of 60 minutes, each animal received intraperitoneal injection of either CLR (40 mg/kg) or vehicle as the anesthetic was switched off. the latency to sustained recovery of righting reflex (unable to be re-positioned supine) was measured.

RESULTS: Of the tested macrolide antibiotics, CLR was the most potent GABA(A) receptor antagonist (approximate IC50: 300 μ M). Bath application of this dose to CA1 pyramidal cells resulted in: (1) a significant increase in the average resting membrane potential (control vs CLR: -57.4 ± 1.2 mV vs -60.2 ± 0.9 mV; $p < 0.01$) (2) increased spike frequency (f-I curve) and (3) a complete blockade of spontaneous inhibitory post-synaptic currents. Intraperitoneal injection of CLR at the cessation of isoflurane anesthesia did not result in a decreased time to end emergence (control vs CLR: 244.4 ± 87.5 s vs 265.4 ± 123.1 s; $n = 12$ per group; $p = 0.70$).

CONCLUSIONS: Despite antagonism of GABA(A) receptors by CLR, emergence remained unaffected by administration of this drug in physiologic ranges. Clarithromycin is known to achieve significant concentrations in human CSF⁴. While CLR and other GABA antagonists (e.g., flumazenil) may have some utility in treating sleep disorders⁵, the failure to influence emergence highlights the differences between sleep and anesthesia and supports the significance of monoaminergic input to the brain stem for arousal after anesthesia.

REFERENCES:

1. J Psychopharm. 2013. 3;28(7):697-702.
2. Clin Infect Dis. 1999, 29(2): 464-5.
3. Anesthesiology. 2011. 115(4): 791-803.
4. J. Antimicrob Chemother. 1993. 32(4): 627-32.
5. Sci Trans Med. 2012. 21;4(161).

S-192.

PREOPERATIVE CEREBROSPINAL FLUID BIOMARKERS PREDICT POSTOPERATIVE COGNITIVE DECLINE

AUTHORS: L. A. Evered¹, B. Silbert¹, D. A. Scott¹, D. Ames², K. Blennow³

AFFILIATION: ¹Anaesthesia, St. Vincent’s Hospital, Melbourne, Australia, ²Anaesthesia, University of Melbourne, Melbourne, Australia, ³Clinical Neurochemistry, Sahlgrenska University, Gothenberg, Sweden

INTRODUCTION: Postoperative cognitive dysfunction (POCD) refers to an objectively measured decline in cognitive function following anesthesia and surgery. It remains to be elucidated if there is any association between POCD and long-term cognitive impairment including Alzheimer’s disease (AD) dementia. Given more than 30% of all operations occur in the elderly, and the known long pre-clinical phase of AD, many people undergoing surgery are already in the pre-clinical phase of AD. Presentation to the OR for surgery fortuitously provides an environment for easy, safe, inexpensive and feasible collection of cerebrospinal fluid (CSF) in these older individuals. This study aimed to measure CSF amyloid beta (Aβ), total-tau (T-tau) and phospho-tau (P-tau) in patients scheduled to undergo non-cardiac surgery, and to identify any association with postoperative cognitive decline.

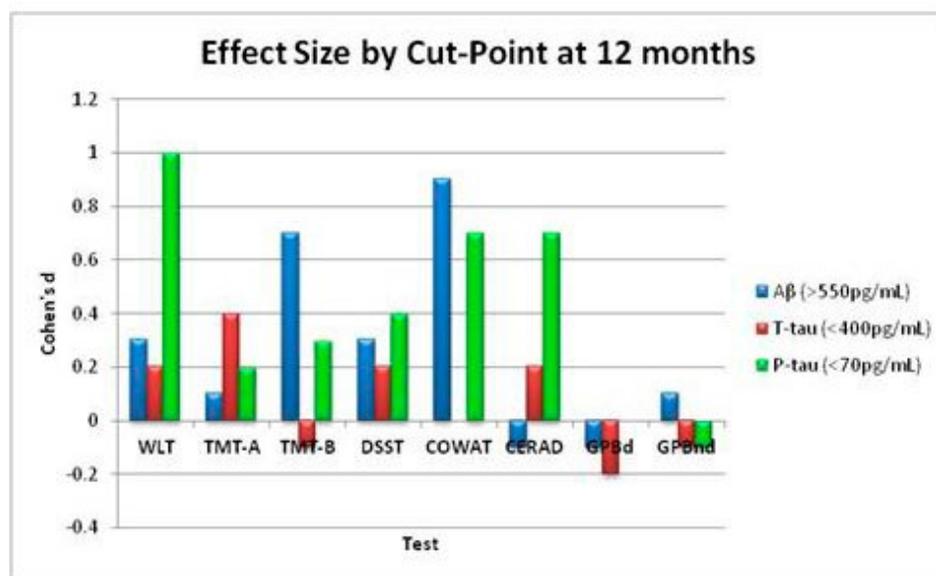
METHODS: All patients required a mini-mental state examination (MMSE) score ≥ 26 for enrolment. CSF was collected during administration of spinal anaesthesia from 59 patients enrolled in the Anaesthesia, Cognition, Evaluation (ACE) study. Patients underwent total hip joint replacement surgery with spinal and general anesthesia. All perioperative factors were recorded and anesthesia was standardised with maintenance of BIS < 60. Five ml of CSF was collected on ice, centrifuged and stored at -80°C. All samples were assayed according to published guidelines[1] in Sweden (KB) for AD proteins. A neuropsychological battery of 8 tests, the clinical dementia rating (CDR), informant questionnaire for cognitive decline in the elderly (IQCODE) and instrumental activities of daily living were assessed at baseline and 3 and 12 months postoperatively.

RESULTS: The mean age of the patients was 70.4y (SD 7.0) and 19 (32%) were male. Baseline cognitive impairment was identified in 25.4% of these patients despite a baseline MMSE ≥ 26. POCD was classified using the reliable change index (RCI)[2] in 8.8% of patients at 3 months postoperatively and the incidence of dementia was 5.4% at 12 months postoperatively. Low baseline Aβ was a significant predictor of POCD at 3 months postoperatively (p=0.03). Low Aβ, high T-tau and high P-tau at baseline predicted poorer test scores (medium and large effect sizes) for neuropsychological test results at 12 months (Figure 1).

CONCLUSIONS: This is the first study to demonstrate an association between baseline CSF biomarkers for AD and postoperative cognitive dysfunction in patients presenting for surgery with ‘normal’ cognitive function as assessed by MMSE ≥ 26. This suggests a possible association between POCD and AD dementia which warrants further investigation.

REFERENCES:

1. Hugo, V., et al., Review Article: Standardization of preanalytical aspects of cerebrospinal fluid biomarker testing for Alzheimer’s disease diagnosis: A consensus paper from the Alzheimer’s Biomarkers Standardization Initiative. Alzheimer’s & Dementia: The Journal of the Alzheimer’s Association.
2. Evered, L., et al., Postoperative cognitive dysfunction is independent of type of surgery and anesthetic. Anesth Analg, 2011. 112(5): p. 1179-85.



S-193.

ESTRADIOL IS INVOLVED IN MEDIATING ELECTROENCEPHALOGRAPHIC HYPEREXCITATORY AND ANESTHETIC EFFECTS OF SEVOFLURANE IN NEONATAL RATS

AUTHORS: J. Zhang¹, C. Xu², D. Puentes², C. Seubert², N. Gravenstein², A. Martynyuk³

AFFILIATION: ¹Anesthesiology, Zhengzhou University, Zhengzhou, China, ²Anesthesiology, University of Florida, Gainesville, FL, ³Anesthesiology and Neuroscience, University of Florida, Gainesville, FL

INTRODUCTION: Neonatal anesthesia induces profound developmental abnormalities in animal models via incompletely understood mechanisms. The current study was set to investigate the roles of steroids in paradoxical sevoflurane-caused hyperexcitatory EEG activity in neonatal rats because both an increase in excitation/inhibition ratio and alterations in steroid signaling during early life are linked to developmental disorders. The loss of the righting reflex (LORR), an assay of anesthetic-induced loss of consciousness in animals, was employed to assess the role of steroids in the anesthetic effects of sevoflurane.

METHODS: The study was approved by the local IACUC. Cortical electroencephalograms (EEGs), hippocampal synaptic activity, and serum levels of steroids were measured in postnatal day 4-6 male and female Sprague Dawley rats. Rats were pretreated with vehicle or steroid hormone modifiers (see Results) 30 minutes prior to sevoflurane anesthesia (6% for 3-min induction and 2.1% for 57-min maintenance). LORR was assessed at 3% sevoflurane (~1MAC in P4-P6 rats).

RESULTS: Sevoflurane caused similar isolated episodes of seizures and persistent, over the entire period of exposure to sevoflurane, EEG spike activity and increased serum corticosteroid, corticosterone, in both genders ($F(2,11) = 16.350, P < 0.001$). In order of increased potency, the corticosteroid receptor antagonist, RU28318, the estradiol receptor antagonist, ICI182780, and the estradiol synthesis inhibitor, formestane, depressed sevoflurane-caused seizures, EEG spikes, and serum levels of corticosterone ($t(7) = 2.814, P = 0.026$). The estradiol-enhanced seizures and spikes were depressed by ICI 182780 and the NKCC1 inhibitor bumetanide, whereas RU28318 depressed seizures only. NKCC1 inhibition reduces the intracellular Cl^- concentration, and thus shifts gamma-aminobutyric acid type A receptor (GABA_AR)-mediated signaling to inhibitory, which is predominantly excitatory in neurons in rostral brain regions of P4-P6 rats, such as cortical and hippocampal neurons. In hippocampal CA1 neurons, estradiol increased the amplitude ($t(6) = -3.381; P = 0.00816$), time rise ($t(6) = -3.747; P = 0.00954$), and area under curve ($t(6) = -2.854; P = 0.029$) of the GABA_AR inhibitor, picrotoxin-sensitive miniature inhibitory postsynaptic currents (Fig. 1). Exogenous estradiol shortened, whereas ICI 182780 and formestane lengthened, the time needed for sevoflurane to induce LORR ($F(3,17) = 16.693, P < 0.001, Fig. 2$).

CONCLUSIONS: These findings provide evidence for the involvement of corticosterone and estradiol in mediation of sevoflurane-caused seizures. Estradiol, but not corticosterone, by enhancing GABA_AR-mediated excitation in the cortex, also contributes to sevoflurane-caused EEG spikes. Estradiol, by enhancing GABA_AR-mediated inhibition in more caudal regions of the brain, contributes to sevoflurane-induced LORR.

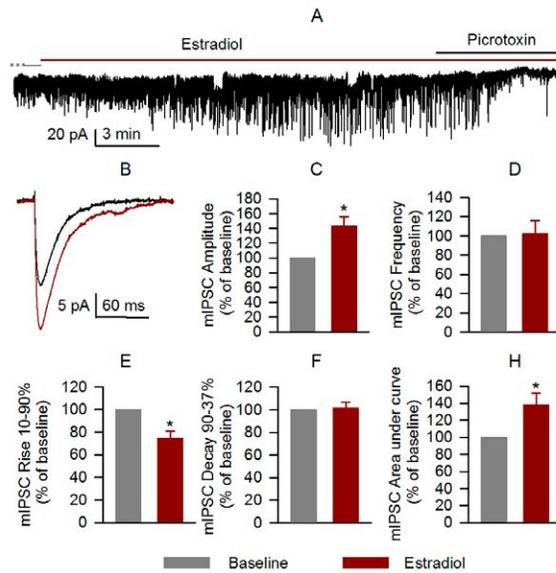
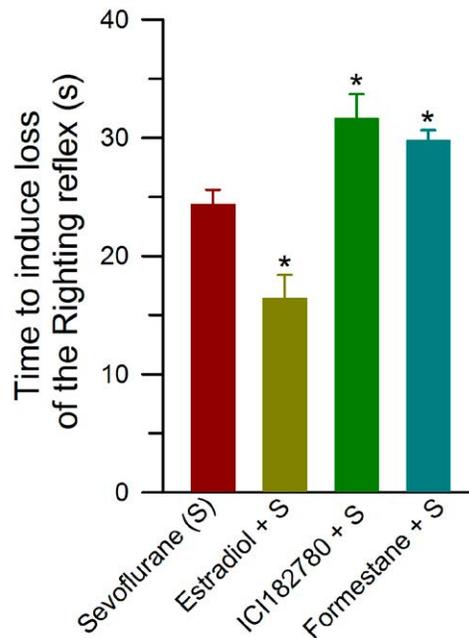


Figure 1.



S-194.**PREGABALIN CAN PREVENT BUT NOT REVERSE COGNITIVE DYSFUNCTION FOLLOWING ABDOMINAL SURGERY IN A RAT MODEL**

AUTHORS: S. Kaminaga¹, T. Kawano², S. Eguchi³, D. Yamanaka², H. Iwata², M. Yokoyama²

AFFILIATION: ¹Center for Innovative and Translational Medicine, Kochi Medical School, Kochi, Japan, ²Anesthesiology, Kochi Medical School, Kochi, Japan, ³Anesthesiology, Tokushima University, Tokushima, Japan

INTRODUCTION: Postoperative cognitive dysfunction (POCD) is common but challenging complication in the elderly. Although its pathogenesis involves various factors, the inflammatory responses in the hippocampus triggered by the surgical procedure are thought to play key roles. Pregabalin can reduce hyperexcitability in neuronal networks by binding to the $\alpha 2\delta$ protein, and be beneficial in the treatment of neuropathic pain as well as postoperative pain. In the present study, we investigated the preventive or therapeutic effect of pregabalin on the cognitive decline following anesthesia and surgery in aged rats.

METHODS: All experimental procedures were approved by the Institutional Animal Care and Use Committee. Aged (24-25 months) male rats were used in this study. Animals received a 2-cm midline incision or anesthesia alone were treated with pregabalin or vehicle control beginning either on early, or late. Each group consisted of 8 animals. For the early treatment group, rats were injected with pregabalin (10mg/kg) intraperitoneally (IP) 1 hour prior to surgery and then 10 mg/kg IP every 12 hour for 3 days. For the late treatment group, same dose of pregabalin was injected during postoperative day 4-7. After two week postsurgical recovery period, cognitive function was assessed using novel object recognition test, which consisted of a familiarization phase and a test phase, separated by one hour retention interval. Recognition memory is expressed as a novel object preference ratio that was calculated as the ratio of time spent exploring the novel object over the total exploring time. After the completion of the cognitive testing, the hippocampus was dissected for measurement of TNF- α by enzyme-linked immunosorbent assay. Differences between the study groups were compared with the Kruskal-Wallis test, and differences between individual groups with the Wilcoxon-Mann-Whitney test. Results with $p < 0.05$ were considered statistically significant.

RESULTS: In the non-surgical group, the novel object preference during testing phase in both early ($79.5 \pm 10.6\%$) and late ($78.2 \pm 11.3\%$) treatment groups were comparable with that of control ($80.1 \pm 9.4\%$). The levels of hippocampal TNF- α were also similar in all groups. On the other hand, the surgical control group showed the decreased the novel object preference of $57.1 \pm 6.5\%$ ($p < 0.05$) and increased hippocampal levels of TNF- α ($p < 0.05$) compared with non-surgical rats. Early treatment with pregabalin attenuated surgery-induced impairment of novel object preference ($72.5 \pm 12.6\%$, $p < 0.05$ vs. surgical control group) as well as increase of TNF- α levels in hippocampus ($p < 0.05$). However, late treatment with pregabalin had no effect on both novel object preference and hippocampal cytokine level.

CONCLUSIONS: Our results demonstrated that pregabalin, when treatment before surgery, and for a sufficient period of time, can prevent the development of hippocampal neuroinflammation and related POCD. Our findings further imply that initiation of treatment with pregabalin after development of POCD may have no therapeutic effect.

S-195.

THE AGING BRAIN: AN AGE-DEPENDENT ANALYSIS OF ELECTROENCEPHALOGRAPH DYNAMICS DURING PROPOFOL AND SEVOFLURANE GENERAL ANESTHESIA

AUTHORS: P. Purdon, K. J. Pavone, O. Akeju, J. M. Lee, E. N. Brown

AFFILIATION: Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA

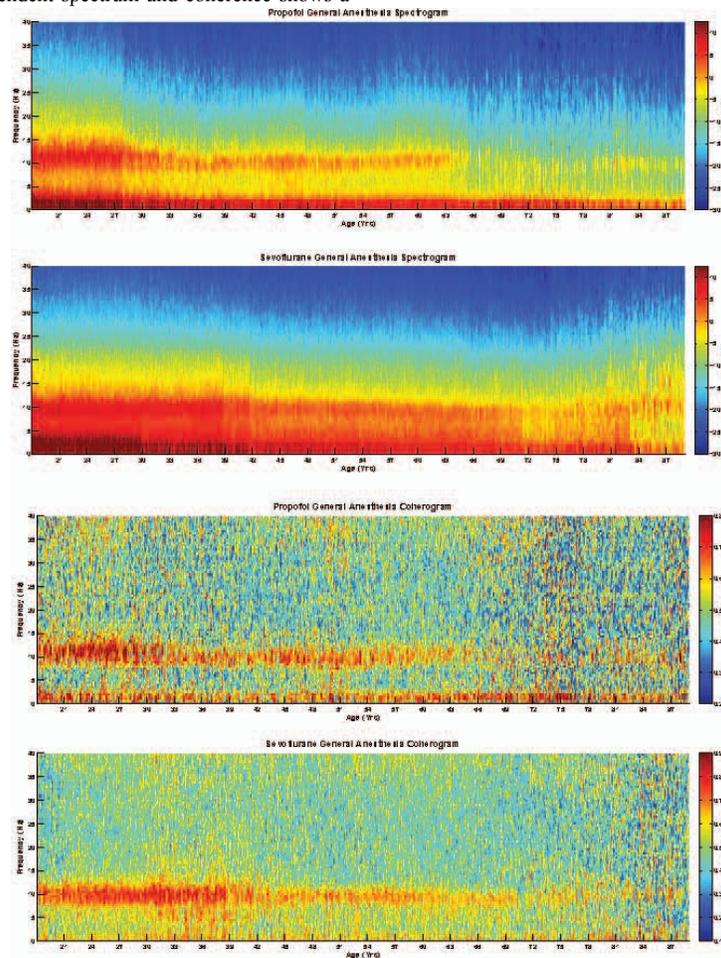
INTRODUCTION: Elderly patients are a vulnerable population of increasing importance in anesthesiology. Postoperative cognitive disorders occur frequently in elderly patients after anesthesia. Significant neurological changes are known to occur during the course of normal aging and are likely related to age-dependent anesthetic effects. The electroencephalogram (EEG) shows stereotyped oscillations under anesthesia that could also change with age. In this study, we characterized propofol- and sevoflurane-induced EEG oscillations as a function of increasing age from young adulthood to old age.

METHODS: We analyzed 155 subjects ages 18 to 89, divided into two cohorts, in which propofol (n=60) or sevoflurane (n=95) were used as the primary anesthetic drug. A four-channel frontal EEG was recorded (Sedline, Masimo, Irvine CA). The EEG spectrum and coherence were estimated using the multi-taper method over a 2-minute period of stable anesthetic maintenance. Age-dependent changes were visualized by plotting mean spectra and coherence as a function of age. Total (0 to 40 Hz) and alpha-band (8-12 Hz) power, and alpha-band coherence, were analyzed as a function of age using linear regression.

RESULTS: The age dependent spectrum and coherence shows a

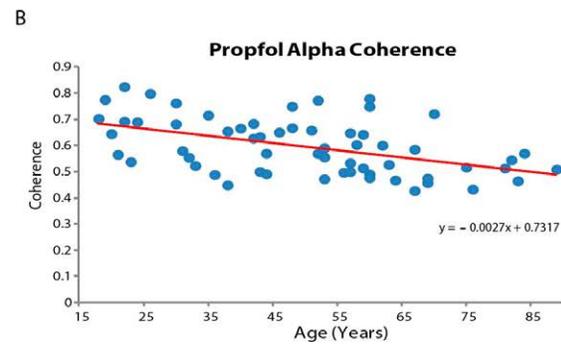
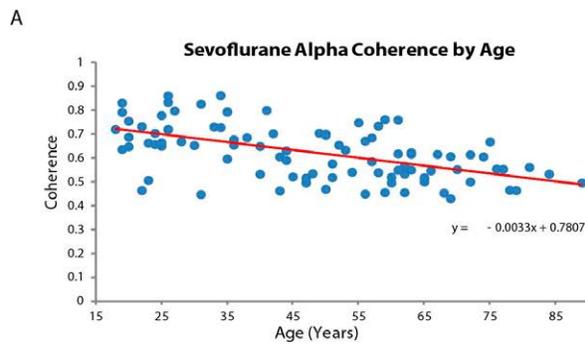
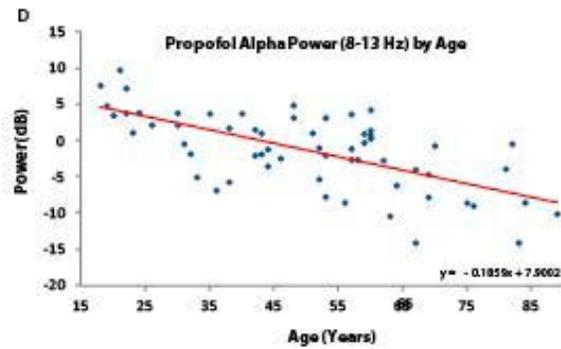
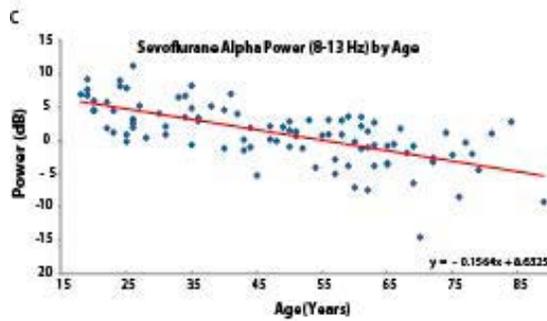
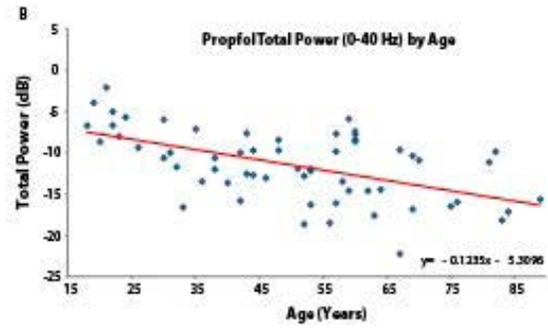
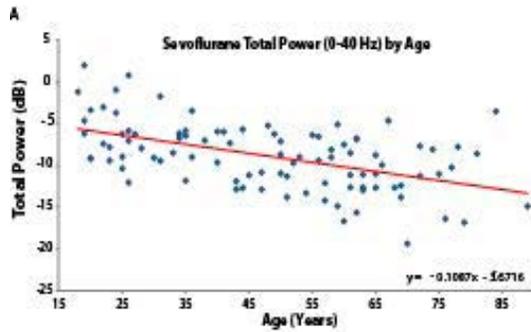
qualitatively similar form with increasing age, featuring alpha and slow-delta (0.1 - 4 Hz) oscillations (Fig 1). However, the power and coherence of these oscillations appears to decrease with increasing age. Total power decreases linearly with age for both sevoflurane ($R^2=0.268$, $p<0.001$, Fig 2A) and propofol ($R^2=0.2975$, $p<0.001$, Fig 2B). Alpha band power also decreases approximately linearly with age for sevoflurane ($R^2=0.4474$, $p<0.001$, Fig 2C) and propofol ($R^2=0.4342$, $p<0.001$, Fig 2D). These decreases in power reflect on average a 3-4 fold difference in EEG amplitude from the youngest to oldest patients studied. Quantitative analysis of alpha band coherence also shows a linear decrease with age for sevoflurane ($R^2=0.3001$, $p<0.001$, Fig 3a) and propofol ($R^2=0.2288$, $p<0.001$, Fig 3b).

CONCLUSIONS: The age-dependent decrease in EEG power and coherence could be related to decreases in grey matter volume and cortical thickness, as well as neurobiological changes, that are known to occur with age. EEG-based depth-of-anesthesia (DOA) monitors use power in the slow/delta and alpha bands, as well as burst suppression, to indicate unconsciousness. The reduced EEG power in elderly patients might cause DOA monitors to have inappropriately high readings, predisposing elderly patients to be in a state of burst suppression at recommended DOA index values. The qualitatively similar form of slow-delta and alpha oscillations, regardless of age, suggests that the form and presence of these oscillations could be used as an alternative to DOA indices to monitor brain states under general anesthesia and sedation in elderly patients.



S-195 • CONTINUED ON NEXT PAGE

S-195 • continued



S-196.

METABOLIZER PHENOTYPES OF CYTOCHROME P450 ENCODING GENES AND POSTOPERATIVE COGNITIVE DYSFUNCTION

AUTHORS: J. Steinmetz¹, C. Jespersgaard², L. S. Rasmussen¹

AFFILIATION: ¹Anaesthesia, HOC4231, Rigshospitalet, DK-2100 Copenhagen, Denmark, ²Clinical Biochemistry and Immunology, Statens Serum Institut, DK-2300 Copenhagen, Denmark

INTRODUCTION: Postoperative cognitive dysfunction (POCD) is a common and important complication in the elderly, but the etiology remains unclear. It has been suggested that anesthetic drugs and their metabolites could possess a toxicity that could contribute to cognitive deterioration after surgery. We aimed to assess if there was an association between POCD and various metabolizer phenotypes of cytochrome P450 encoding genes.

METHODS: After IRB approval we included patients aged >40 years who underwent elective non-cardiac surgery in regional or general anesthesia. The data from a subgroup of patients anesthetized with propofol have previously been reported¹. In this re-analysis of previously collected data, POCD was identified using a neuropsychological test-battery on three occasions, at baseline, one week, and three months after non-cardiac surgery as part of the Second International Study of Postoperative Cognitive Dysfunction (ISPOCD2). Pyrosequencing was used for genotyping of CYP2C19*2, *3, CYP2D6*3, *4, *5 and *6, and patients were characterized as ultra (three wild type alleles), extensive (two wild type alleles), intermediate (one wild type allele), or poor (no wild type alleles) metabolizers.

RESULTS: In total, 976 patients with a median age of 64 years were included of which 337 (35%) received anesthesia with propofol, 484 (50%) had volatile anesthesia, and 155 (15%) received other types of anesthesia. Ninety-three of the 895 patients (10.4%) who underwent neuropsychological testing one week after surgery had POCD, and 75 of 842 patients (8.9%) had POCD after three months. There was no significant association between the various types of metabolizers and the risk of POCD (Table 1).

CONCLUSIONS: Various metabolizer phenotypes based on common cytochrome P450 polymorphisms do not seem to be associated with postoperative cognitive dysfunction.

REFERENCES:

1. Steinmetz J et al. Cytochrome P450 Polymorphism and Postoperative Cognitive Dysfunction. *Minerva Anesthesiologica* 2012; 78: 303-9.

Table 1. Phenotype frequencies. Postoperative cognitive dysfunction (POCD) assessed at one week, or three months after surgery according to metabolizer phenotype based on polymorphisms in cytochrome P450 encoding genes CYP2C19 and CYP2D6. Data given as numbers (%), and groups were compared using Chi-square test.

	One week assessment			Three month assessment		
	POCD	No POCD	P	POCD	No POCD	P
CYP2C19 (2*; 3*)	N=93	N=797	0.76	N=75	N=762	0.38
Extensive metabolizer	66 (71.0%)	575 (72.1%)		53 (70.7%)	547 (71.8%)	
Intermediate metabolizer	26 (28.0%)	206 (25.9%)		19 (25.3%)	202 (26.5%)	
Poor metabolizer	1 (1.0%)	16 (2.0%)		3 (4.0%)	13 (1.7%)	
CYP2D6 (3*; 4*; 5*; 6*)	N=92	N=777	0.45	N=75	N=743	0.72
Ultra metabolizer	7 (7.6%)	36 (4.6%)		6 (8.0%)	36 (4.8%)	
Extensive metabolizer	50 (54.3%)	408 (52.5%)		38 (50.7%)	395 (53.2%)	
Intermediate metabolizer	33 (35.9%)	281 (36.2%)		24 (32.0%)	266 (35.8%)	
Poor metabolizer	2 (2.2%)	52 (6.7%)		7 (9.3%)	46 (6.2%)	

Subspecialty Abstracts

Obstetric Anesthesiology

S-197.**CRYSTALLOID VERSUS COLLOID COLOAD WITH PHENYLEPHRINE INFUSION DURING SPINAL ANAESTHESIA FOR ELECTIVE CAESAREAN DELIVERY: THE EFFECTS ON MATERNAL HAEMODYNAMICS AND FOETAL ACID-BASE STATUS**

AUTHORS: V. Rewari¹, D. Singhal², R. Ramachandran¹, A. Trikha¹, Chandralekha¹, N. Singh³

AFFILIATION: ¹Department of Anaesthesiology, All India Institute of Medical Sciences, New Delhi, India, ²Department of Anaesthesiology, Medica Hospital Pvt. Ltd., Birtamode, Jhapa, Nepal, ³Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, New Delhi, India

INTRODUCTION: We designed a double-blind randomized controlled study to compare the effects of crystalloid versus colloid coload in combination with a prophylactic phenylephrine infusion. The primary outcome was the incidence of maternal hypotension. The secondary outcomes were incidence of reactive hypertension, bradycardia, nausea and vomiting, umbilical artery and vein gas analysis and neonatal Apgar score at 1 and 5 minutes.

METHODS: 60 ASA physical status I and II parturients with singleton pregnancies scheduled for elective caesarean delivery under spinal anaesthesia were recruited in this study. Group A patients received coload with 500 ml of lactated Ringer's solution whereas Group B patients received 500 ml of 6% Hydroxyethyl Starch solution at the start of spinal injection and infused within 5-7 minutes. The phenylephrine infusion was started simultaneously in a dose of 1 ml/min (50 µg/min) and was either on or off according to BP and HR measurements at 1-minute intervals till the uterine incision.

RESULTS: Maternal demographics, surgical times, foetal acid base status and Apgar scores were similar between groups. The incidence of maternal hypotension was 20% in Group A and 10% in Group B ($P > 0.05$). The incidence of bradycardia was more in Group A (6.6% VS 0%, $P < 0.05$). The episodes of reactive hypertension, maximal and minimal recorded SBP and total dose of phenylephrine required did not differ statistically between the two groups ($P > 0.05$).

CONCLUSIONS: Crystalloid or colloid infusion, administered as coload in a volume of 500 ml along with a prophylactic phenylephrine infusion shows no difference in the incidence and severity of hypotension with similar neonatal outcome.

S-198.**A PROSPECTIVE STUDY OF CORRELATION BETWEEN MULTI-ORIFICE EPIDURAL CATHETER DEVIATION AND UNILATERAL BLOCK IN POST-CESAREAN ANALGESIA AFTER USING A NEW PCA PUMP**

AUTHORS: S. Irikoma

AFFILIATION: Anesthesiology, Seirei Hamamatsu General Hospital, Hamamatsu, Japan

INTRODUCTION: Epidural catheter deviation is one of the causes of unilateral block in postoperative epidural analgesia for cesarean delivery. We previously reported that cut-off value of epidural catheter deviation led to unilateral block was 7 mm from the midline of spine in cases with 3 ml/h dosing rate PCA pumps. We examined the effect of the magnitude of epidural catheter deviation on unilateral block by prospectively reviewing cases in which new PCA pumps were used for post-cesarean pain relief.

METHODS: A prospective study on cesarean delivery cases followed up by anesthesiologists from July 2012 to November 2012 in Seirei Hamamatsu General Hospital. Position of the catheter tip was confirmed with post-operative X-ray films. Combined spinal-epidural anesthesia was performed in all cases. Multi-orifice catheter was placed through Th11-12 or Th12-L1 to 5 cm cephalad direction. Eight mg hyperbaric bupivacaine and 20 µg fentanyl were injected into spinal subarachnoid space through L3-4. After surgery 0.2% ropivacaine was started with 4 ml/h dosing rate using a new PCEA pump. We noted that the distance of tip of the catheter from right or left of the midline of spine. We evaluated analgesic effect by using cold test. Unilateral block was defined as a negative cold test on only the same side as the catheter deviation. Different anesthesiologist evaluated X-ray film and analgesic effect. We used ROC curve to study cut-off value and accuracy. Catheter placement on lumbar area, catheter tip not recognized in an X-ray film and no analgesic evaluation after surgery was excluded from the study.

RESULTS: There were 151 cesarean sections in this period and 94 cases were included in this study. There were 33 unilateral blocks. We described ROC curve. Cut-off value was 7 mm and AUC was 0.8 (Figure 1).

CONCLUSIONS: In our study over 7 mm epidural catheter deviation correlated to unilateral block, and accuracy was moderate in cases using new PCA pumps. There may be other predictors of unilateral block in post-cesarean analgesia.

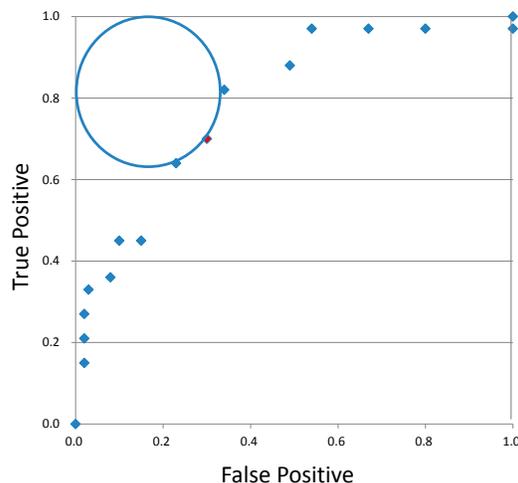


Figure 1. ROC curve

S-199.

DICLOFENAC SUPPOSITORY IS EQUALLY EFFECTIVE COMPARED WITH AN OPIOID-FREE EPIDURAL ANALGESIA FOR PAIN RELIEF AFTER CAESAREAN SECTION: PRELIMINARY RESULTS OF PROSPECTIVE RANDOMIZED STUDY

AUTHORS: M. Takamatsu¹, Y. Imao¹, K. Bamba¹, Y. Kamiya¹, H. Baba²

AFFILIATION: ¹Anesthesiology, Niigata University Medical & Dental Hospital, Niigata, Japan, ²Anesthesiology, Niigata University, Niigata, Japan

INTRODUCTION: Opioid-free epidural anesthesia is a choice of postoperative analgesia in order to avoid postoperative nausea and vomiting (PONV) after Cesarean section. Recently, early ambulation from Cesarean section is emphasized to prevent thromboembolic diseases and facilitate baby care, and epidural analgesia sometimes causes leg weakness to disturb early ambulation. Moreover, pain of uterine contraction after Cesarean section is effectively treated by diclofenac suppositories not by opioid-free epidural analgesia. We hypothesized that regular administration of NSAIDs is as effective as opioid-free epidural analgesia.

METHODS: The study was approved by the local ethics Committee of Niigata University Hospital.

The period covered by the study was July 1, 2014, to October 10, 2014. Subjects were 27 women undergoing elective or emergency cesarean section with epidural anesthesia (group E, n=14) or diclofenac sodium suppositories (group D, n=13) for postoperative pain relief (Table 1, Figure 1). Both groups received spinal anesthesia with 0.5% hyperbaric bupivacaine and 0.1 mg morphine hydrochloride and 100µg fentanyl.

In Group E, an epidural catheter was placed at T9-L1 for induction of anesthesia. After operation, patient received 0.2% ropivacaine via patient-controlled epidural analgesia (PCEA).

In Group D, diclofenac suppositories were given at the end of surgery and then every 12 h from anesthesia initiated for 4 times.

Pain level was evaluated by a Numerous Rating Scale (NRS). NRS (at movement) at 48 h after spinal anesthesia was the primary endpoint. Secondary endpoints were NRS at 48 h (at rest) and at 24 h, and 60 h (at rest and movement) and additional analgesic administration, for out of bed, ambulation and uterine contraction. Unpaired t-test was used for comparisons with a normal distribution, and Mann-Whitney U test for those with non-parametric values (significance at P<0.05).

RESULTS: The mean age, duration of operation, and gestational age were similar the two groups. For the primary endpoint measure in this study, the median (interquartile range [range]) NRS score at 48h did not differ significantly between the two groups evaluated. The NRS on movement at 48 h was 4.5 (4.00-6.00 [0-9]) for group E and 4 (3.00-4.00 [1-9]) for group D (p=0.08). (Figure 2). The respective medians of NRS on movement and at rest did not significantly differ between the two groups.(Figure 3). In Group D, additional analgesic administration was less than in Group E.

Two cases of complications interfering with ambulation (nausea and sensory disturbance) were observed in Group E. Uterine contraction and other such side effects were not significant.

CONCLUSIONS: Diclofenac sodium suppositories every 12 hours were efficacious as same as opioid-free epidural analgesia in postoperative analgesia after cesarean section. This simple and safe method might be alternative method for postoperative analgesia after Cesarean section in patients with contraindications epidural anesthesia, even advantageous early ambulation in perinatal mothers.

Table 1 : exclusion criteria

- Could not obtain the written consent such as mental illness and minors, from the subject himself
- contraindications neuraxial anesthesia
- renal dysfunction, of gastrointestinal ulceration
- Other, who is principal investigator was judged unsuitable as subjects

Figure 1 : Recruitment flow diagram

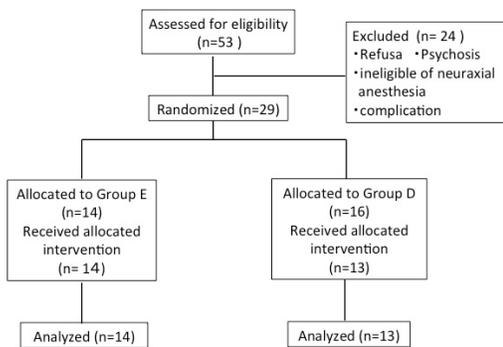


Figure. 2

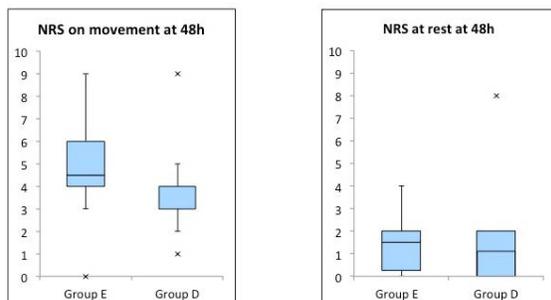
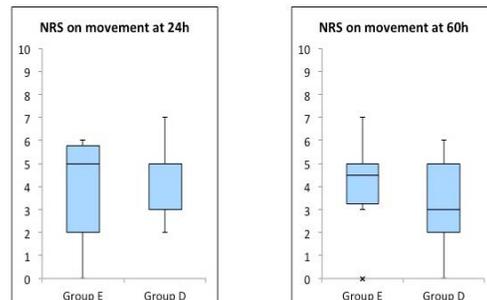


Figure. 3



S-200.

WHY DID IT TAKE THAT LONG? A STUDY OF FACTORS INFLUENCING CESAREAN DELIVERY TIMES

AUTHORS: M. Meng¹, A. Gonzalez², R. Smiley¹

AFFILIATION: ¹Anesthesiology, Columbia University, New York, NY, ²Anesthesiology, UMDNJ-Anesthesiology, Newark, NJ

INTRODUCTION: What is the average cesarean delivery time in an academic hospital? When should we consider a combined spinal epidural (CSE)? Is performing a CSE rather than a spinal for a tertiary cesarean delivery (CD) worth the risk of a severe PDPH from the Touhy needle? The aim of our study was to investigate the surgical time needed for a primary (C1), secondary (C2), tertiary (C3) and quaternary or more (C4) CD at our institution. A secondary aim was to assess the effect of other factors that might alter surgical time. Factors affecting CD times have been studied before^{1,2}, but differences in practices exist that make any such results only moderately generalizable.

METHODS: We conducted a retrospective study of 1352 women undergoing CD electively (481) and emergently (871) from January to December 2011. Scheduled cases done on the day scheduled were considered elective; all others were classified as emergencies. Data was gathered from our electronic anesthesia record and electronic charting by nursing staff. We examined the effect of C1 vs C2-C4, age, gestational age, BMI, whether the patient had undergone a trial of labor, elective vs emergent, the anesthetic performed, and performance of tubal ligation (BTL) on skin to skin time, skin to uterine incision time, and uterine incision to skin closure time. The effect of categorical variables was compared by ANOVA, with Scheffe's post hoc test. A regression model was used to assess the combined effect of all independent variables.

RESULTS: There was a statistical difference between C1, C2, C3, and C4 CD when looking at skin to closure times, skin to uterus times and uterus to closure times (Table 1). Linear regression demonstrated that the factors which affect surgical time are: BMI, GA, number of prior CS and BTL (Table 2), but these independent factors can only account for 9% of the variance. BTL added 8 min to the total surgical time.

CONCLUSIONS: There was a statistical difference in surgical time between a primary CD and repeat CD. C1 and C2 CD are completed in mean times of 56 and 60 min, respectively, making a single-shot spinal adequate anesthetics for these cases. C3 and C4 CD mean times are 70 and 82 min, respectively; these are the cases that might require prolonged neuraxial anesthesia, especially for those cases that fall above the mean. When the anesthesiology team

considers the time for onset of anesthesia and the time for surgical prepping and draping of the patient, it is not unreasonable to perform a CSE for C3 and C4 CD, especially if some of the factors shown to have a moderate impact on surgical times are present as well. One weakness of the study is that we did not evaluate experience of the operating surgeon, that information is not easy to obtain from electronic records. We should be able to assess this factor in further analysis. It is possible that first year OB residents perform most C1 CD and more senior residents or fellows are involved in the complicated cases (previous abdominal surgery and C2-C4 cases) making differences between the categories less dramatic than they might otherwise be.

REFERENCES:

1. Wilson, S. Int J Obstet Anesth 2010
2. Doherty, D. A. Aust N Z J Obstet Gynaecol 2008

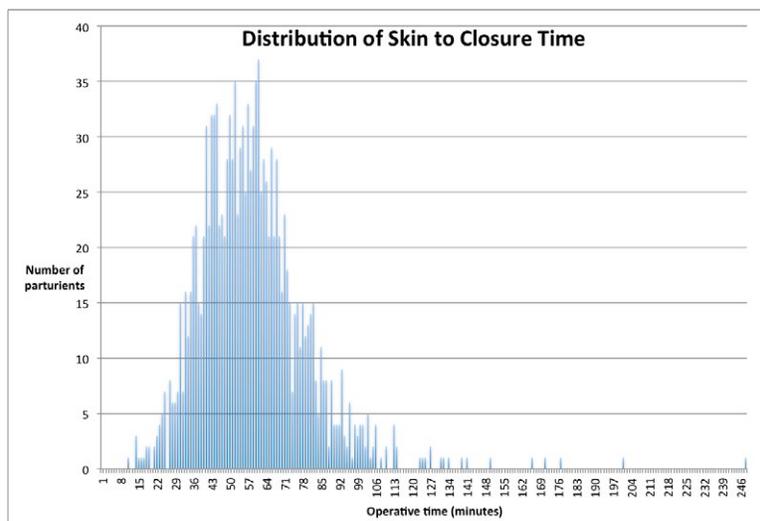
(Table 1) Effect of Repeat Cesarean on Operative Time

CD	Skin to closure time (min)	Skin to uterus (min)	Uterus to closure (min)
C1	56 ± 19ω*‡	9 ± 4ω‡	46 ± 17‡
C2	60 ± 19*‡	13 ± 6‡	47 ± 15‡
C3	70 ± 28*ω‡	15 ± 7‡	54 ± 25*ω
C4	82 ± 31*ω•	17 ± 9*ω	63 ± 29*ω

* Statistically different than C1; ω Statistically different than C2;
• Statistically different than C3;
‡ Statistically different than C4

(Table 2) Linear Regression on Skin to Closure Time (R-squared = 0.09)

Independent Variables	Coeff.	Std. Err.	pValue	95% CI
BMI	Coeff.	0.08	<0.001	0.15-0.48
Gestational age	-0.60	0.19	0.002	-0.97(-0.22)
C2	3.41	1.28	0.008	0.89-5.92
C3	9.83	2.22	<0.001	5.46-14.19
C4	21.71	3.80	<0.001	14.24-29.17
BTL	7.57	1.91	<0.001	3.81-11.32
Constant	68.31	7.69	<0.001	53.23-83.40



S-201.

RACIAL DISPARITIES IN MORBIDITY AND MORTALITY AMONG PARTURIENTS WITH PREECLAMPSIA AND ECLAMPSIA: AN ANALYSIS OF THE NATIONWIDE INPATIENT SAMPLE

AUTHORS: J. Nizamuddin¹, S. Rana², S. Shahul¹

AFFILIATION: ¹Department of Anesthesia, Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Brookline, MA, ²Section of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, The University of Chicago School of Medicine, Chicago, IL

INTRODUCTION: Preeclampsia/eclampsia is a leading cause of worldwide maternal mortality. Previous studies examining racial disparities in the prevalence of preeclampsia and eclampsia have yielded conflicting results^{1,2}; however, a higher mortality rate of preeclampsia/eclampsia among African-American women has been noted¹. We sought to examine racial differences in the prevalence of preeclampsia/eclampsia and examine differences in maternal comorbidities and pregnancy and delivery characteristics and complications that may help delineate the basis of these disparities.

METHODS: We obtained weighted estimates of the number of hospitalizations for deliveries complicated by preeclampsia and eclampsia using discharge diagnosis (ICD-9 codes) obtained through the Nationwide Inpatient Sample (NIS) from 2007 to 2011. We calculated the prevalence of preeclampsia/eclampsia among White, African American, and Hispanic women. For each group, we then calculated the prevalence of several baseline characteristics and comorbidities, as well as complications of pregnancy and delivery. We then calculated the case fatality rate among parturients with preeclampsia/eclampsia who developed each of these complications.

RESULTS: Among 16,889,164 deliveries, 708,508 (4.2%) were diagnosed with preeclampsia and eclampsia. There were 1,336 maternal deaths and 83,600 of fetal deaths. The prevalence of preeclampsia-eclampsia was significantly higher in African-American than White women (5.9% vs 3.7%); higher maternal mortality (Adjusted OR 3.358) and higher fetal mortality (Adjusted OR 2.582) were also noted in African-American patients, even after adjusting for income, region, diabetes, and payer type (Table 1). A higher case fatality rate was seen in African-American women who developed pulmonary embolism, coagulopathy, stroke, postpartum hemorrhage, or placental abruption than White women with the same complication (Table 2).

CONCLUSIONS: This large database analysis showed significant racial disparities in the prevalence of preeclampsia and eclampsia in the United States and its associated mortality. Several comorbidities and complications have been identified which are associated with a higher mortality in African American women; further studies are needed to determine whether these complications have a causative role in worsening mortality among parturients with preeclampsia/eclampsia.

REFERENCES:

1. Am J Public Health. 2007 February; 97(2): 247-251.
2. Am J Public Health. 2007 January; 97(1): 163-170.

	Weighted N (%)			P
	White	Black	Hispanic	
No. of Patients	513590	212940	249915	
Patient Characteristics				
Age (years)				< 0.001
10 - 19	25912 (5.67)	23412 (12.48)	25173 (11.39)	
20 - 29	229377 (50.17)	98971 (52.77)	113195 (51.24)	
30 - 39	179680 (39.3)	57558 (30.69)	73282 (33.17)	
40 - 49	22248 (4.87)	7600 (4.05)	9280 (4.2)	
Median Household Income for Patient's Zip code (percentile)				< 0.001
0 - 25th	111646 (22.07)	103080 (49.86)	97771 (40.25)	
26th - 50th	132286 (26.14)	45664 (22.09)	59689 (24.57)	
51st - 75th	135656 (26.81)	35191 (17.02)	51087 (21.03)	
76th - 100th	126391 (24.98)	22792 (11.02)	34340 (14.14)	
Hospital Characteristics				
Hospital Region				< 0.001
Northeast	96998 (18.88)	42544 (19.98)	31716 (12.69)	
Midwest	100801 (19.62)	26687 (12.53)	9404 (3.76)	
South	212527 (41.37)	127330 (59.79)	111965 (44.79)	
West	103425 (20.13)	16395 (7.7)	96875 (38.76)	
Patient Comorbidities				
Diabetes Without Chronic Complications	13278 (2.58)	7294 (3.43)	8280 (3.31)	< 0.001
Diabetes With Chronic Complications	2396 (0.47)	1263 (0.59)	1118 (0.45)	0.007
Renal Failure	1039 (0.2)	884 (0.42)	830 (0.33)	< 0.001
Chronic Renal Failure	986 (0.19)	704 (0.33)	621 (0.25)	< 0.001
Liver Disease	901 (0.18)	350 (0.16)	577 (0.23)	< 0.001
Pregnancy Characteristics				
Multiple Gestation	35410 (6.89)	9073 (4.26)	8748 (3.5)	< 0.001
Multiparity	2409 (0.47)	2986 (1.4)	3081 (1.23)	< 0.001
Cesarean Delivery	290168 (56.48)	121707 (57.15)	131801 (52.73)	0.0012
Hypertension	46408 (9.03)	34385 (16.05)	29339 (8.14)	< 0.001
Obesity	38688 (7.53)	23347 (10.96)	17119 (6.85)	< 0.001
Vaginal Delivery	508338 (98.95)	209589 (98.42)	247995 (99.21)	< 0.001

	Case mortality rates per 100,000 deliveries with that condition			
	White	Black	Hispanic	p
Cardiac / Pulmonary				
Pulmonary Embolism	4672.9	7368.4	6666.7	0.0016
Mechanical Ventilation	4275.7	7829.6	4948.9	0.1600
Central Nervous System (CNS)				
Stroke	6179.8	13496.9	7476.6	0.0022
Obstetrical				
Coagulopathy	446.1	1449.3	940.0	0.0012
Placental Abruption	209.4	140.7	82.5	0.0019
Postpartum Hemorrhage	149.6	497.8	79.7	0.0016
Composite Comorbidity	651.6	1577.5	816.9	.0317

S-202.

WITHDRAWN.

S-203.

MATERNAL RISK FACTORS FOR ANESTHESIA-RELATED ADVERSE EVENTS DURING CESAREAN DELIVERIES

AUTHORS: G. Li, J. Guglielminotti

AFFILIATION: Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Anesthesia-related adverse events (ARAEs) in obstetrics are a rare cause of severe maternal morbidity or mortality but are highly preventable. The risk of ARAEs in cesarean delivery is significantly higher than in vaginal delivery. However, little is known about the individual maternal risk factors for ARAEs in cesarean delivery. This study aims to identify potentially modifiable maternal risk factors for ARAEs in cesarean delivery to facilitate the development of targeted interventions for improving obstetric anesthesia safety.

METHODS: Data came from the State Inpatient Database (SID) for New York from 2003 to 2012. Discharge records for cesarean delivery were identified with International Classification of Diseases, Ninth Revision, Clinical Modification codes (ICD-9-CM). ARAEs, patients characteristics and delivery characteristics were

recorded either directly from the SID data or with a combination of ICD-9-CM diagnosis and procedures codes. Univariate analysis for comparisons of discharges with and without ARAEs used Fisher test or Chi-square test. Variables with a p-value <0.2 in the univariate analysis were entered into a logistic regression model with backward selection.

RESULTS: A total of 785,854 discharges indicating cesarean delivery were included in the analysis. At least one ARAE was recorded in 5,715 discharges (7.27/1,000 [95%CI 7.08;7.46]). The results of maternal factors associated with ARAEs are presented in Table 1. The maternal factor most predictive of ARAEs was pulmonary hypertension [adjusted odds ratio (aOR) 2.30 [1.08;4.89]], followed by obesity (aOR 1.66 [1.47;1.87]), sickle cell disease (aOR 1.65 [1.13;2.42]) and cardiac valvular disease (aOR 1.53 [1.23;1.89]).

CONCLUSIONS: The most important maternal risk factors for ARAEs are comorbidities such as pulmonary hypertension, obesity, sickle cell disease, and cardiac valvular disease. Intervention programs targeting women with these comorbid conditions are needed to improve obstetric anesthesia safety.

Table 1: Uni- and multivariate analysis of risk factors for anesthesia-related adverse events in cesarean delivery. Results are expressed as number (%)

	Univariate analysis	Multivariate analysis
Patients characteristics		
	Odds ratio [95% CI]	Odds ratio [95% CI]
Age (year)	0.82 [0.71;0.95]	0.83 [0.72;0.96]
≤ 19	Ref	Ref
20-29	0.96 [0.91;1.02]	0.95 [0.90;1.00]
30-39	0.88 [0.79;0.99]	0.87 [0.77;0.97]
≥ 40		
Obesity	1.57 [1.40;1.76]	1.66 [1.47;1.87]
Pulmonary hypertension	2.97 [1.40;6.28]	2.30 [1.08;4.89]
Cardiac valvular disease	1.65 [1.33;2.03]	1.53 [1.23;1.89]
Severe preeclampsia or eclampsia	1.18 [1.02;1.37]	1.20 [1.03;1.40]
Preexisting diabetes mellitus	0.82 [0.65;1.04]	0.76 [0.60;0.97]
Sickle cell disease	1.67 [1.14;2.45]	1.65 [1.13;2.42]
Asthma	1.22 [1.08;1.37]	1.18 [1.05;1.33]
Pregnancy and delivery characteristics		
Multiple gestation	1.16 [1.03;1.30]	1.20 [1.06;1.34]
Previous cesarean delivery	1.08 [1.02;1.14]	1.13 [1.06;1.20]
Type of cesarean delivery		
- Not during labor not urgent	Ref	Ref
- Not during labor urgent	0.93 [0.85;1.03]	1.00 [0.90;1.10]
- During labor not urgent	0.98 [0.92;1.04]	1.03 [0.97;1.10]
- During labor urgent	1.05 [0.98;1.14]	1.15 [1.05;1.25]
Non-elective admission type	0.94 [0.89;0.99]	0.94 [0.89;0.99]
General anesthesia	1.30 [1.19;1.43]	1.30 [1.19;1.43]

S-204.**CONTINUOUS SPINAL LABOR ANALGESIA, ALSO
A HOT TOPIC****AUTHORS:** M. Meng, A. Lee, R. Smiley**AFFILIATION:** Anesthesiology, Columbia University,
New York, NY**INTRODUCTION:** Several reports in recent years have described an increase in maternal temperature in association with labor epidural analgesia (LEA).¹ The relationship between maternal temperature and continuous spinal labor analgesia (CSLA) has never been reported.**METHODS:** In a retrospective cohort study, quality assurance data from December 2008 to December 2013 was reviewed, to identify patients who had CSLA. Each patient was matched with 2 patients who received LEA, based on parity, duration of labor (2-4 hours or >4 hours) and BMI. Maternal temperatures on admission and throughout labor were recorded. The standard protocol at our institution was to obtain maternal temperature every 2 hours in labor, but missing values were common.**RESULTS:** 33 patients had CSLA > 2 hours. No difference in maximal temperature or incidence of fever (T >38°C) was seen between CSLA and LEA groups. 5 patients in the LEA cohort (n=66) developed fever vs. 3 in the CSLA cohort (n=33), (p = 1). A clinical diagnosis of chorioamnionitis was made in 3 of 5 and 2 of 3 cases of fever in the LEA and CSLA groups, respectively. All cases with fever not attributed to chorioamnionitis, developed elevated temperature after >7 hours of catheterization.**CONCLUSIONS:** The incidence of fever in both the spinal and epidural catheter cohorts (3%) is lower than in many other reports.¹ CSLA was associated with intrapartum temperature patterns similar to LEA. The stimulation of the epidural space may be more important than the type of neuraxial blockade. CSE labor analgesia has been reported to have similar rates of maternal fever to epidural analgesia.^{2,3} Type of local anesthetic may affect fever rates.⁴**REFERENCES:**

1. Anesth Analg. 2010;111:1467-75.
2. Br J Anaesth. 2011;107(5):762-8.
3. Int J Obstet Anesth. 2011;20(4):312-7.
4. Chang Gung Med J. 2011;34(3):286-92.

S-205.

DOES PAIN IMPACT INFORMED CONSENT FOR NEURAXIAL ANESTHESIA IN THE PARTURIENT: A PILOT STUDY

AUTHORS: C. Burkle, D. Olsen, H. Sviggum, A. Jacob

AFFILIATION: Anesthesiology, Mayo Clinic, Rochester, MN

INTRODUCTION: Patient consent for labor anesthesia presents unique challenges for anesthesiologists. Most prior studies are limited by small sample sizes with limited data and compare multiple levels of patient pain.¹ Contrastingly, this pilot study set out to determine whether patients arriving to labor and delivery (L&D) with any amount of pain recalled risks to neuraxial anesthesia at the same level as patients reporting no pain. Secondary outcome measures included group differences with regard to satisfaction with the communication of risks of neuraxial anesthesia and the preferred timing and modes of communication of those risks.

METHODS: Following Review Board approval, consecutive gravida 1 para 0 English-speaking parturients presenting to L&D for induction of labor, cesarean delivery or management of active labor were included. Each was consented for neuraxial anesthesia according to routine standards in our practice. Risks presented included headache, infection, nerve damage and bleeding. At the time of consent, a verbal pain score (0-10; 0 = none, 10=worst) was recorded. Following delivery, consenting patients were assessed for (Fig. 1) level of satisfaction with the informed consent process, level of anxiety at the time of the consent discussion, specific items recalled from the consent discussion (4 true risks and 2 distractors) and the time and preferred mode of communication of risks.

RESULTS: TA total of 106 patients were consented to participate in the study; 10 patients were excluded due to missing initial pain scores, leaving 96 for analysis. Overall, 38/96 (39.6%) preferred to discuss risks 1 month prior to anticipated delivery, 33/96 (34.4%) on arrival to L&D, 20/96 (20.8%) immediately prior to neuraxial placement, and 5/96 (5.2%) during first prenatal visit. Nearly all, 90/96 (93.8%), were very satisfied with the communication of risks of neuraxial anesthesia. After delivery, patients could recall the following risks being discussed at the time of consent: headache 84/96 (87.5%), infection 85/96 (88.5%), nerve damage 84/96 (87.5%), bleeding 74/96 (77.1%). Interestingly, 15/96 (16.7%) and 25/96 (26.0%) of patients recalled discussions about slurred speech and decreased drug efficacy (distractors), respectively. Only 20/96 (20.8%) of patients recalled all discussed risks and none of the distractors. At the time of consent for neuraxial anesthesia, the median (IQR) reported pain score was 6 (0, 9) and median reported level of anxiety was 3 (1, 7). Accuracy of recall was not significantly associated with the presence of pain (Fig 2, p=0.927) or anxiety (Fig 3, p=0.860) at the time of consent.

CONCLUSIONS: Less than a quarter of patients correctly recalled all risks presented during the consent process. Presence, or lack, of pain or anxiety was not associated with recall accuracy. A majority of patients preferred receiving information on the risks of neuraxial anesthesia either one month prior to or upon arrival to the labor suite. The most preferred mode of communication was through a combination of both written and verbal means.

REFERENCES:

1. Anesth Analg ; 112: 912-915 (2011)

Figure 1

SURVEY NUMBER _____

INSTRUCTIONS:

Please check the box that best corresponds to your answer for each question below. Your questionnaire sheet will be collected with your other materials by the anesthesia team. Thank you for your willingness to assist us with this project.

(1) How satisfied were you with the pain relief provided by your epidural or spinal anesthesia?

Very satisfied
 Somewhat satisfied
 Neutral
 Somewhat dissatisfied
 Very dissatisfied
 Prefer not to answer

(2) How satisfied were you with the communication of risks associated with your epidural or spinal anesthetic?

Very satisfied
 Somewhat satisfied
 Neutral
 Somewhat dissatisfied
 Very dissatisfied
 Prefer not to answer

(3) Please describe the level of distress (anxiety) you were experiencing at the time the risks of epidural or spinal anesthesia were communicated to you: (1 = no distress, 10 = most distress you have ever experienced) _____

Please document which risks were mentioned to you before your epidural or spinal anesthetic:

	Yes	No	Unsure	Prefer not to answer
(4) Headache	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(5) Slurred speech	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(6) Infection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(7) Decreased effectiveness of other pain medications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(8) Nerve damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(9) Bleeding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(10) Please state when you would prefer to be informed of any risks involved with epidural or spinal anesthesia. (Answer only one)

During your first prenatal visit
 1 month prior to expected delivery
 Upon arrival to labor and delivery
 Immediately prior to epidural or spinal placement
 Prefer not to answer

Figure 1 (continued)

(11) Please state how you would want to be informed of any risks involved with epidural or spinal anesthesia. (Answer only one)

Informational pamphlet alone
 Personal discussion with your anesthesia provider alone
 Both informational pamphlet and discussion with your anesthesia provider
 Prefer not to answer

(12) What is your level of education?

Some high school
 High school graduate
 Some college
 College graduate
 Graduate degree
 Prefer not to answer

(13) Which of the following best describes you? (Mark all that apply)

Hispanic or Latino
 White or Caucasian
 Black or African American
 American Indian or Alaskan Native
 Asian or Pacific Islander
 Something else, please specify: _____
 Prefer not to answer

(14) Which medical service cared for you during your pregnancy?

Obstetrics
 Family Medicine
 Midwife
 Prefer not to answer

(15) Did you receive a written pamphlet describing risks and benefits of labor anesthesia (epidurals and spinals) at any point during your pregnancy?

Yes
 No
 Unsure
 Prefer not to answer

(16) Please sign last page of attached HIPAA Authorization Form and check here

ONCE LAST PAGE IS SIGNED, PLACE THE ENTIRE SURVEY IN ENVELOPE PROVIDED.

THANK YOU

S-205 • continued

Figure 2. Effect of Pain on Recollection of Risk Factors

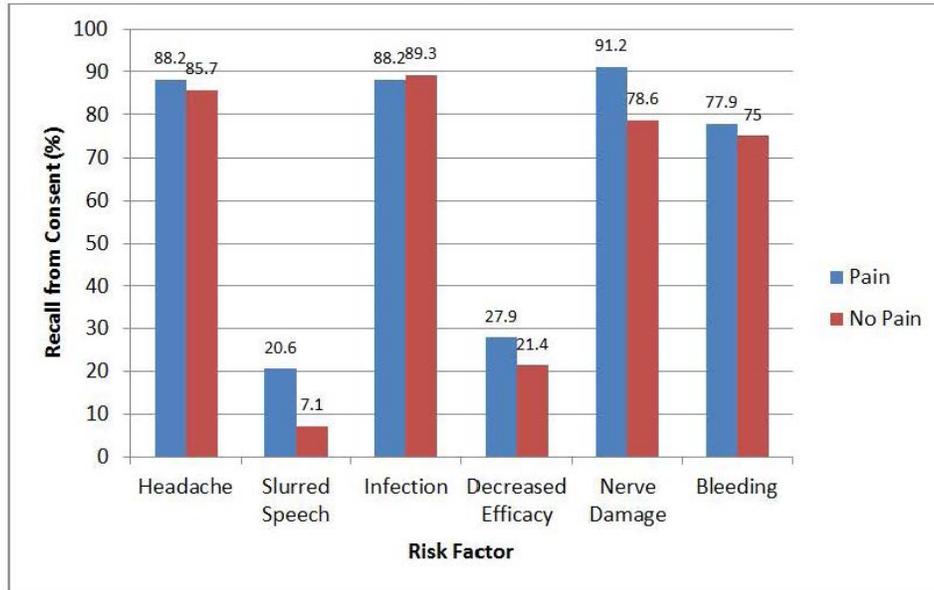
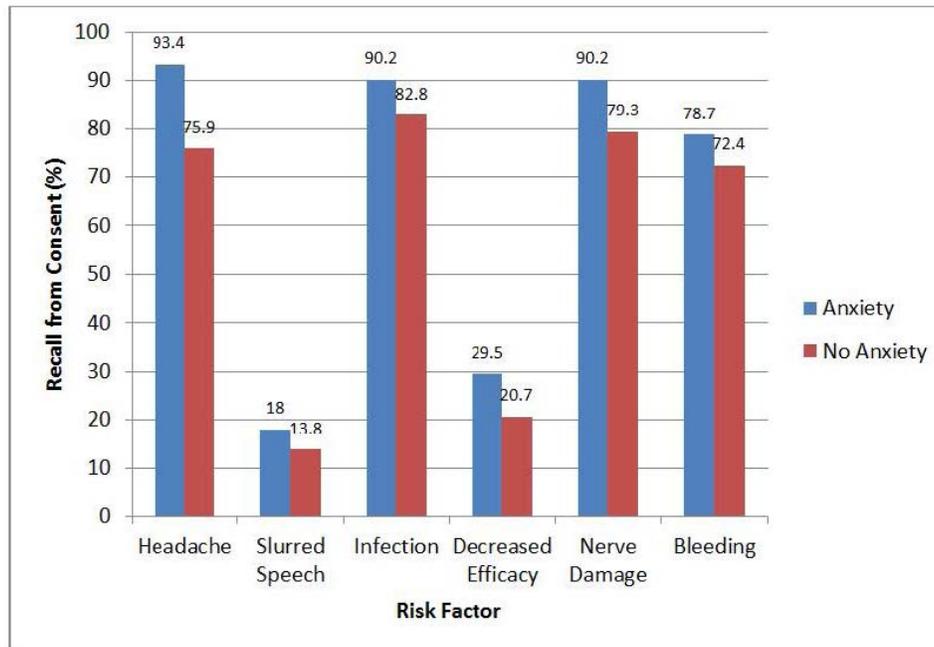


Figure 3. Effect of Anxiety on Recollection of Risk Factors



S-206.

TEMPORAL TRENDS IN SEVERE MATERNAL ADVERSE OUTCOMES AND ANESTHESIA-RELATED ADVERSE EVENTS IN CESAREAN DELIVERIES IN NEW YORK STATE, 2003-2012

AUTHORS: J. Guglielminotti, G. Li

AFFILIATION: Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Cesarean delivery is associated with significantly increased risks of severe maternal adverse outcomes (SMAOs) and anesthesia-related adverse events (ARAEs), compared with vaginal delivery. The increase in cesarean delivery rate along with the increase in maternal comorbidities may pose a special challenge to obstetric safety. This study examines the temporal trends in SMAOs and ARAEs in New York State during the last decade.

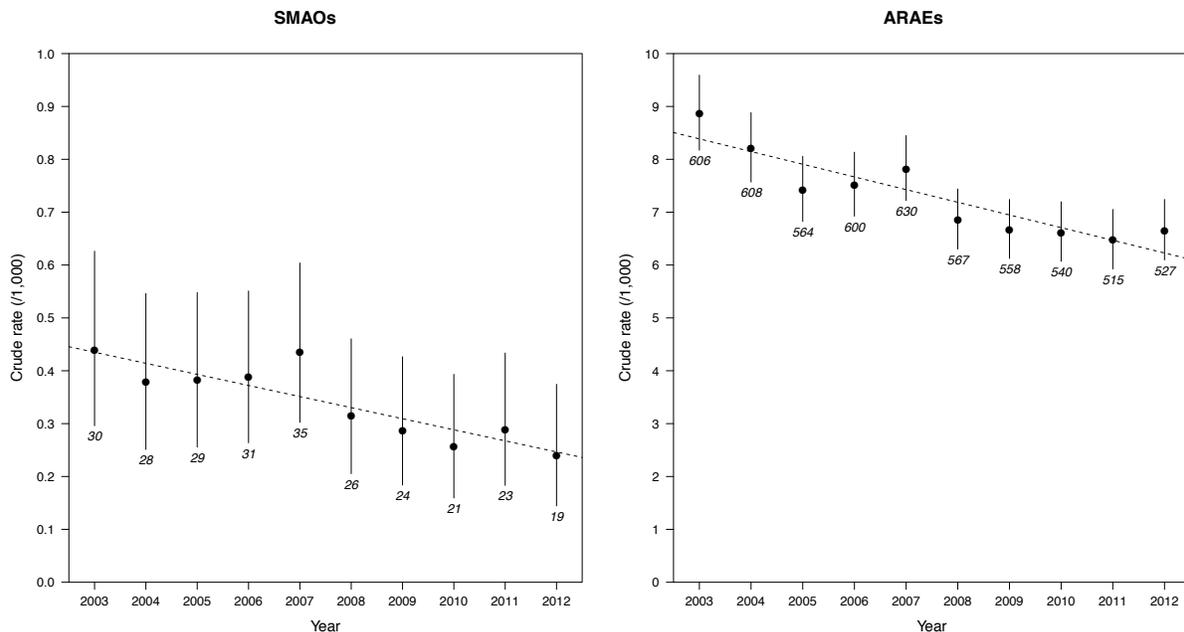
METHODS: Data came from the State Inpatient Database for New York from 2003 to 2012. Discharge records for cesarean delivery were identified with International Classification of Diseases, Ninth Revision, Clinical Modification codes. The following variables were recorded: Charlson comorbidity index, SMAOs including in-hospital death or cardiac arrest, and ARAEs. For each year of the study period, the proportion or the crude rate for the event of interest was calculated as the ratio of the number of cesarean deliveries with the event to the number of cesarean deliveries for the year.

A sensitivity analysis of the trends in ARAEs rate was performed according to 3 hospital characteristics: annual volume of cesarean delivery (low-, intermediate- or high-volume hospital), presence of a residency program (yes or no) and location (urban or rural). The Cochran–Armitage test for trends was used to assess the statistical significance of changes over time.

RESULTS: During the years 2003-2012, 785,854 discharges indicating cesarean delivery were included in the analysis. SMAOs were recorded in 266 discharges (0.33/1,000 [95%CI:0.30;0.38]), and at least one ARAE in 5,715 discharges (7.27/1,000 [95%CI:7.08;7.46]). The proportion of deliveries through cesarean section increased from 28.7% in 2003 to 34.7% in 2009 and levelled off thereafter. The proportion of cesarean deliveries with a Charlson comorbidity index greater than 1 increased from 3.5% in 2003 to 6.4% in 2012 (p<0.0001). A statistically significant decrease in the rate of SMAOs was observed, from 0.44/1,000 in 2003 to 0.24/1,000 in 2012 (p=0.004) along with a decrease in the rate of ARAEs, from 8.9/1,000 in 2003 to 6.6/1,000 in 2012 (p<0.0001) (Figure 1). The decrease in ARAEs rates was observed across hospitals regardless of delivery volume, teaching status, and rural/urban location.

CONCLUSIONS: Despite increased maternal comorbidities, SMAOs and ARAEs rates in cesarean deliveries have decreased significantly during the last decade in New York State. Further research is warranted to identify the contributory factors underlying the marked improvement in obstetric anesthesia safety.

Figure 1: Crude rate of severe maternal adverse outcomes (SMAOs; left panel) and anesthesia-related adverse events (ARAEs; right panel) in cesarean deliveries in New York State from 2003 to 2012. The vertical lines indicate the exact 95% confidence interval, the subscript number the number of events for the corresponding year and the dashed line the linear regression line.



S-207.**ADMINISTRATION OF RECOMBINANT THROMBOMODULIN IN A RAT MODEL OF PREECLAMPSIA IMPROVES SPONTANEOUS HYPERCONTRACTILITY AND HYPOREACTIVITY TO OXYTOCIN IN ISOLATED MYOMETRIAL STRIPS**

AUTHORS: H. Hino¹, M. Hirayama², H. Miyakawa¹, M. Arai¹, T. Tateda¹

AFFILIATION: ¹Anesthesiology, St.Marianna Univ. School of Medicine, Kawasaki-shi, Japan, ²Anesthesiology, St.Marianna Univ. School of Medicine Yokohamashi Seibu hospital, Yokohama-shi, Japan

INTRODUCTION: It is well-recognized that preeclampsia (PE) is a major contributor to mortality and morbidity in both the mother and the fetus. Studies demonstrate that PE is a major risk factor not only for premature delivery,¹ but also for atonic hemorrhage after delivery, due to hyporeactivity to the uterotonic.² However, the pathophysiology of uterine hypercontractility and hyporeactivity to oxytocin in PE is still unknown. Interestingly, recent evidence has shown that thrombin may be involved in uterine hypercontractility. The aim of this study was to investigate spontaneous uterine contraction and to assess whether administration of recombinant thrombomodulin (r-TM), an anti-disseminated intravascular coagulation drug, improves uterine contractility and reactivity to oxytocin in an in vitro model of PE.

METHODS: A total of 44 rats were randomly divided into 4 groups: the control group (C group, n = 10); PE group (P group, n = 12); control group administered r-TM (CT group, n = 12); and PE-group administered r-TM (PT group, n = 10). To establish an experimental rat model of PE, a modification of Sakawi's method³ was employed in the P and PT groups; the nitric oxide synthase inhibitor L-NG-nitroarginine methyl ester was administered orally from day 6 to day 21 of pregnancy, and lipopolysaccharide (1 µg/kg) was injected intraperitoneally on day 14 of pregnancy. r-TM or saline was administered intravenously to normal pregnant and experimental PE rats, respectively, for 4 days. Myometrial strips were isolated and clipped in organ bath chambers. After equilibration, the amplitude and frequency of myometrial contractions were measured over 10 min; the same measurements were then recorded during oxytocin exposure (10⁻⁶ mmol/dL). Other factors associated with PE were evaluated on day 21 of pregnancy.

RESULTS: Significant increases in mean arterial blood pressure, albuminuria, and VEGFR-1 values were observed in the P group compared with the C group. Although the frequency of spontaneous contractions did not differ among the 4 groups, the mean area under curve (AUC) was significantly greater in the P group compared with the C-group. Administration of r-TM improved hypercontractility (C group, 41 ± 24; P group, 101 ± 66; PT group, 30 ± 33 gs; p < 0.05). While oxytocin failed to increase the mean AUC in the P group compared with the C group, r-TM improved hyporeactivity to oxytocin (P group vs. PT group: 90 ± 100 vs. 656 ± 690%; p < 0.05).

CONCLUSIONS: Myometrial strips derived from experimental PE rats exhibited severe spontaneous hypercontractility and hyporeactivity to oxytocin. Administration of r-TM improved these features, suggesting that thrombin might play an important role in the pathophysiology of PE; therefore, r-TM may be a candidate drug for the treatment of PE.

REFERENCES:

1. J Perinat Med, Vol.28, p49, 2000
2. Am J Obstet Gynecol, Vol.209, pe1, 2013
3. Anesthesiology, Vol.93, p1446, 2000

S-208.**MATERNAL MAGNESIUM PROTECTS THE FETAL BRAIN IN A RAT MODEL OF INTRAPARTUM NONINFECTIOUS INFLAMMATORY FEVER**

AUTHORS: S. Segal¹, C. Pancaro¹, J. Marchand²

AFFILIATION: ¹Anesthesiology, Tufts University School of Medicine, Boston, MA, ²Anesthesiology, Tufts Medical Center, Boston, MA

INTRODUCTION: Fever in labor is associated with seizures, cerebral palsy and other fetal brain injuries. Labor epidural analgesia is a common risk factor for intrapartum fever and is associated with a noninfectious increase in maternal interleukin-6 (IL-6).¹ We previously reported that systemic injection of IL-6 in pregnant rats leads to fever and fetal brain microglial activation and inflammation.² Magnesium sulfate (MgSO₄) is commonly used clinically and reduces the risk of neonatal brain injury. We hypothesized that maternal MgSO₄ would alter the maternal and fetal brain effects of IL-6.

METHODS: With DLAM approval, pregnant rats (N=12) were injected with Saline (n=4), IL-6 (n=4) or MgSO₄ and IL-6 (n=4) at 0, 1.5, and 3 hr on gestational day 20 (GD20; term=22d) and core temperature was recorded. 8 hr post injection, dams were anesthetized, fetuses delivered, and fetal forebrains removed and processed for evidence of neuroinflammation (microglial activation by staining for ED-1). Temperature differences were compared by RM ANOVA, and counts of ED-1+ cells by chi-square.

RESULTS: Compared to saline, IL-6 injection increased temperature while MgSO₄ decreased it progressively at 3 hours (vehicle 37 ± 0.15 °C, IL-6 37.3 ± 0.14, IL-6 MgSO₄ 36.2 ± 0.4; P=0.03). ED-1 was significantly activated in fetal brains from mothers exposed to IL-6, but maternal Mg+2 blocked this activation (Figure). Cell counts were significantly elevated in the IL-6 group (mean± SD, 61 ± 5.7) compared to saline (9.5 ± 0.7), but were markedly reduced in the IL-6 + Mg group (15.5 ± 2.1).

CONCLUSIONS: Maternal IL-6 induces fever and causes fetal neuroinflammation. Maternal magnesium significantly attenuates fever and protects the fetal brain from inflammation. These findings may be relevant in modeling the effect of maternal fever associated with epidural analgesia on the fetus.

REFERENCES:

1. Anesth Analg 2010; 111 (6):1467-75.
2. SOAP 45th Annual Meeting, April 24-28, 2013

Subspecialty Abstracts

Pain Mechanisms

S-209.

THE ROLE OF CAFFEINE ON NEUROPATHIC PAIN AND THE EFFICACY OF GABAPENTIN IN RATS

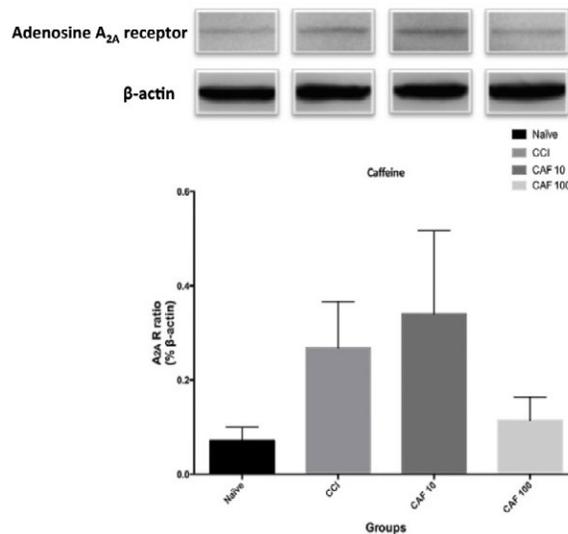
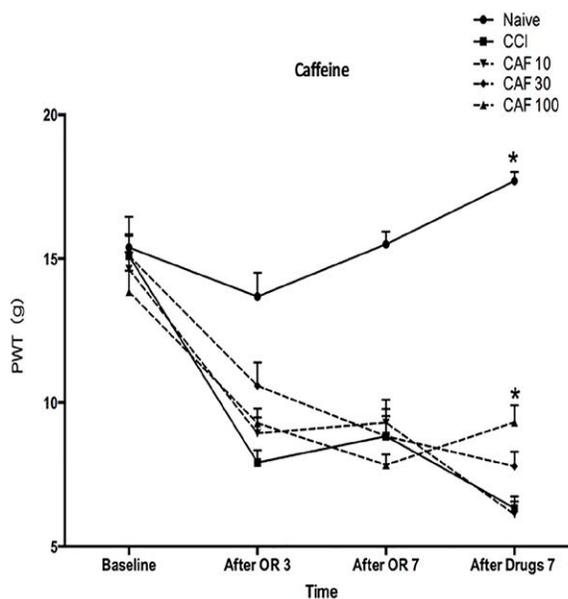
AUTHORS: Y. Zhang, Y. Huang, L. Shen

AFFILIATION: Anesthesiology, Peking Union Medical College Hospital, Beijing, China

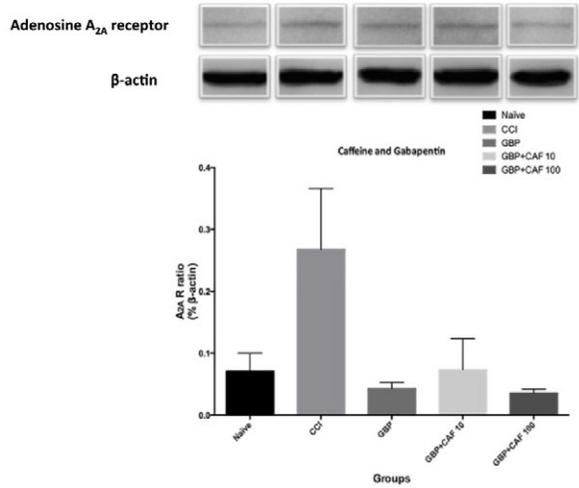
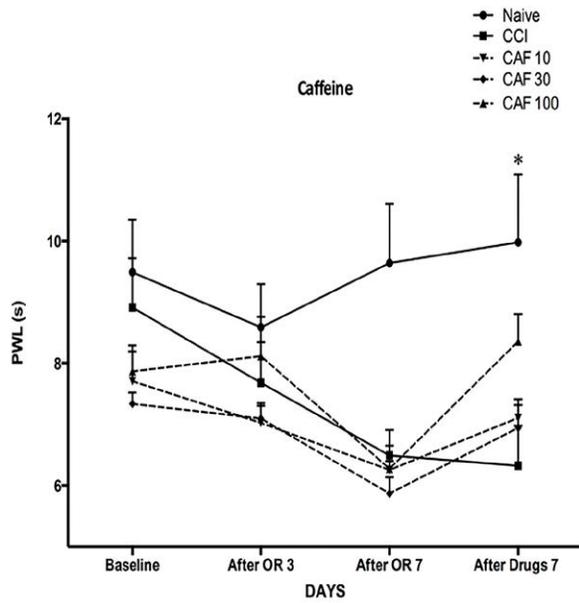
INTRODUCTION: Caffeine can significantly increase the analgesic's effect on acute pain¹. However, whether caffeine enhances the analgesic on chronic pain is still unclear. Nowadays, gabapentin are widely used in relieving neuropathic pain². The aim of this study was to investigate the potential analgesic effect of caffeine or gabapentin alone and the combination of them. 60 male SD rats were randomly divided into ten groups: no treatment group (Naïve), sham operation group (Sham), chronic constriction injury of the sciatic nerve group (CCI)^{3,4}. There were 8 subgroups in CCI group: normal saline treated group (NS), gabapentin 100mg/kg group (GBP)⁵, caffeine 10, 30, 100 mg/kg groups (CAF 10, 30, 100) [1], combination of gabapentin 100mg/kg and caffeine 10, 30, 100 mg/kg groups (GBP+CAF 10, 30, 100), n=6. The mechanical paw withdrawal threshold (PWT) and thermal paw withdrawal latency (PWL) were monitored to assess pain behavior before surgery and on days postoperative 3, 7 and 14 days⁶. All drugs were injected intraperitoneally once a day on 7 consecutive days from the seventh day after surgery. All rats were sacrificed on the postoperative 14-day and L4-L6 spinal dorsal horn were kept for molecular biology experiment. To investigate the protein expression of adenosine A_{2A} receptor and the gene expression of adenosine A_{2A} receptor and PKA in spinal dorsal horn, we used Western Blot and Real-time PCR. Caffeine 10, 30mg/kg group had no obvious therapeutic effect on neuropathic pain, however, caffeine 100mg/kg group did have analgesic effect (P<0.05). Real-time PCR revealed that compared to CCI group, the gene expression of adenosine A_{2A} (Adora2a) and PKA (Prkaca) of were all increased except using gabapentin alone. Western Blot suggested that caffeine 10mg/kg group increased the expression of adenosine A_{2A} receptor. Otherwise, caffeine 100mg/kg group decreased the expression of adenosine A_{2A} receptor. In the combination of gabapentin and caffeine, outcomes showed that caffeine 10, 30mg/kg groups attenuated the analgesic effect of gabapentin. However, caffeine 100mg/kg group didn't affect the analgesic effect of gabapentin on neuropathic pain. On the contrary to previous studies, we observe that high dose of caffeine has analgesic effect. Low dose of caffeine will attenuate the analgesic efficacy of gabapentin. The mechanism may involve the cAMP signaling pathway.

REFERENCES:

1. Sawynok J. Caffeine and pain[J]. Pain, 2011, 152(4):726-729.
2. Kukkar A, Bali A, Singh N, et al. Implications and mechanism of action of gabapentin in neuropathic pain[J]. Arch Pharm Res, 2013, 36(3):237-251.
3. Ma C. Animal models of pain[J]. Int Anesthesiol Clin, 2007, 45(2):121-131.
4. Bennett G J, Xie Y K. A peripheral mononeuropathy in rat that produces disorders of pain sensation like those seen in man[J]. Pain, 1988, 33(1):87-107.
5. Ma L L, Liu W, Huang Y G, et al. Analgesic effect of gabapentin in a rat model for chronic constrictive injury[J]. Chin Med J (Engl), 2011, 124(24):4304-4309.
6. Austin P J, Wu A, Moalem-Taylor G. Chronic constriction of the sciatic nerve and pain hypersensitivity testing in rats[J]. J Vis Exp, 2012(61).



S-209 • continued



S-210.**GLUTAMATE TRANSPORTER -1 PLAYS AN IMPORTANT ROLE IN THE DEVELOPMENT OF MIRROR IMAGE PAIN IN THE SPARED NERVE INJURY MODEL IN RATS**

AUTHORS: M. Kinoshita, Y. Matsuoka, R. Kaku, A. Taniguchi, H. Omiya, N. Muto, H. Morimatsu

AFFILIATION: Department of Anesthesiology and Resuscitology, Okayama University Graduate School of Medicine, Okayama, Japan

INTRODUCTION: Mirror image pain (MIP) is a symptom showing hyperalgesia on the contralateral side of the affected side in chronic neuropathic pain conditions.

MIP is reported in diseases on unilateral lesion such as disc herniation, complex regional pain syndrome, and after chordotomy. Although the pathogenesis of MIP is still unclear, there are some reports that the development of MIP is involved in the inflammatory responses, calcium oscillation in glial cells in the spinal cord (SC).

The aim of this study is to investigate the relation between expression of cytokines, glial markers and receptors in SC, and development of MIP in unilateral nerve injury model in rats.

METHODS: All experiments were approved by the animal care and use committee at Okayama University. We used 10-week old (10W) male Sprague Dawley rats. Rats underwent spared nerve injury (SNI) (Woolf et al. 2000) with some modification. Briefly, left tibial nerve was ligated tightly, whereas common peroneal and sural nerve remained intact. Naïve rats remained intact. Mechanical allodynia on bilateral hind paw was assessed with von Frey filaments before, 1, 3, 7, 10, and 14 days after the surgery. The force applied to the hind paw (50% paw withdrawal threshold (PWT)) was calculated by the formula described by Chaplan et al. (1994). The maximum force was limited to 15.00 g. We excluded rats whose preoperative PWT were less than 13.00 g. The onset of MIP was defined as PWT less than 10.00 g on the contralateral side. On day 14, we sacrificed rats and resected SC. mRNA was extracted from SC. Expression of mRNAs in bilateral L5 SC were measured by quantitative RT-PCR (qPCR). We measured expression of interleukin-1 β , interleukin-18, ionized calcium-binding adaptor molecule-1, glial fibrillary acidic protein, brain-derived neurotrophic factor, and glutamate transporter-1 (GLT-1).

Statistical analysis was performed by ANOVA or Mann-Whitney U test.

RESULTS: Rats that did not show hyperalgesia on the ipsilateral side were excluded from the study. PWT on the ipsilateral side was bottomed at day 7 and lasted until day 14. MIP incidence was 33.3% at day 14.

qPCR revealed that SNI did not induce changes in expression of cytokine, neurotrophin, and glial marker mRNAs in SC at day 14. On the other hand, GLT-1 mRNA was significantly suppressed in bilateral SC in SNI rats compared to naïve rats (ipsilateral : $p = 0.004$, contralateral : $p < 0.001$, fig. 1). Given that GLT-1 in SC plays a role to scavenge excess amount of glutamate, which results in suppression of neuronal excitation, down-regulation of GLT-1 in contralateral SC seemed to be a key in the development of MIP. To check this possibility, GLT-1 expression in SNI rats with and without MIP were compared. However, bilateral GLT-1 expression were not statistically different between rats with and without MIP (fig. 2).

CONCLUSIONS: Our results implicated that GLT-1 down-regulation might play a role in the development of MIP although further studies will be required.

Figure 1 GLT-1 (SNI vs naïve)

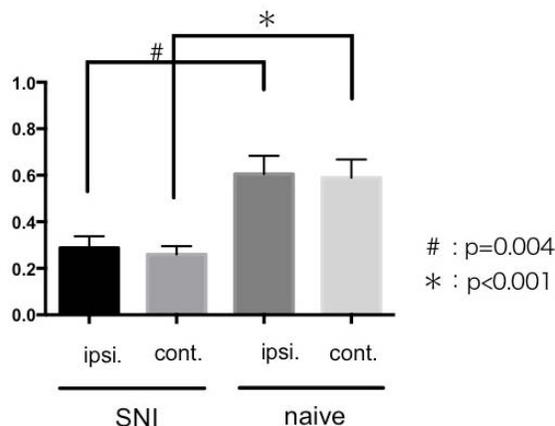
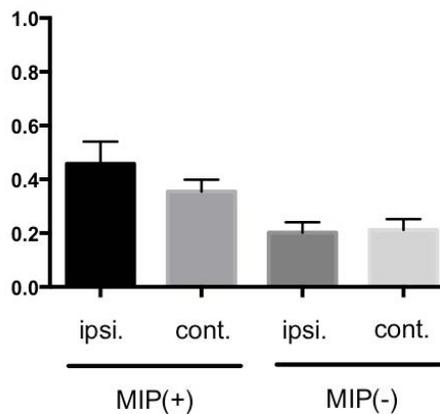


Figure 2 GLT-1(MIP(+)) vs MIP(-)



S-211.

WITHDRAWN.

S-212.

WITHDRAWN.

S-213.**CHARACTERIZATION OF NEURONS EXPRESSING DELTA AND MU OPIOID RECEPTORS IN DESCENDING PAIN CONTROL CIRCUITRY IN MICE****AUTHORS:** S. A. Low, J. J. Peters, G. Scherrer**AFFILIATION:** Anesthesia, Stanford University, Palo Alto, CA

INTRODUCTION: The rostral ventromedial medulla (RVM) is an essential region in the brainstem that gates the descending control of pain. Projection neurons in the RVM modulate painful sensations, notably by regulating the incoming sensory information as it enters the spinal cord. Three populations of modulatory projecting neurons (ON, OFF, or Neutral cells) have been described in the RVM based on their action potential firing pattern in response to painful stimuli. Under normal conditions, ON and OFF cells oscillate between periods of active firing and quiescence. In the event of a painful stimulus, ON cell activity increases and OFF cell activity decreases, while Neutral cell activity does not change¹. Studies in which pain thresholds are changed have shown that ON cells are most active in hypersensitive states (e.g. chronic injury) and OFF cells in hyposensitive states (e.g. systemic morphine)². Thus, the bimodal coordination of ON and OFF cell activity in the RVM modulates pain thresholds by ON cell mediated facilitation or OFF cell mediated inhibition of pain transmission³.

Mu and delta opioid receptors (MOR and DOR) are G protein-coupled receptors that regulate neurotransmission. MOR distribution along descending RVM projections has been investigated using pharmacological and electrophysiological methods. These studies have demonstrated that MOR is expressed by ON cells and inhibits action potential firing in these neurons to depress descending pain facilitation. Unlike MOR, the role of DOR in the RVM remains unclear. In this study, we used knock-in reporter mice that express DOR^{eGFP} and MOR^{mCherry} fusion proteins to reveal the location of DOR expressing neurons in the RVM and examine possible DOR and MOR co-expression.

METHODS: Fluorogold, a retrograde tracer, was stereotaxically injected into the lumbar dorsal horn of reporter mice. Mice were transcardially perfused with a 4% formaldehyde solution and hindbrain was sectioned on a cryostat. Tissue was processed using fluorescent immunohistochemistry.

RESULTS: Our immunohistochemical experiments revealed that 43% of spinally projecting neurons are DOR⁺. Further characterization showed that 60% of DOR⁺ cells are GABA⁺ while less than 1% of DOR⁺ cells express 5HT. Importantly, MOR and DOR expression in the RVM is overlapping with 57% of DOR⁺ cells coexpressing both receptors and 67% of these MOR⁺/DOR⁺ cells being Fluorogold⁺.

CONCLUSIONS: Our results suggest that DORs are predominately in inhibitory projection neurons, and, like MORs, DORs may be expressed by ON cells. Additionally, MORs and DORs are also found in separate populations which may be inhibitory interneurons, since the populations of MOR⁺ and DOR⁺ cells that independently express each receptor are predominately Fluorogold⁻/GABA⁺. In combination with ongoing functional studies, these results will elucidate the function of DORs in RVM neurons and indicate how DOR and MOR cooperate to fine tune descending pain control.

REFERENCES:

1. Fields, H et al. *J Neurosci.* 1983;3(12):2545-52.
2. Ossipov, M et al. *J Clin Invest.* 2010;120(11):3779-87.
3. Fields, H. *Nat Rev Neurosci.* 2004 Jul;5(7):565-75.

S-214.**THE EFFECT OF LOW-FREQUENCY TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION ON POSTOPERATIVE PAIN RELIEF IN SKIN/MUSCLE INCISION AND RETRACTION-INDUCED RATS****AUTHORS:** G. Chen, C. Hung**AFFILIATION:** Physical Therapy, National Cheng Kung University (NCKU), Tainan, Taiwan

INTRODUCTION: Persistent postoperative pain is a common problem in various surgical procedures. However, its unclear mechanism suggests whether transcutaneous electrical nerve stimulation (TENS) is reliable for pain relief from the skin/muscle incision and retraction (SMIR) procedure. When the tissue is damaged resulting in neuropathic pain, it provokes pain symptoms in which they are characterized into allodynia and hyperalgesia. Assuredly, TENS is a safe therapy that can be used to treat neuropathic pain to examine the basis of the central sensitization. Therefore, the purpose of this study is to determine the effect of low-frequency TENS on postoperative pain relief and its underlying mechanism.

METHODS: Male Sprague-Dawley rats (200-250 g) were obtained from the Laboratory Animal Center of National Cheng Kung University (Tainan, Taiwan). They were randomly assigned to the following groups: sham-operated group, skin/muscle incision and retraction (SMIR) group, and SMIR with low-frequency TENS (SMIR-TENS-LF) group. The animals had been housed in cages (2-3 per cage) with free access to food and water. The rats underwent surgery for allodynia and hyperalgesia. The SMIR-operated group received the skin and muscle incision and retraction. The sham-operated group had the skin and muscle incision done but not the retraction. von Frey filaments and Hargreaves plantar tests were used to assess the symptoms of postoperative pain. The von Frey stimuli used are the 4 g, 6 g, 10 g, and 15 g for 10 times each for 6-8 seconds on the ipsilateral and contralateral sides of the rats' hindpaws. The Plantar test is used to test the ipsilateral and contralateral hindpaws for three trials with one-minute time intervals in between. The SMIR-TENS-LF group received the TENS treatment set at 2 Hz and 100 μ s with a duration of 20 minutes per day (one time) and 5 days per week for 2 weeks.

RESULTS: The SMIR rats displayed significant hypersensitivities to the mechanical and thermal stimuli in the ipsilateral and contralateral hindpaws on postoperative day 3. There are significant differences in mechanical allodynia and thermal hyperalgesia among the sham-operated group, SMIR group, and SMIR-TENS-LF group. The allodynic levels in the SMIR group are significantly higher than the sham group ($P < 0.05$); whereas, the hyperalgesic levels in the SMIR group are significantly lower than the sham group ($P < 0.05$). The SMIR-TENS-LF group is significantly low than the SMIR and sham groups ($P < 0.05$).

CONCLUSIONS: Low-frequency TENS can relieve the symptoms and may suppress the progression of postoperative pain evoked by SMIR surgery. It could demonstrate an immediate recovery in the sensory hypersensitivities. Future implications are to analyze more about the TENS-analgesic mechanism and employ this treatment strategy by using TENS to reverse the symptoms of postoperative pain.

REFERENCES:

1. *Reg Anesth Pain Med.* 2014; 39(4): 322-328.
2. *Pain.* 2008; 135: 119-30. 3) *Journal of Pain.* 2009; 10(2): 221-9.

S-215.

CENTRAL CXCL12-CXCR4 AXIS CONTRIBUTES TO THE PAIN INDUCTION IN A MOUSE MODEL OF COMPLEX REGIONAL PAIN SYNDROME-TYPE I

AUTHORS: X. Luo¹, W. L. Tai¹, L. Sun¹, Q. Qiu¹, Z. Xia¹, S. K. Chung², C. Cheung¹

AFFILIATION: ¹Anaesthesiology, The University of Hong Kong, Hong Kong, China, ²Anatomy, The University of Hong Kong, Hong Kong, China

INTRODUCTION: The precise etiology of complex regional pain syndrome-type I (CRPS-I) is still unknown, which limits the development of therapeutic strategy for CRPS-I patients¹. Recently, we found that the axis of CXCL12 and its receptor CXCR4 has been involved in the induction of peripheral neuropathic pain², although roles of this axis in central processing of CRPS-I have not been reported. Therefore, this study determined the roles of central CXCL12/CXCR4 axis in the pain induction of CRPS-I using a mouse model.

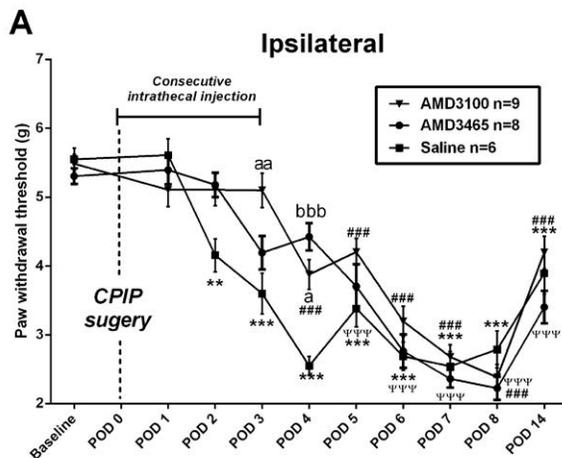
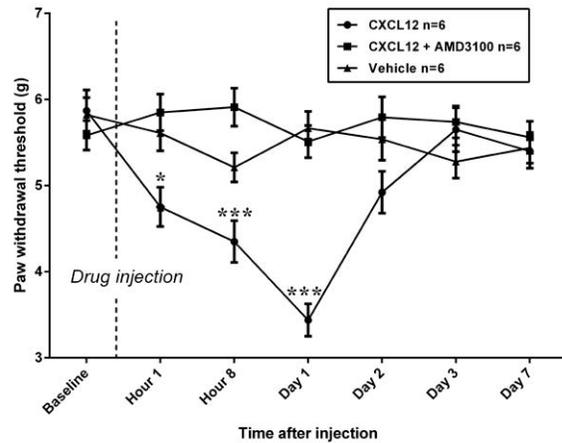
METHODS: Adult male C57BL/6N wild-type mice following the protocol of animal experiments which has been approved by the Committee on the Use of Live Animals in Teaching and Research, The University of Hong Kong (Permit No. 2610-11). Chronic post-ischaemia pain (CPIP) model was used as an animal model of CRPS-I³. CXCL12 rat peptide and two CXCR4 antagonists (AMD3100 and AMD3465) were prepared in saline on the day of experiment. The impairment of the motor function was detected by rotarod test. Paw withdrawal threshold of mice was assessed by von Frey test. To detect pain molecules in the spinal cord, L3-L5 spinal cord segment of mice was harvested for mRNA extraction and real time (RT)-PCR analysis.

RESULTS: Intrathecal administration of rat CXCL12 peptide (200ng) induced mechanical allodynia, which was reversed by co-injection of AMD3100 (5µg), implicating that central CXCL12/CXCR4 axis may contribute to the induction of pathological pain. The rotarod test showed that 4-days consecutive single intrathecal injection of AMD3100 or AMD3465 (10µg per day) did not impair the motor function. Following ischaemia-reperfusion injury, the ipsilateral hindpaws of CPIP mice showed edema for at least 1 day and mechanical allodynia from post-operative day (POD) 2 to POD 21. And, intrathecal AMD3100 or AMD3465 (from 1 hour before surgery to POD 3, 10µg per day) attenuated the induction of mechanical allodynia in CPIP mice. To learn the molecular mechanisms, RT-PCR analysis indicated that, among pain-related molecules, post-ischaemic injury increased mRNA levels of TNF-α, IL-1β, IL-6, SP and prodynorphin and decreased mRNA level of CGRP on POD 3. Then, this study showed that the intrathecal injection of AMD3100 (4 days, 10µg per day) downregulated mRNA levels of TNF-α, IL-1β, IL-6, adrenomedullin, proopiomelanocortin, endothelin-1, intercellular adhesion molecule 1 and vascular cell adhesion molecule 1 in CPIP mice on POD 3.

CONCLUSIONS: This research uncovers that CXCL12/CXCR4 axis contributes to the pain enhancement in normal mice centrally. It also reports that spinal antagonism of this axis attenuates the induction of pain and regulates the production of pain-related molecules in a mouse model of CRPS-I. Taken together, these findings implicate that central CXCL12/CXCR4 would be therapeutic target for alleviating chronic pain in CRPS-I patients.

REFERENCES:

1. Nature Reviews Neurology (2014) 10: 518-528.
2. PLoS ONE (2014) 9: e104860.
3. Pain (2004) 112: 94-105.



S-216.

BRAIN MORPHOLOGICAL INVESTIGATION IN CHRONIC PAIN PATIENTS WITH NEUROPATHIC CHARACTERISTICS

AUTHORS: S. Sugimine, Y. Ogino, H. Obata, S. Saito

AFFILIATION: Anesthesiology, Gunma University Graduate School of Medicine, Maebashi, Japan

INTRODUCTION: Neuropathic characteristics are deeply involved with developing chronic pain over the years. The aim of the current study is to investigate the chronic pain mechanisms by examining the relationships between neuropathic characteristics and brain morphological changes using voxel-based morphometry (VBM) in chronic pain patients.

METHODS: First, we assessed neuropathic characteristics using painDETECT questionnaire (PD-Q) in twelve chronic pain patients. Second, to assess the gray matter volume changes by using VBM, the patients underwent head magnetic resonance imaging (MRI) scans. We applied multi-regression analysis between the two assessments above.

RESULTS: There were strong positive correlations between PD-Q scores and gray matter volumes in the bilateral ACC ($p < 0.001$), right insula ($p < 0.001$) and right posterior cingulate cortex ($p < 0.002$).

CONCLUSIONS: Our data suggest the notion that the chronic pain patients with neuropathic characteristics over the years tend to have gray matter volume changes in brain regions supposed to have involvement with the cognition and the emotion rather than the perception of pain.

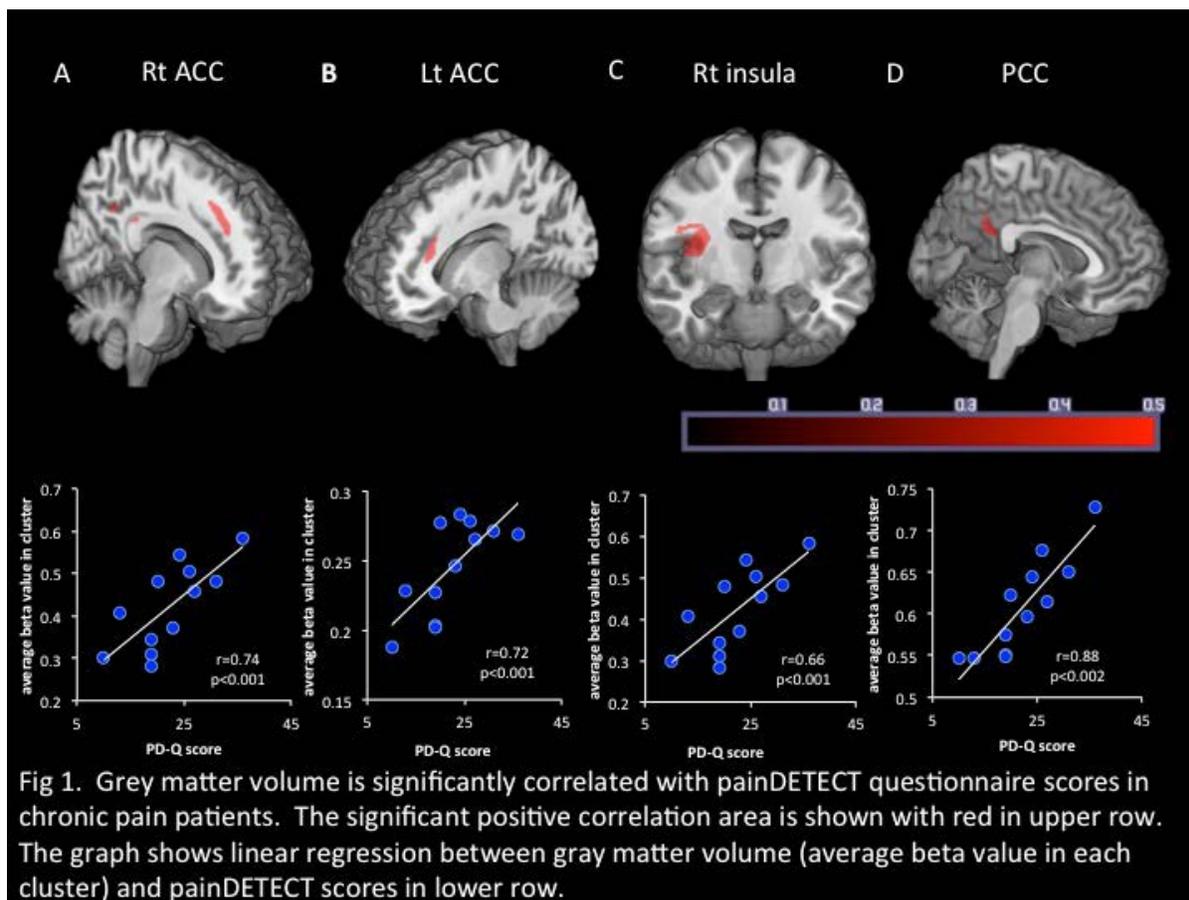


Fig 1. Grey matter volume is significantly correlated with painDETECT questionnaire scores in chronic pain patients. The significant positive correlation area is shown with red in upper row. The graph shows linear regression between gray matter volume (average beta value in each cluster) and painDETECT scores in lower row.

S-217.**IN VIVO ELECTROPHYSIOLOGICAL ANALYSES OF ANTINOCICEPTIVE ACTION OF SEVOFLURANE IN THE RAT SUBSTANTIA GELATINOSA NEURONS****AUTHORS:** Y. Funai, T. Mori, H. Yamasaki, K. Nishikawa**AFFILIATION:** Anesthesiology, Osaka City University Graduate School of Medicine, Osaka, Japan

INTRODUCTION: Volatile anesthetics is known to act on a wide variety of receptors (e.g. GABAA, glycine, nicotinic, and glutamate), and ion channels (e.g. sodium, potassium, and calcium) in the central nervous system¹), and produce powerful hypnosis. However, the analgesic property in spinal nociceptive transmission is not fully understood. Previous electrophysiological studies demonstrated isoflurane augments GABAA receptor-mediated inhibitory postsynaptic currents²) or reduces glutamatergic transmission³) in the rat spinal cord slice. But it is not determined whether volatile anesthetics acts in a similar manner and produces effective analgesia in vivo. In this study, we examined the effects of sevoflurane (SEV) on synaptic responses in the substantia gelatinosa (SG, lamina II) of the spinal dorsal horn by using in vivo extracellular and whole cell patch-clamp recording technique.

METHODS: Our Animal Care and Use Committee had approved this study. Male Sprague-Dawley rats aged 6-9 weeks, weighing 200-350 g were used. Under urethane anesthesia, rats were intubated after tracheostomy for mechanical ventilation (1-1.5 ml/g/min). After lumbar laminectomy was performed, a tungsten or patch electrode was inserted in the SG, and then extracellular or whole-cell voltage-clamp recordings were obtained, respectively. SEV (1.5-5%) was administered from the vaporizer during the recordings. To examine nociceptive responses, we applied pinch stimuli (2 kg) to the hind paw using the forceps with the strain-sensing Pinch-meter. Data are presented as mean \pm SEM.

RESULTS: In the extracellular recording, SEV dose-dependently decreased the frequency of pinch-evoked action potentials (Fig.1). Patch-clamp analysis revealed that SEV was more likely to decrease the frequency (80.4% of control at SEV1.5%; 44.4% at SEV3%; 40.2% at SEV5%; 83.4% at Washout) than the amplitude (93.5% of control at SEV1.5%; 94.8% at SEV3%; 60.2% at SEV5%; 90.2% at Washout) (Fig.2) of spontaneous excitatory postsynaptic currents (EPSCs) at the holding potential of -70mV. No outward or inward currents were elicited. More than 3% of SEV were needed to significantly inhibit the pinch-evoked EPSCs. On the other hand, SEV showed the non-uniform effect for inhibitory postsynaptic currents (IPSCs) at a holding potential of 0 mV. Out of 10 SG neurons tested, spontaneous IPSCs decreased in 6, increased in 2, and did not change in 2 neurons after the inhalation of SEV.**CONCLUSIONS:** Extracellular recordings clearly showed the dose-dependent analgesic effect of inhaled SEV. Patch-clamp recordings suggest that the primary analgesic mechanism is the dose-dependent presynaptic inhibition of the glutamate release from the primary afferent terminals at the spinal dorsal horn. High dose (>3%) of SEV may also have postsynaptic effect and shows stronger analgesia. Further experiments are needed to elucidate the involvement of IPSCs in the analgesic property of SEV.

REFERENCES:

1. N Eng J Med 348: 2110-24, 2003.
2. Anesthesiology 102: 379-86, 2005.
3. Anesth Analg 98: 1718-23, 2004.

Fig.1

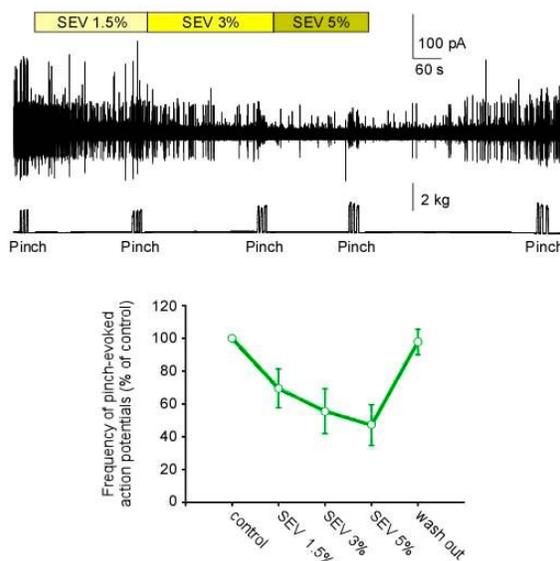
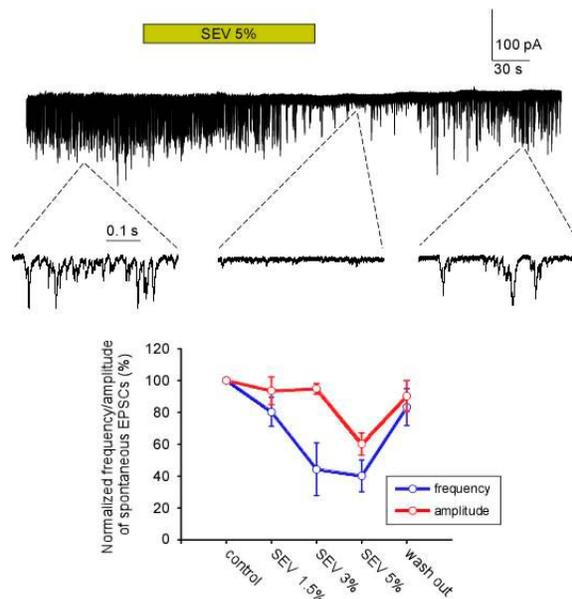


Fig.2



S-218.**THE EFFECT OF CHRONIC NICOTINE WITHDRAWAL ON INDUCED POSTOPERATIVE PAIN IN RATS**

AUTHORS: A. C. Mavarez¹, K. Candiotti¹, K. I. Gomez², J. Alfonso², N. L. Newman², Y. F. Rodriguez-Blanco³, Y. Zhang⁴

AFFILIATION: ¹Department of Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, FL, ²Department of Anesthesiology, University of Miami, Miami, FL, ³Department of Anesthesiology, Clinical Research, University of Miami Miller School of Medicine, Miami, FL, ⁴Department of Anesthesiology, University of Miami, School of Medicine, Miami, FL

INTRODUCTION: Research has demonstrated the analgesic properties of nicotine¹ and acute exposure to systemic nicotine has anti-nociceptive effects in rodents². Studies in animal models have shown that chronic nicotine exposure results in tolerance to nicotine-induced antinociception³ and discontinuation of smoking leads to withdrawal symptoms, including hyperalgesia⁴. It is also known that patients who smoke, require larger amounts of opioids after surgery compared to non-smokers. This increase in opioid consumption suggests that withdrawal of smoking may increase nociceptive activity, which is suppressed by chronic nicotine. The purpose of this study is to assess the influence of chronic nicotine and nicotine withdrawal on mechanical pain thresholds.

METHODS: IRB approval was obtained and IACUC standards were followed. 4 week-old male and female Sprague Dawley rats were used. Each group had 6 to 8 rats. Animals were divided into two groups: nicotine treatment group and related control group. In the treatment group, animals were provided an oral self-administered sweetened (0.5% sucrose) nicotine solution as drinking water, dosed at 10 mg/kg/day for 4 weeks. Using an immunochromatographic assay, nicotine levels were monitored by measuring urine cotinine (a long-lived metabolite of nicotine). Urine cotinine concentrations higher than 1000 ng/ml were considered similar to levels noted in humans who smoke. In the control group, rats were provided sweetened (0.5% sucrose) drinking water. To analyze the effects of nicotine or nicotine-withdrawal on mechanical sensitivity, hindpaw withdrawal thresholds were measured using von Frey filaments once a week in the 4 weeks of treatment and once a day in the three days of withdrawal.

RESULTS: Mechanical thresholds increased in the nicotine-treated rats compared with the control group ($p < 0.05$ in males and females). Nicotine withdrawal decreased the mechanical thresholds on day 1 for males ($p < 0.05$), and days 1 and 2 for females ($p < 0.01$ and $p < 0.001$), it later returned to normal on day 3 of withdrawal (Figure 1 & 2), compared to the control group. There was a significant association between nicotine withdrawal and decreased mechanical thresholds. There were no significant differences among gender.

CONCLUSIONS: This study demonstrated that chronic nicotine treatment has an analgesic effect; however, after discontinuation of nicotine, animals demonstrated reduced mechanical thresholds (hyperalgesia).

REFERENCES:

1. Anesthesiology 2010; 113 (4):977-92
2. NeurosciLett 2004; 366:86-91
3. JPharmacol Exp Ther. 2005; 315(2):959-64
4. Addict Behav 1984; 9 (1): 95-8

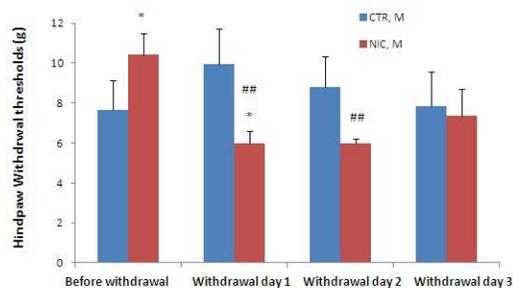


Figure 1. Nicotine and nicotine-withdrawal effects on mechanical sensitivity--- Males.
* $p < 0.05$ CTR vs. NIC at the same time point. ## $p < 0.01$, NIC vs. Nicotine-withdrawal day 1 or day 2. CTR, M—Control Group, Males; NIC, M—Nicotine Group, Males.

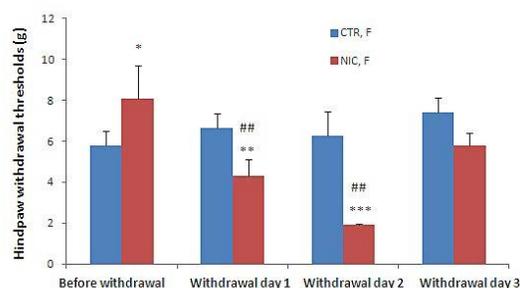
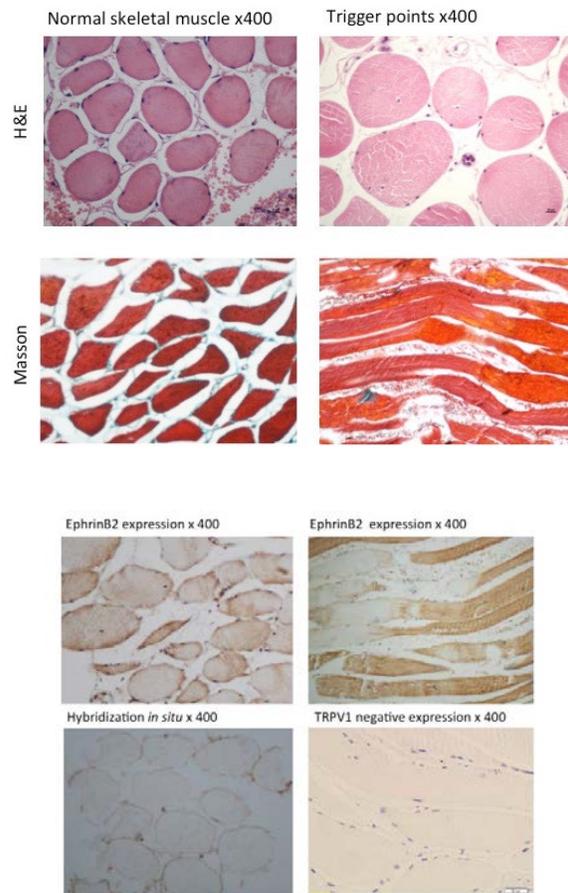


Figure 2. Nicotine and nicotine-withdrawal effects on mechanical sensitivity--- Females.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, CTR vs. NIC at the same time point. ## $p < 0.01$, NIC vs. Nicotine-withdrawal day 1 or day 2. CTR, F—Control Group, Females; NIC, F—Nicotine Group, Females.

S-219.**EFFECT OF PERIPHERAL NERVE INJURY ON GABAergic INHIBITORY SYNAPTIC TRANSMISSION IN THE MOUSE SPINAL CORD DORSAL HORN****AUTHORS:** T. Takasusuki, Y. Numata, K. Ishikawa, S. Yamaguchi**AFFILIATION:** Anesthesiology, Dokkyo Medical University, Mibu, Japan**INTRODUCTION:** To clarify the influence of nerve ligation on the depression of spinal GABAergic inhibitory synaptic transmission in development of neuropathic pain, we observed optical imaging of hyperpolarization activated by GABA in the spinal cord dorsal horn using voltage-sensitive dye. Furthermore, the expression of NKCC1 (Na-K-Cl cotransporter) and KCC2 (K-Cl cotransporter) in nerve-ligated mice spinal dorsal horn were analyzed by quantitative real-time RT-PCR method.**METHODS:** The sciatic nerve partial ligation was performed in 6-8 week-old male ICR mice according to Seltzer's protocol under halothane anesthesia. The spinal cord slices were prepared one week after ligation and incubated for 20 min with a di-4-ANEPPS for optical imaging. After rinsing, the spinal slices were placed into the recording chamber on the microscope stage and perfused by Krebs' solution with tetrodotoxin, continuously. Fluorescent changes of di-4-ANEPPS in the spinal cord dorsal horn were measured using MiCAM02. During the recording, GABA (100 μ M) was perfused for 90 sec.**RESULTS:** The visualized hyperpolarization in the ipsilateral spinal dorsal horn was attenuated by the perfusion of GABA in ligated mouse. However, this attenuation was not observed in contralateral spinal dorsal horn in ligated mice and sham-operated mice. Furthermore, the expression of NKCC1 was increased and KCC2 was decreased in the spinal dorsal horn after sciatic nerve ligation. These findings suggest that nerve injury may lead to the up-regulation of NKCC1 and down-regulation of KCC2 in the spinal dorsal horn and increase of intracellular Cl⁻ concentration, consequently. As a result of increase of intracellular Cl⁻, hyperpolarization produced by GABA was alleviated.**CONCLUSIONS:** Inhibition of hyperpolarization due to homeostatic changes of Cl⁻ in the dorsal horn neuron may have a pivotal role for development of neuropathic pain.

S-220.**INVOLVEMENT OF EPHRIN-B2, NOT TRPV1 EXPRESSION IN SARCOMERES OF MYOFASCIAL TRIGGER POINTS IN THE UPPER TRAPEZIUS MUSCLE****AUTHORS:** F. Qi¹, Y. Guo¹, C. Ding¹, Y. Wang²**AFFILIATION:** ¹Department of Anesthesiology, Qilu Hospital of Shandong University, Jinan, China, ²Department of Pathology, Qilu Hospital of Shandong University, Jinan, China**INTRODUCTION:** Myofascial pain syndrome (MPS) is an important clinical condition derived from myofascial trigger points (MTrPs) located in a taut band (TB). The pathophysiological mechanism of MTrPs is not fully understood. The current study was to investigate the expression of Ephrin-B2 and TRPV1 in sarcomeres of MTrPs in the upper trapezius muscle.**METHODS:** Thirty-five patients with MPS and 20 healthy volunteers were recruited in this study. Snap-frozen muscle specimens, biopsied from MTrPs in the TB or the normal control of trapezius muscles, were examined by Hematoxylin and Eosin (HE) and MASSON stain. Ephrin-B2 and TRPV1 expression was detected by immunohistochemistry and/or hybridization in situ, respectively.**RESULTS:** Necrotic, regenerating and inflating muscle cells were found in MTrPs than in healthy control. Ephrin-B2 lower expressions in regenerating muscle and contracture muscle cells of sarcomeres but relatively higher than the healthy control. No TRPV1 expressions in regenerating muscle and contracture muscle cells of MTrP.**CONCLUSIONS:** Lower expression of Ephrin-B2, not TRPV1 might play a pivotal role in the pathogenesis in sarcomeres of MTrPs.

Subspecialty Abstracts

Pain Medicine

S-221.**PARAVERTEBRAL BLOCK FOR REFRACTORY PAIN DUE TO POSTHERPETIC NEURALGIA****AUTHORS:** T. Suzuki, Y. Kawai, M. Sugimoto**AFFILIATION:** Morinomiya Hospital, Department of Anesthesia, Osaka, Japan**INTRODUCTION:** Thoracic paravertebral block (PVB) is effective for pain relief in postherpetic neuralgia (PHN) and an alternative to thoracic epidural block (EB). Although EB has limitations, for instance, under medication of antiplatelets and anticoagulants, PVB can be used under such conditions. PVB may also avoid hypotension and urinary retention which EB often induces. No report has compared PVB with EB in view of analgesic efficacy in chronic PHN state. In this study, we observed the analgesic potency of PVB in EB-refractory PHN.**METHODS:** After IRB approval, we studied ten thoracic PHN patients aged 71-93. For ten outpatients having received EB once a week for more than a year until March 2013, PVB was introduced as an alternative of EB since April. Patients having received EB less frequently than every two weeks were not included in this study. The pain severity was evaluated with the use of visual analog scale (VAS). Patients were followed once a week and PVB was done when VAS was six and above and/or patients complained of sleep disturbance due to pain. PVB was performed under ultrasound guidance and 0.2% 25ml levobupivacaine with 2mg dexamethasone was injected. Doses of medications (pregabalin, amitriptyline, loxoprofen and fentanyl patch) were not increased.**RESULTS:** All patients were satisfied with receiving PVB and no patient wanted to receive EB again. Three months after introducing PVB, the intervals of block were extended to 2 (5 patients), 3 (3 patients) and 4 (2 patients) weeks. After six months, two patients needed no block, and the intervals of block for the other patients were 2 (3 patients), 3 (2 patients) and 4 (3 patients) weeks. After a year, six patients needed no block and the intervals of block for the other patients were 2 (2 patients) and 4 (2 patients) weeks.**CONCLUSIONS:** In this study, the ten patients had suffered severe allodynia and hyperalgesia, and needed EB once a week for more than a year. PVB brought them at least 1-3 days pain-free period and the recurrence of unbearable pain was delayed to several weeks without any complication. Moreover, the intensity of pain gradually got smaller as PVB was repeated. PVB might be more effective than EB for pain relief in thoracic PHN patients.

S-222.**WITHDRAWN.**

S-223.

PREDICTIVE FACTORS FOR THE DEVELOPMENT OF COMPLEX REGIONAL PAIN SYNDROME TYPE I IN THE UPPER EXTREMITY: RESULTS FROM THE NATIONWIDE INPATIENT SAMPLE 2007-2011

AUTHORS: A. Elsharydah, S. H. Hong, S. T. Krazit

AFFILIATION: Department of Anesthesiology and Pain Management, UT Southwestern Medical Center, Dallas, TX

INTRODUCTION: Complex regional pain syndrome type I (CRPS-1) is a disabling pain disorder with unclear etiology, usually triggered by an injury to a limb such as trauma or surgery with or without specific nerve injury. It is not clear why some patients develop CRPS-1 and some do not. Therefore, identifying predictors for its development is helpful for early detection and treatment. The objective of this study is to identify possible risk factors for the development of CRPS type-1 in the upper extremity utilizing a huge national database.

METHODS: Data from the nationwide inpatient sample (NIS) for years 2007 to 2011 were queried to identify adult patients with the ICD-9 CM diagnosis of CRPS-1 in the upper limb (33721). Multiple logistic regression analyses were conducted to investigate the

significant predictors for CRPS-1. The model was adjusted to the patient demographics, comorbidities and hospital characteristics. Odds ratios (OR) with 95% confidence limits (CL) and p-value were reported.

RESULTS: There were 3211 patients with the discharge diagnosis of CRPS-1 in the upper limb out of an inpatient sample of 22,403,611. CRPS-1 peaks between age 45 and 55. Multiple logistic regression analyses revealed that female gender, Caucasian race, higher median household income, depression and drug abuse are associated with higher rate of CRPS-1. On the other side, diabetes, obesity, peripheral vascular disease, hypothyroidism, chronic renal failure, alcohol abuse and anemia are associated with lower rate of CRPS-1 (see table 1 for OR and CL values).

CONCLUSIONS: Our study identified some of the important predictors for development of complex regional pain syndrome type I. Such information should be useful for physicians for early recognition, diagnosis and treatment of patients at risk.

REFERENCES:

- Ulus Travma Acil Cerrahi Derg, 16(2), 144-148. (2010)
- Pain, 129(1), 12-20. (2007)
- Pain, 103(1), 199-207. (2003)

Table 1. Odds ratios and 95% confidence limits for the predictive factors for the development of CRPS-1 in the upper extremity.

Characteristics	Odds ratio	95% confidence limits	
		Lower limit	Higher limit
Gender Female vs male	1.627	1.505	1.759
Race/ethnicity			
Black vs Caucasian	0.647	0.575	0.729
Hispanic vs Caucasian	0.458	0.386	0.543
Asian vs Caucasian	0.305	0.200	0.465
Median household income High vs low	1.430	1.287	1.588
Comorbidities			
Depression	1.564	1.431	1.708
Drug abuse	1.502	1.315	1.716
Alcohol abuse	0.365	0.293	0.454
Diabetes	0.610	0.549	0.677
Hypothyroidism	0.866	0.775	0.966
Anemia	0.675	0.606	0.752
Obesity	0.753	0.675	0.840
Chronic renal failure	0.469	0.401	0.550
Peripheral vascular disease	0.503	0.414	0.611

S-224.**A SINGLE CENTER, RANDOMIZED, OPEN-LABEL TRIAL TO COMPARE THE SAFETY AND EFFICACY OF CALDOLOR USED SINGLY AND IN COMBINATION WITH OFIRMEV IN TOTAL KNEE OR HIP ARTHROPLASTY SURGERY PATIENTS****AUTHORS:** A. Gupta, K. Voralu**AFFILIATION:** Anesthesiology, Pain Medicine, Drexel University College of Medicine, Philadelphia, PA

INTRODUCTION: Compare the effectiveness and perioperative use of Caldolor alone and in combination with Ofirmev in total knee or hip arthroplasty orthopedic procedures. **Design.** Randomized, single center; open-label trial to compare the safety and efficacy of Caldolor used alone versus Caldolor in combination with Ofirmev in total knee or hip arthroplasty surgery patients. Patients were selected during their perioperative evaluation for elective surgeries planned at Drexel College of Medicine/Hahnemann University Hospital.

Patients. A total of 78 adult patients between the ages of 18-65 undergoing knee or hip arthroplasty surgeries.

Interventions. Two groups of 39 patients were randomized to receive either 800 mg of Caldolor at the induction of anesthesia, followed by 800 mg of Caldolor every 6 until discharge or for a total of up to 120 hours (5 days). Group 2 patients received 800 mg Caldolor at the induction of anesthesia and 1000 mg Ofirmev at the time of surgical wound closure, followed by 800 mg Caldolor plus 1000 mg Ofirmev every 6 hours until discharge for a total of up to 120 hours (5 days).

METHODS: Effectiveness of Caldolor versus Ofirmev was demonstrated by measuring patients' self-assessment of pain intensity using a visual analog scale (VAS; assessment completed at rest and with movement). Secondary end points were based on opioid requirements, patients' quality of recovery scale (QoR), length of hospital stay, length of PACU stay, PONV medication requirements, incidence of opioid-related side effects, and safety as determined by the incidence of treatment-emergent adverse events.

RESULTS: In the immediate post-operative period, there was no difference observed between the two groups. On day 3, Group 2 patients receiving 1000 mg Ofirmev in addition to 800 mg Caldolor, assessed lower VAS scores ($p < 0.002$), compared to patients in Group 1 received only 800 mg Caldolor. There were no significant differences in QoR scores; Mean (SD) was measured 177 for Group 1 ($n=35$) and 179.5 for Group 2 ($n=39$). Time to discharge from PACU for Group 1 was recorded as 85.6 mins ($SD=78.50$), whereas, time to discharge was 71.1 mins ($SD=78.97$) for patients in Group 2. Although, comparisons between study groups in terms of time to discharge from PACU were not statistically significant. In contrast, statistical significance was noted between both groups on incidence of adverse events ($p<0.001$), need for anti-emetic medications ($p<0.001$), and opioid consumption ($p<0.001$).

CONCLUSIONS: In summary, Caldolor and Ofirmev demonstrated statistical significance in decreasing adverse events, opioid consumption, and need for antiemetic medications. Furthermore, with continued medication administration, it was noted that on day three of combined administration of Caldolor and Ofirmev provided improved pain scores in comparison to use of Caldolor alone.

Summary: Randomized clinical trial was performed to determine the overall clinical benefit of utilizing multimodal pain modalities, which include Caldolor and Ofirmev for orthopedic total knee and hip replacements.

S-225.**INTRAOPERATIVE ACETAMINOPHEN FOR PEDIATRIC POST-TONSILLECTOMY PAIN RELIEF: A COMPARISON OF 2 SURGICAL TECHNIQUES****AUTHORS:** R. Ritchie¹, P. A. Sloan¹, A. Reddy¹, D. Chau², M. F. Lukens¹, S. Nimma¹**AFFILIATION:** ¹Anesthesiology, University of Kentucky, Lexington, KY, ²Anesthesiology, Children's Hospital of the King's Daughters, Norfolk, VA

INTRODUCTION: Postoperative pain control following tonsillectomy can be challenging in the pediatric population. Intravenous acetaminophen has been recommended to improve postop pain relief and reduce requirements (and possibly side effects) of perioperative opioids.¹ The purpose of this study was to assess the efficacy of IV acetaminophen for the relief of post-tonsillectomy pain among children comparing 2 different surgical techniques, and also comparing patient diagnosis of chronic tonsillitis (CT) versus obstructive sleep apnea (OSA).

METHODS: A randomized, prospective, nurse/parent-blinded, clinical trial compared intraoperative IV acetaminophen (15 mg/kg) with saline for the relief of post-tonsillectomy/adenoidectomy pain. Following IRB approval, patients were randomized to receive either acetaminophen (Group A) or saline (Group B), in addition to intraop fentanyl (2 mcg/kg), for the management of postop pain. Patients were randomized for surgical indication of either CT or OSA. All patients received the identical dose of intraop antiemetics and decadron (0.3 mg/kg). Postop PACU nurses, blinded to patient group, recorded pain scores (FACES scale, 0-10) on PACU arrival, and phase II of recovery. Fentanyl doses were recorded for intraop use, and all phases of recovery. A post-hoc analysis of data was completed to assess differences in pain relief and discharge time according to surgical technique (cauterization versus coblator).

RESULTS: 76 patients were enrolled, with 69 completing ($N=Gp A-36; Gp B-33$) the study. The mean (SD) age was 6.4 (2.5) yrs and mean weight of 28.6 (14.1) kg. In Group A (acetaminophen) 17 patients had a diagnosis of CT, and 19 a preop diagnosis of OSA. In Group A (acetaminophen) 20 patients underwent cauterization technique, and 13 patients had coblator surgical technique. Mean fentanyl dosing for Group CT and Group OSA was the same intraoperatively (1.9 vs 1.9 mcg/kg) and in PACU phase I (0.47 vs 0.44 mcg/kg) with no significant statistical ($p<0.05$) differences. Mean fentanyl dosing (intraop or postop) was not statistically different regardless of surgical technique. Pain scores assessed by blinded recovery room nurses were similar between all groups. Use of antiemetics postop was minimal with no difference between treatment groups.

CONCLUSIONS: 1) Postoperative use of opioids did not vary with tonsillectomy surgical technique suggesting that postoperative pain is similar for both cauterization or coblator technique. 2) Postoperative use of opioids did not vary with preoperative diagnosis (OSA versus CT) suggesting that postoperative pain is similar regardless of primary surgical indication.

REFERENCES:

1. Wong I. Paediatric Anaesthesia 2013; 23:475

S-226.

WITHDRAWN.

S-228.**COMPARISON OF A SINGLE DOSE OF INTRAVENOUS PARACETAMOL WITH SINGLE DOSE OF RECTAL INDOMETHACIN FOR PAIN MANAGEMENT AFTER OPEN SEPTORHINOPLASTY SURGERY**

AUTHORS: Dabir¹, T. Parsa², M. Abbasinazari³, Y. Parviz⁴

AFFILIATION: ¹Anesthesiology and Pain Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ²Anesthesiology and Critical care, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ³Department of Clinical Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ⁴School of Pharmacy, Islamic Azad University, Tehran, Iran, Islamic Republic of

INTRODUCTION: Septorhinoplasty is associated with moderate pain intensity¹. Paracetamol is widely used for relief of acute postoperative pain^{2,3}. The purpose of this study was to investigate if a single dose of IV paracetamol would provide better postoperative analgesia compared with a single dose of indomethacin suppository, or placebo in patients undergoing open septorhinoplasty.

METHODS: This prospective, randomized, double-blind, placebo controlled trial was approved by the local Research Ethics Committee and written informed consent was obtained from each participating patient. Seventy-five American Society of Anesthesiologists physical status I-II patients, 30 women and 45 men, aged 18-40 yr, undergoing elective open septorhinoplasties with general anesthesia were randomly divided into 3 groups of 25 each. They received either IV paracetamol 1 g in 100 ml normal saline, indomethacin 100 mg rectally, or 100 mL of 0.9% normal saline IV, 20 minutes before completion of surgery. Oral clonidine 0.5 mg was given to all patients one hour before surgery. Anesthesia was induced with midazolam, fentanyl, sodium thiopental and

atracurium. Anesthesia was maintained with O₂ 100%, atracurium, and continuous infusions of propofol and remifentanyl. The electrocardiogram, arterial oxygenation (SpO₂) and blood pressure were monitored throughout the procedure. In all patients topical phenylephrine 0.25% was applied for nasal mucosal decongestion and 14 mL solution of 1% lidocaine + epinephrine combination were injected in the septum, sites of incision, and osteotomy line. Systolic arterial pressure was kept between 80 mmHg and 90 mmHg for controlled hypotensive anesthesia. Postoperative pain was assessed using a 0-10 visual analog scale at 15, 30 minutes, and 1, 2,3,4,5, 6, 7 and 8 hours after anesthesia. Patients received IV morphine for supplemental analgesia if pain scores were 4 or greater. The degree of sedation was evaluated using a 6-points Ramsay sedation scale.

RESULTS: Patients' and surgical characteristics, and intraoperative fentanyl and remifentanyl use were similar in 3 groups. No statistically significant difference in pain scores, sedation scores, supplemental morphine consumption, and side effects was found between the groups during study period ($P > 0.05$). All the patients experienced adequate pain relief after septorhinoplasty. Few patients in either group required additional analgesia within the first 8 h with no statistical differences between the groups ($p < 0.05$). No serious side effects was detected in either group.

CONCLUSIONS: Analgesic efficacy of prophylactically administration of a single dose of IV paracetamol was not superior to that of a single dose of rectal indomethacin or placebo in open septorhinoplasty patients.

REFERENCES:

1. Eur Arch Otorhinolaryngol 2012; 269: 1613-21,
2. Drugs 2003; 63:15-22,
3. Minerva Anestesiol 2009; 75: 644-53.

S-229.

EFFECT OF INTRAPERITONEAL ADMINISTERED RUBUS COREANUS ON HYPERALGESIA INDUCED BY REPEATED INTRAMUSCULAR INJECTION OF ACIDIC SALINE IN RATS

AUTHORS: Y. Park¹, G. Choi¹, H. Kang¹, C. Baek¹, Y. Jung¹, S. Park²

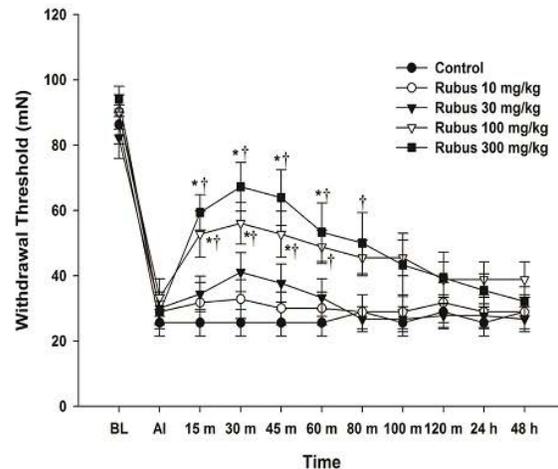
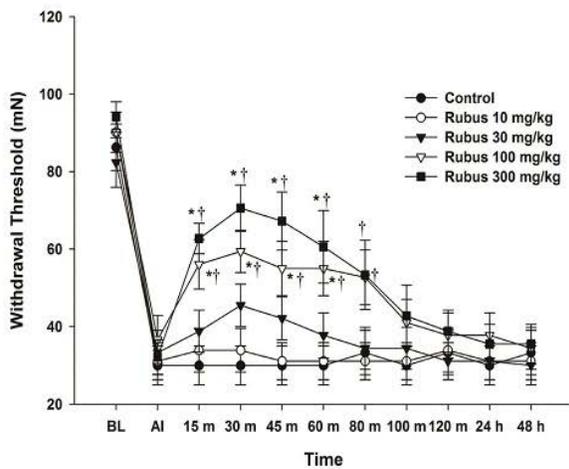
AFFILIATION: ¹Anesthesiology and Pain medicine, Chung-Ang University Hospital, Seoul, Korea, Republic of, ²Anesthesiology and Pain Medicine, Eulji University Medical Center, Daejeon, Korea, Republic of

INTRODUCTION: The aim of this study was to assess the antinociceptive activity of Rubus coreanus (RC) on hyperalgesia induced by repeated intramuscular injections of acidic saline in rats and to examine the mechanisms involved.

METHODS: Rats were injected intraperitoneally with a 0.9% saline vehicle or various doses of RC after the development of hyperalgesia. Rats were then injected intraperitoneally with yohimbine, dexmedetomidine, prazosin, naloxone, atropine, or mecamlamine 10 min before RC injection. The mechanical withdrawal threshold (MWT) was assessed with von Frey filaments.

RESULTS: The MWT was significantly increased after intraperitoneal injection of 300 mg/kg of RC when compared with the MWT after the development of hyperalgesia. Injection of RC with yohimbine and mecamlamine showed a significant decrease in the MWT when compared with RC injection, while dexmedetomidine showed a significant increase in the MWT.

CONCLUSIONS: RC showed an antinociceptive activity against chronic muscle-induced pain, and the effect of RC may be mediated by alpha-2 adrenergic receptor and nicotinic cholinergic receptor.



S-230.

PAIN MANAGEMENT AFTER RADICAL PROSTATECTOMY SURGERY: SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

AUTHORS: G. P. Joshi¹, T. Jaschinski², F. Bonnet³

AFFILIATION: ¹Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX, ²Institute for Research in Operative Medicine, Institute for Research in Operative Medicine, Witten/Herdecke University, Cologne, Germany, ³Department d'Anesthesie Reanimation, Hôpital Tenon, Assistance Publique Hôpitaux de Paris Université Pierre & Marie Curie, Paris, France

INTRODUCTION: Increase in prostate-specific antigen screening has resulted in increase in the diagnosis of prostate cancer, which in turn has increased the incidence of radical prostatectomy (RP) surgery. However, the literature assessing pain therapy after RP has not been systematically evaluated. The aim of this study was to evaluate available literature on the pain management after RP. This information could be used to determine the strength of available evidence and knowledge gaps, which could guide future research. In addition, this review can serve as a starting point for developing recommendations for clinical decision-making in pain management after RP surgery.

METHODS: Medline, Embase, and CENTRAL were searched for RCTs and case controlled studies (CCTs), published until October 2012, assessing analgesic, anesthetic, and surgical interventions in patients undergoing RP. Primary outcome measures were postoperative pain scores and secondary outcome measures were supplemental analgesic requirements and recovery outcomes (e.g., adverse effects, functional recovery). We also manually retrieved publications referred in studies identified by our preceding

search. For the critical appraisal of included studies we used the Cochrane Collaboration's tool for assessing the risk of bias. The recommendations were formulated by the PROSPECT Working Group www.postoppain.org.

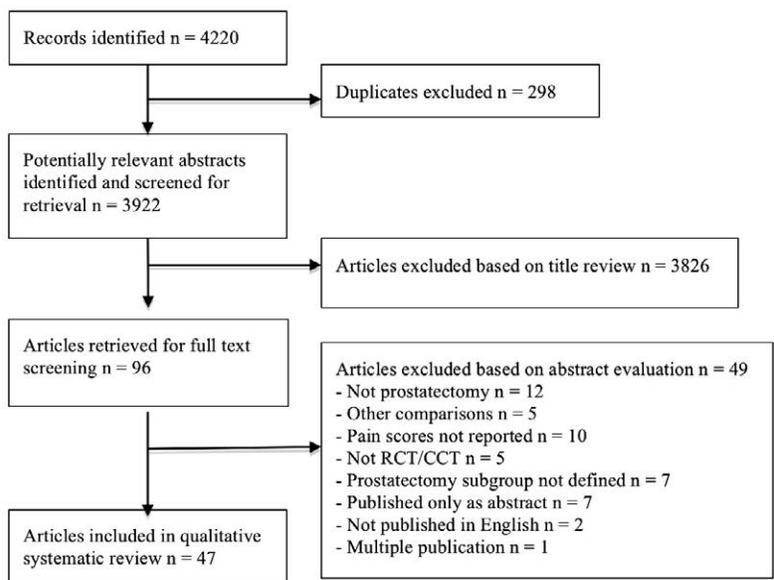
RESULTS: The PRISMA flow chart showing identification of included studies is shown in figure 1. Of the 47 studies included, open approach was performed in 39 studies, laparoscopic approach was performed in 1 study and robotic-assisted laparoscopic approach was performed in 3 studies. Open procedure was compared with laparoscopic or robotic-assisted laparoscopic procedure in 3 studies. The surgical approach was unclear in one study. The interventions evaluated NSAIDs, COX-2 specific inhibitors, lidocaine infusion, opioids, topical lidocaine and topical nicotine, α_2 adrenergic agonists, NMDA antagonists, melatonin, muscarinic antagonists, and local/regional anesthesia (i.e., epidural analgesia, intrathecal opioids, TAP blocks, and wound infiltration). Most analgesic treatments improved pain relief and/or reduced opioid requirements. However, there were significant differences in the study designs and the variables evaluated, precluding quantitative analysis.

CONCLUSIONS: This study provides clinicians with supporting arguments for and against the use of various interventions for pain management after radical prostatectomy (Table). Of note, the recommendations are based on evidence from unimodal analgesic interventions. Because the choice of an analgesic intervention should be determined upon a balance between its analgesic efficacy and the associated risks, neuraxial blocks (i.e., epidural analgesia and spinal morphine) may not be necessary, as an optimal multimodal analgesic technique (see Table) provides similar pain relief and postoperative recovery. Also, COX-2 specific inhibitors are preferred because of the lack of platelet effect and thus avoidance of concerns of increased blood loss.

Table: Overall recommendations for the management of pain associated with radical prostatectomy.


<p>Intraoperative Interventions • Dexamethasone 4-8mg, IV • Parenteral acetaminophen + cyclooxygenase-2 specific inhibitor, if not given preoperatively • At the end of surgery, infiltration of surgical incisions with local anesthetic • Intravenous lidocaine infusion may be used, but only when other approaches are not appropriate</p>
<p>Postoperative Interventions • Muscarinic receptor antagonists to treat urinary catheter-related discomfort • Moderate-to-low intensity pain (VAS)</p>

Figure: PRISMA flow chart showing identification of included references



S-231.

TRAMADOL FOR ACUTE PAIN MANAGEMENT IN CONJUNCTION WITH SEROTONIN RECEPTOR ANTAGONIST ANTIEMETIC DRUGS

AUTHORS: V. S. Lima, R. El Dib, E. M. Ganem, G. A. Barros

AFFILIATION: Anesthesia, Botucatu Medical School Univ Estadual Paulista, Botucatu, Brazil

INTRODUCTION: Approximately 35% of patients may experience moderate-to-severe pain at home after being released from hospital for an ambulatory surgery¹. Tramadol is on the second step of the analgesic ladder described by the World Health Organization (WHO) and is a widely used opioid due to its low rates of respiratory and sedative effects compared to the third-step WHO opioids (e.g. morphine, fentanyl) while providing equal analgesic efficacy. Tramadol is on the second step of the analgesic ladder described by the WHO and is a widely used opioid due to its low rates of respiratory and sedative effects while providing equal analgesic efficacy². The serotonin receptor antagonist antiemetic drugs are antagonists of 5-HT receptor, whereas tramadol is a 5-HT reuptake inhibitor and a release enhancer of 5-HT. The antiemetic properties of ondansetron and other analogs are based on the blockage of 5-HT3 receptors located on the chemoreceptor trigger zone and enteric neurons. This receptor is also expressed by the primary afferent fibers and by the neurons of the dorsal horn³. This mutually contrasting action on 5-HT transmission may explain the conflicting results of some studies regarding the interaction between tramadol and serotonin receptor antagonist antiemetic drugs.

METHODS: We included only randomized controlled trials (RCTs) in this systematic review. We searched the following

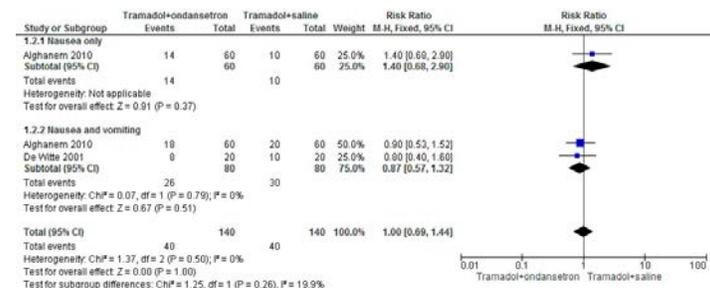
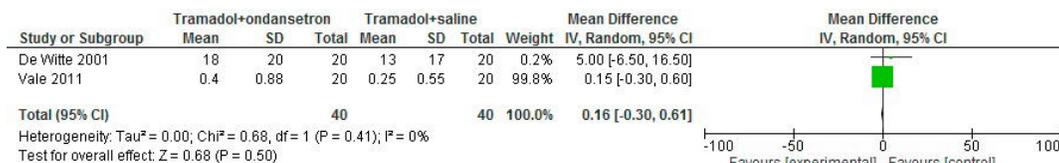
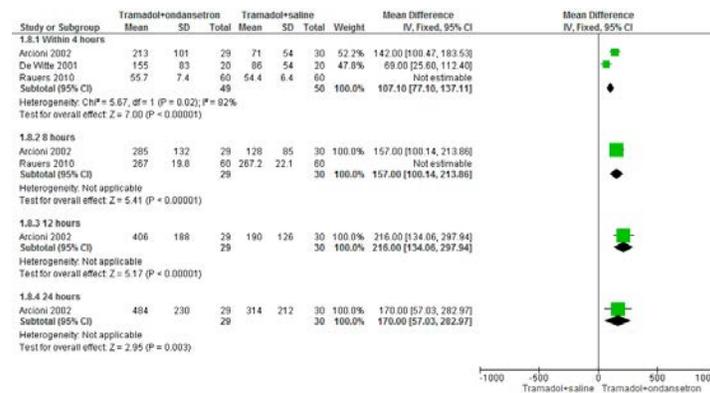
sources to identify randomized or quasi-randomized controlled trials evaluating serotonin receptor antagonists antiemetic drugs and tramadol: the Cochrane Central Register of Controlled Trials (CENTRAL); MEDLINE (1966 to present); EMBASE (1980 to present); LILACS (1982 to present).

RESULTS: We found 7 RCTs. Until this date, the data analyzed were the tramadol consumption (fig.1), the pain score in the visual analogue scale (fig.2) and the cumulative incidence of nausea and vomiting (fig.3)⁴⁻¹⁰.

CONCLUSIONS: Higher doses of tramadol maybe required when administered in conjunction with serotonin receptor antiemetic drug.

REFERENCES:

1. Acta Anaesthesiologica Scandinavia 1997;41(8):1017-22;
2. Canadian Journal Anaesthesia 2000;47:968-73;
3. American journal of human genetics 1997;60:284-95;
4. Surgical Endoscopy 2010;24:353-8
5. Anesthesia Analgesia 2002;94:1553-7;
6. Anaesthesia 1999;54(3):289-92.
7. Anesthesia Analgesia 2001;92:1319-21;
8. The Journal of International Medical Research 2003;31:267-271;
9. The Journal of Pain 2010;11(12):1274-1281.
10. Pharmacology 2011;88:182-187.



S-232.

CURRENT STATUS OF CANCER PAIN MANAGEMENT IN CANCER HOSPITAL/ THE ROLE OF INTERVENTIONS

AUTHORS: S. Hattori, J. Takarada, H. Sakurai, N. Nakaigawa

AFFILIATION: Cancer Pain Service, Cancer Institute Hospital of JFCR, Tokyo, Japan

INTRODUCTION: In the past two decades, WHO’s establishment of cancer pain management along with the use of palliative medicine consultants, has succeeded to reduce pain in 90% of the patient with cancer pain using standard systemic opioids. However, 10-15% of patients experience severe pain that is resistant to these conservative analgesic therapies. We consider interventional approach such as neurolysis and spinal analgesia to these patients (see table below). The purpose of this presentation is to introduce current status of cancer pain management in our cancer hospital and to emphasize the necessity of intervention for intractable cancer pain.

METHODS: A thorough chart review was conducted over a period from April, 2009 to June, 2014. Demographic data was collected on all 1756 patients who had been referred to palliative care team (PCT)

RESULTS: Throughout the review period, 24.1±3.8 %(Mean±SD) of the patient referred to PCT ended up with interventions. Celiac plexus block significantly reduced NRS from 6 to 3(median) after the procedure(Fig.2). Intrathecal administration significantly reduced NRS and systemic opioid requirements(Fig 3).

CONCLUSIONS: Neurolysis and spinal analgesia can provide much needed pain relief for patients with both visceral and somatic pain that we failed to control by systemic medications. Although interventional approach is not a stand-alone therapy, physicians treating cancer pain in palliative care should be aware of these interventional techniques to provide alternative therapies to patients with refractory cancer pain.

Therapy for Cancer Pain Patients

	Conservative treatment	Epidural analgesia	Intrathecal analgesia (with implantable port)	neurolysis	others
2009 (n=307)	225	58	18	10	11
2010 (n=300)	237	42	17	18	10
2011 (n=332)	273	36	20	21	6
2012 (n=346)	280	45	17	17	7
2013 (n=364)	306	42	13	14	71
March, 2014 (n=107)	91	13	8	2	1

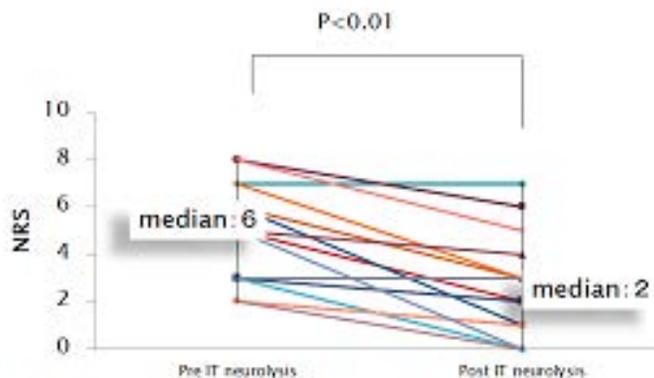


Fig2: NRS changes, pre/post sympathetic neurolysis (Wilcoxon ranked test n=22)

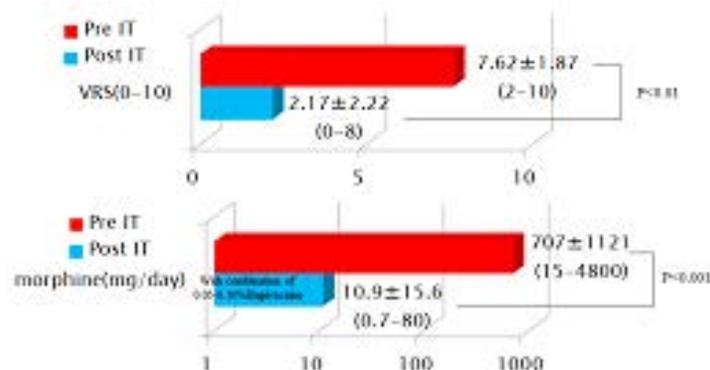


Fig3: Pre/Post IT treatment (n= 51) NRS and morphine dose

S-233.

TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK VERSUS SURGICAL WOUND INFILTRATION FOR PAIN MANAGEMENT AFTER OPEN ABDOMINAL HYSTERECTOMY: A RANDOMIZED CONTROLLED TRIAL

AUTHORS: I. Gasanova¹, J. C. Alexander², B. Ogunnaike¹, G. P. Joshi³

AFFILIATION: ¹Anesthesiology and Pain Management, UT Southwestern Medical Center, Dallas, TX, ²Anesthesiology and Pain Management, UT Southwestern, Dallas, TX, ³Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX

INTRODUCTION: Several systematic reviews have reported analgesic efficacy of TAP blocks in patients undergoing abdominal surgery¹. However, TAP blocks have not been compared with surgical wound infiltration. This randomized, controlled, observer-blinded study was designed to compare the analgesic efficacy of TAP blocks with wound infiltration in patients undergoing open total abdominal hysterectomy (TAH). We hypothesized that bilateral TAP blocks would provide superior analgesia compared to wound infiltration. The primary aim of the study was to compare opioid requirements at 48 h after surgery.

METHODS: After IRB approval, 43 consenting patients undergoing elective TAH via Pfannenstiel incision were randomized to one of two groups – bilateral ultrasound-guided TAP blocks using bupivacaine 0.5% 20mL on each side or wound infiltration prior to closure with liposomal bupivacaine 266mg diluted to a total of 60mL injected in the peritoneal, subfascial and subcutaneous planes (20mL in each plane). The remaining aspects of intraoperative care, including GA and analgesic techniques (i.e., dexamethasone 4mg IV, acetaminophen 1gm IV and ketolorac 30mg IV) as well as postoperative care were standardized. Pain management in the first 24h postoperative period included acetaminophen 1gm q 8h

po, ketorolac 30mg, IV q 8h, and IV-PCA morphine. In the 24-48h postoperative period, patients received ibuprofen 800mg and acetaminophen 1gm q 8h po supplemented with hydrocodone/acetaminophen 5mg/325mg 1-2 tablets, as needed.

An investigator blinded to group allocation, documented VAS pain scores (0=no pain and 10=worst pain) at rest and with coughing, supplemental opioid requirements, nausea (none=0, mild=1, moderate=2, severe=3), vomiting and rescue antiemetics at 2, 6, 12, 24, and 48h postoperatively. The data were analyzed using Student's t test and Kolmogorov-Smirnov test with a p-value <0.05 considered significant.

RESULTS: One patient was excluded from the analysis because of reoperation within 24h. There were no differences between the groups with respect to demographics, intraoperative opioid use, duration of surgery, and PACU stay as well as opioid requirements in the PACU and in first 24h after surgery, however there was a significant difference in hydrocodone/acetaminophen use on the 2nd postoperative day (Table 1). The pain scores at rest and with coughing were significantly lower in the wound infiltration group at 12 and 24h and with coughing at 2 and 6 h (Table 2). The nausea scores, occurrence of vomiting, and need for rescue antiemetics were similar. All patients resumed oral intake and ambulated the morning after surgery, and were discharged home within 48h after surgery.

CONCLUSIONS: In this preliminary study, wound infiltration with liposomal bupivacaine provided superior pain relief at rest and on coughing for up to 24h and reduced opioid requirements between 24 and 48h after TAH. We used “regular” bupivacaine, rather than liposomal bupivacaine for TAP block because it was only approved for wound infiltration at the time of study design.

REFERENCES:

1. Acta Anaesthesiol Scand 2010; 54: 529-35.

Table 1: Baseline characteristics of patients by treatment assignment. Data are expressed as mean (standard deviation). * Indicates P<0.05. Group 1=Bilateral transversus abdominis plane (TAP) block with “regular” bupivacaine and Group 2=Surgical wound infiltration with liposomal bupivacaine. PACU=Post Anesthesia Care Unit.

Characteristic	Group 1 (n = 21)	Group 2 (n = 21)
Age (years)	44.1 (5.4)	43.1 (4.2)
Body Mass Index (kg/m ²)	31.3 (4.1)	33.2 (5.9)
Duration of surgery (min)	202.2 (18.8)	223.0 (15.6)
Duration of PACU Stay (min)	57.8 (12.5)	57.1 (13.1)
Intraoperative fentanyl (mcg)	338.1 (46.6)	320.2 (45.9)
Intraoperative hydromorphone (mg)	0.9 (0.2)	1.0 (0.3)
PACU hydromorphone (mg)	0.14 (0.2)	0.1 (0.1)
Morphine 24 h (mg)	48.8 (39.6)	39.5 (30.6)
Acetaminophen/hydrocodone tablets 24-48 h (numbers)	3.57 (2.7)	1.8 (1.8)*

Table 2: Pain Score at rest and during coughing at various time points. Values are means (standard deviation). *Indicates P<0.05. Group 1=Bilateral transversus abdominis plane (TAP) block with “regular” bupivacaine and Group 2=Surgical wound infiltration with liposomal bupivacaine.

	PACU		2 Hours		6 Hours		12 Hours		24 Hours		48 Hours	
	Rest	Cough	Rest	Cough	Rest	Cough	Rest	Cough	Rest	Cough	Rest	Cough
Group 1 (n=21)	2.0 (2.1)	3.6 (2.9)	3.0 (2.3)	5.1 (2.1)	3.5 (2.7)	5.9 (2.4)	4.5 (3.3)	6.6 (2.3)	3.6 (2.6)	6.1 (2.3)	2.9 (2.4)	5.0 (2.3)
Group 2 (n=21)	1.3 (1.4)	2.2 (2.1)	1.8 (1.4)	2.6 (1.6)*	1.7 (1.5)	2.5 (1.7)*	1.9 (1.4)*	3.2 (1.7)*	1.2 (1.1)*	3.5 (1.6)*	1.3 (1.7)	3.6 (1.5)

S-234.

PERIOERATIVE PREGABALIN REDUCES SENSORY DEFICIT AFTER RADICAL MASTECTOMY

AUTHORS: E. Babar Melik¹, B. Ogunnaike¹, R. Rao², R. Makinde¹, J. Pai¹, O. Ogunkua¹, G. P. Joshi¹

AFFILIATION: ¹Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX, ²Department of Surgery, University of Texas Southwestern Medical Center, Dallas, TX

INTRODUCTION: The incidence of persistent postoperative pain (PPP) after mastectomy is reported to be 30-70%¹. PPP is thought to be neuropathic in origin², which may present as hyperalgesia and/or sensory deficit.

Pregabalin may be of benefit in prevention of PPP³. This randomized, double-blind, placebo-controlled trial was designed to assess the effects of pregabalin on acute and chronic pain after mastectomy.

METHODS: Women (n=47) undergoing unilateral modified radical mastectomy or lumpectomy with axillary node dissection were randomized to receive pregabalin 300 mg, po or placebo 1-2 h preoperatively. Thereafter, pregabalin 150 mg or placebo was administered twice daily until postoperative day 14. Postoperative pain management included IV-PCA morphine followed by oral opioids. Patients were visited daily while in the hospital and followed via telephone on postoperative days 7, 14, 30, and 90. Assessments of numbness were performed on POD 1, at discharge, and on POD 7, 14, 30 and 90. In addition, postoperative pain scores, opioid consumption, pregabalin-related side effects, quality of sleep, and patient satisfaction were also recorded.

RESULTS: The pregabalin (n=23) and placebo (n=24) groups were similar with respect to postoperative pain scores, opioid consumption, and patient satisfaction (Table). However, none of the pregabalin treated patients complained of numbness compared with 16.6% to 29% in the placebo group (Figure). The most common adverse effects of pregabalin were dizziness and somnolence.

CONCLUSIONS: Although there was no difference in pain scores following mastectomy, patients receiving pregabalin did not complain of numbness.

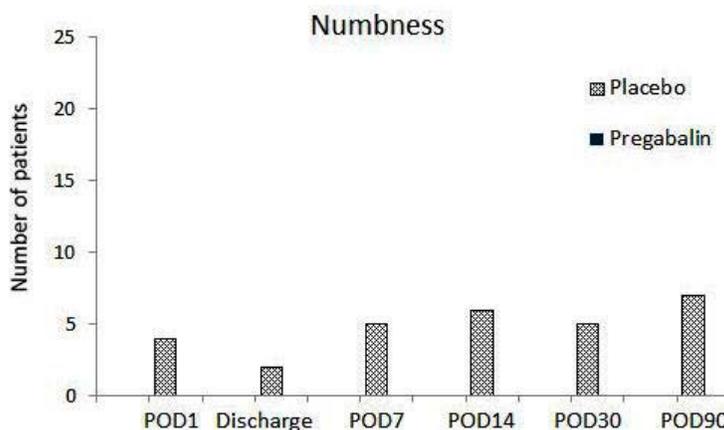
This observation indicates that pregabalin may be effective in alleviating sensory deficits, a common presentation of neuropathic pain.

REFERENCES:

1. Pain; 12: 725-46, 2011.
2. Pain;153:1390-6, 2012.
3. Br J Anaesth;106:454-62, 2011.

The effects of pregabalin on numbness

	Placebo(n=24)	Pregabalin(n=23)	p-values
POD1	4/24 = 16.6%	0/23	<0.0001
At Discharge	2/24 = 12.5%	0/23	<0.0001
POD7	6/24 = 25%	0/23	<0.0001
POD14	6/24 =25%	0/23	<0.0001
POD30	6/24 = 25%	0/23	<0.0001
POD90	7/24 =29%	0/23	<0.0001



S-235.

SINGLE DOSE SYSTEMIC ACETAMINOPHEN TO PREVENT POSTOPERATIVE PAIN: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

AUTHORS: M. E. Rodes, G. S. De Oliveira

AFFILIATION: Anesthesiology, Northwestern University, Chicago, IL

INTRODUCTION: Improvement of postoperative pain outcomes seems to be an important pathway to augment patients' quality of postsurgical recovery. The use of preventive analgesic modalities may result in better postoperative pain control for surgical patients, however, pharmacological interventions that are effective to treat postoperative pain may not have the same efficacy when utilized as a preventive analgesic strategy. Several clinical studies have examined the use of systemic acetaminophen in the perioperative setting with varying results. In addition, previous quantitative systematic reviews did not differentiate between a preventive and treatment effect of the drug. It is therefore unknown whether a single dose of systemic acetaminophen is an effective strategy to prevent postsurgical pain. The main objective of the current investigation was to examine the effect of systemic acetaminophen on postoperative pain outcomes when the drug was given as a preventive analgesic strategy. We also sought to investigate a possible association between acetaminophen dose and drug effects on postoperative pain outcomes.

METHODS: A systematic search was performed to identify randomized controlled trials that evaluated the effects of a single dose of systemic acetaminophen on pain outcomes in a large variety of surgical procedures. Meta-analysis was performed using a random-effects model.

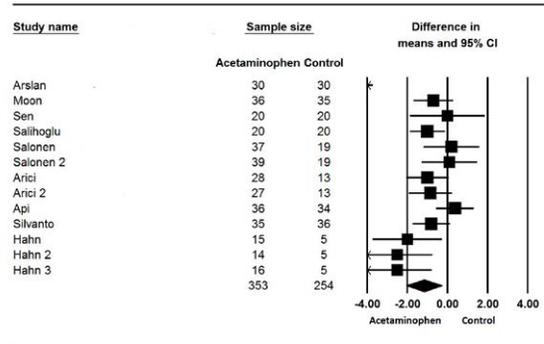
RESULTS: Eleven randomized controlled trials evaluating 740 subjects were included in the analysis. The weighted mean difference (95% CI) of the combined effects favored acetaminophen over control for early pain at rest (<4h, -1.1 (-2.0 to -0.2)) and early pain on movement (<4h, -1.9 (-2.8 to -1.0)). Postoperative opioid consumption was decreased in the systemic acetaminophen group compared to control, with weighted mean difference (95% CI) of -9.7 (-13.0 to -6.4) mg intravenous morphine equivalents. Systemic acetaminophen also reduced postoperative nausea and/or vomiting compared to control, OR (95% CI) of 0.25 (0.13 to 0.47), NNT (95% CI) 3.3 (2.3 to 5.9).

CONCLUSIONS: Systemic acetaminophen, when used as a single dose preventive strategy, is an effective intervention to reduce postoperative pain and opioid consumption. As reduction in postoperative opioid consumption seems to be an important factor in improving postoperative quality of recovery, a single preventive dose of systemic acetaminophen may be a viable intervention to improve postoperative quality of recovery. Systemic acetaminophen also appears to reduce postoperative nausea and/or vomiting, which would be expected to have a similar effect. Doses greater than 1g were not associated with greater reduction in pain outcomes.

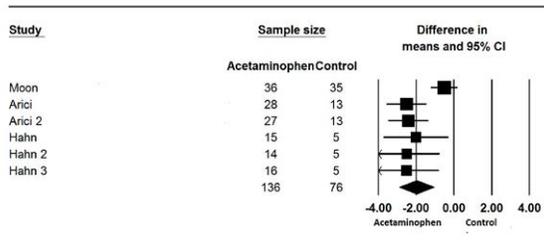
REFERENCES:

1. J Clin Anesth. 2013;25:188-92.
2. Afr J Med Sci. 2012;41:429-36.
3. Agri. 2011;23:160-66.
4. Arch Gynecol Obstet. 2011;284:1455-60.
5. Anesth Analg. 2009;109:1327-30.
6. Surg Laparosc Endosc Percutan Tech. 2009;19:321-3.
7. Acta Anaesthesiol Scand. 2009;52:1200-6.
8. Agri. 2009;21:54-61.
9. Int J Clin Pract. 2009;63:105-11.
10. Acta Anaesthesiol Scand. 2007;51:1147-54.
11. Acta Anaesthesiol Scand. 2003;47:138-45.

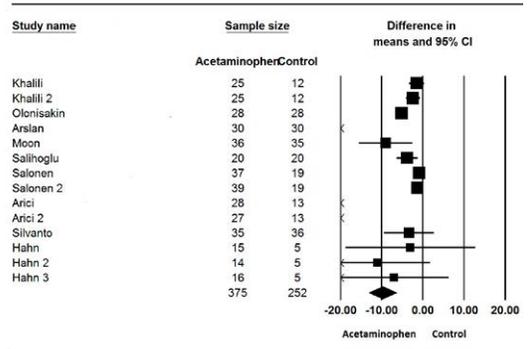
Early pain at Rest



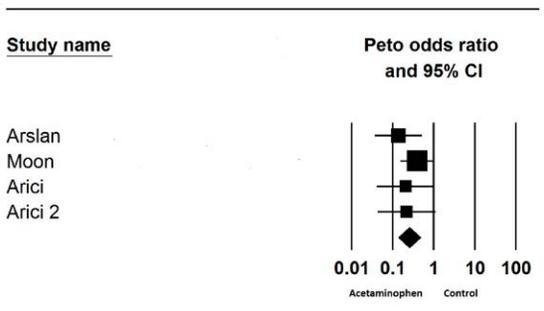
Early Pain on Movement



Opioid Consumption



Postoperative Nausea and/or Vomiting



S-236.

WITHDRAWN.

S-237.**EFFECTS OF INTRAOPERATIVE KETAMINE ON ACUTE AND CHRONIC POSTOPERATIVE PAIN AFTER BREAST CANCER SURGERY****AUTHORS:** A. Cho, D. LEE, E. Lee**AFFILIATION:** Anesthesia and Pain Medicine, Pusan National University Hospital, Busan, Korea, Republic of**INTRODUCTION:** Ketamine is a N-methyl-D-aspartate receptor antagonist that have been reported to have a morphine-sparing effect during the early postoperative period¹. However, effect of ketamine on chronic postoperative pain is still in debate^{2,3}. We performed a randomized, controlled, double-blind study primarily to assess the effect of ketamine on chronic pain after breast cancer surgery. Secondary objective was to assess the early postoperative analgesic effect and the outcomes of ketamine.**METHODS:** Seventy four patients undergoing elective breast cancer surgery were randomly assigned to control and ketamine groups. Ketamine group received IV ketamine before incision (0.5 mg/kg), and followed by infusion until the end of surgery (2 ug/kg/min). The same volume of saline bolus and infusion were given for control group. Patient controlled morphine analgesia was used for postoperative pain management. Numeric rating scale at rest (NRSr) and during coughing or movement (NRSd), cumulative morphine consumption, and complications were recorded during 24 hours after surgery. NRS, development of subacute and chronic postoperative pain, limited performing self-care, usual activities, and arm and shoulder movement were also investigated at 1, 3, and 6 months after surgery.**RESULTS:** The flow of patients enrolled in this study is shown in Fig. 1. Seventy four patients were randomized (control 37, ketamine 37) and 71 patients were included (control 37, ketamine 34) for acute postoperative outcomes. Analysis of the outcomes for 1 and 3 months after surgery included 67 patients (control 34, ketamine 33) and 64 patients were completed entire study course (control 32, ketamine 32). Patients and operative data were similar between two groups (Table 1). Cumulative morphine consumption, NRSr, and NRSd at 1, 6, and 24 hours after surgery did not show any differences between two groups (Fig. 2.). Recovery time, incidence of postoperative nausea and vomiting, and requirement for antiemetics during 24 hours after surgery were not significantly different. However, frequency of shivering was lower (20.6% vs 43.2%) and extubation time was longer (887.9 ± 335.5 sec vs 660.0 ± 262.2 sec) in ketamine group compared with control group (Table 2). NRSr, NRSd (Fig.3.), development of chronic pain, and other parameters at 1, 3, and 6 months after surgery were not significantly different (Table 3).**CONCLUSIONS:** Intraoperative low-dose ketamine failed to reduce severity and incidence of acute and chronic postoperative pain after breast cancer surgery.**REFERENCES:**

1. Pain 2005; 113:61-70.
2. Eur J Pain 2009; 13:497-505.
3. Anesth Analg 2009; 109:1963-71.

S-237 • continued

Table 1. Demographic data and intraoperative outcomes

Variables	Control (n=37)	Ketamine (n=34)	P-value
ASA physical status (I/II)	30 (81.1)/7 (18.9)	24 (70.6)/10 (29.4)	0.406
Age (years)	50.2 (6.7)	51.8 (7.7)	0.352
Weight (kg)	57.2 (9.5)	57.0 (6.1)	0.896
Height (cm)	157.3 (5.8)	157.8 (6.1)	0.732
BMI (kg/m ²)	23.1 (3.6)	22.9 (2.5)	0.788
Duration of surgery (min)	219.1 (76.1)	217.4 (72.6)	0.924
Duration of anesthesia (min)	245.1 (75.3)	245.5 (72.0)	0.983
Propofol (mg)	1281.4 (478.0)	1463.0 (471.1)	0.112
Remifentanyl (ug)	1845.2 (794.4)	1870.0 (655.5)	0.886
Ketamine (mg)	0	52.6 (9.0)	<0.0001
Types of surgery			
Mastectomy /s flap surgery	6 (16.2)	3 (8.8)	0.345
Mastectomy /c local flap	7 (18.9)	11 (32.4)	
Mastectomy /c extended flap	24 (64.9)	20 (58.8)	
ALND	21 (56.8)	11 (32.4)	0.056
Ephedrine or atropine use	4 (10.8)	2 (5.9)	0.675

Data are mean (SD) or number (%). BMI, body mass index; ALND, axillary lymph node dissection

Table 3. Subacute and chronic postoperative outcomes

Variable	After 1 month			After 3 months			After 6 months		
	Control (n=34)	Ketamine (n=33)	P-value	Control (n=34)	Ketamine (n=33)	P-value	Control (n=32)	Ketamine (n=32)	P-value
Number of patients who experienced pain at rest	24 (70.6)	23 (69.7)	0.936	19 (55.9)	20 (60.6)	0.695	16 (50.0)	14 (43.8)	0.616
Number of patients who experienced pain during coughing or movement	33 (97.1)	29 (87.9)	0.197	30 (88.2)	23 (69.7)	0.062	25 (78.1)	18 (56.3)	0.062
Pain management	1 (2.9)	5 (15.2)	0.080	2 (5.9)	3 (9.1)	0.673	3 (9.4)	1 (3.1)	0.497
Disability of arm and shoulder	12 (36.3)	12 (36.4)	0.927	2 (5.9)	5 (15.2)	0.259	2 (6.3)	4 (12.5)	0.672
Affecting daily life	0 (0)	1 (3.0)	0.493	0 (0)	0 (0)	-	3 (9.4)	4 (12.5)	1.000
Affecting self care	10 (29.4)	6 (18.2)	0.281	1 (2.9)	2 (6.1)	0.614	0	0	-

Data are number (%).

Table 2. Acute postoperative outcomes

Variables	Control (n=37)	Ketamine (n=34)	P-value	
Extubation time (s)	660.0 (262.2)	887.9 (335.5)	0.002	
Recovery time (min)	28.3 (13.5)	29.6 (12.1)	0.674	
PONV	0-24h	9 (24.3)	10 (29.4)	0.789
Requirement for antiemetics	0-24h	2 (5.4)	4 (11.8)	0.417
Shivering	0-1h	16 (43.2)	7 (20.6)	0.047

Data are mean (SD) or number (%). PONV, postoperative nausea and vomiting.

Subspecialty Abstracts

Patient Safety

S-238.**ELEVATED TROPONINS IN THE PERIOPERATIVE PERIOD INCIDENCE AND TIMING**

AUTHORS: G. Cuff¹, M. Bloom¹, R. Potosky¹, M. Bilbily¹, C. Singh¹, J. Huang², S. Jain¹

AFFILIATION: ¹Anesthesiology, NYU School of Medicine, New York, NY, ²Information Technology, NYU School of Medicine, New York, NY

INTRODUCTION: Serum troponin levels are employed as sensitive markers of perioperative ischemia and/or infarction and result in elevated levels 2-4 hours after myocyte damage, and peak at approximately 12 hours. This measurement is insightful, as ischemia may be subclinical in the perioperative period. Reportedly, infarcts occur 24-48 hours postoperatively. However, we sought to examine this and determine the specific incidence and time period when troponin elevations occurred in our patient population. This data is useful to direct our perioperative specialists when and where to focus increased scrutiny.

METHODS: With IRB approval, a retrospective analysis of 44,800 cases during 2013 and the first quarter of 2014 were reviewed to determine if and when troponins were elevated during the perioperative period. All cases were performed at NYU Langone Medical Center with cardiac surgical cases excluded. Surgical services which did not send any troponin values during the course of the study were also excluded. Specifically, time to peak troponin and which surgical service was performing the operation was evaluated.

RESULTS: A total of 44,800 non cardiac cases were performed over 2013 and the first quarter of 2014. Troponins were drawn on 3736 patients with 633 cases having a positive troponin. Vascular surgery was the surgical department with the highest percentage of cases having a positive troponin (15%). 13% of troponins peaked immediately post op while 47% of peak troponins occurred greater than 24 hours after departing the operating room. The distribution of positive troponins by service is shown in the pie chart. Ortho Spine & Joints are over-weighted because of the high volume of cases (> 15% of all cases).

CONCLUSIONS: Our results confirm a significant intra-operative risk with a majority of peak troponins in the first 24 hours (peak time 12-16 hours after surgery), and an elevated incidence out to 48 hours. There may be an artifact in clustering of times due to fixed collection times for blood samples. As perioperative specialists, knowing when ischemia occurs and which patients are at high risk for having positive troponins will allow us to conduct future studies aimed at preventing and limiting the morbidity and mortality from myocardial ischemia. This study provides quantitative measures of the relative risk of various types of surgery and the timing of myocardial damage in the perioperative period.

S-239.

NOT MODERATE BUT MILD HYPOTENSION IS ALSO ABLE TO REDUCE BLOOD LOSS DURING SINGLE-LEVEL POSTEROLATERAL FUSION OF LUMBAR SPINE

AUTHORS: H. Yogo

AFFILIATION: Anesthesiology, Tomishiro Central Hospital, Tomigusuku, Japan

INTRODUCTION: Controlled hypotension during anesthesia in major spinal surgery is a widely used technique to reduce intraoperative blood loss and transfusion requirement¹. Moderate hypotension might be clinically used by controlling mean arterial blood pressure (MAP) between 60 - 70 mmHg, or lowering systolic blood pressure (SBP) up to 30 mmHg or 30 % below the patient's usual SBP^{2,3}. Although anesthesiologists must be aware of ischemic complications such as cerebral infarction, cardiac arrest and visual loss during hypotension⁴, it is still difficult to quantify those potential risks because the ischemic threshold of individual organs is impossible to estimate. Therefore it is necessary to deliberate safer hypotensive management where you keep not too low blood pressure while reducing bleeding during spinal surgery. The aim of this study is to explore the correlation between the degree of mild hypotension and blood loss to maintain the adequate level of hypotension.

METHODS: With approval of IRB, we conducted retrospective 20 chart reviews in single-level posterolateral fusion of lumbar spine (PLF) under sevoflurane-remifentanyl anesthesia from December 2011 to August 2014. We evaluated the average blood pressure of the recorded values at 5-minute intervals during surgery, preoperative baseline blood pressure, and blood loss divided by body weight and surgical time (ml/kg/min). We excluded 7 cases because average MAP during surgery was below 70 mmHg which are considered as moderate hypotension controlling. The correlativity between various values of blood pressure and blood loss of 13 cases (Male/Female: 9/4, age; 53 to 76 years old) were assessed by Spearman's rank-order test.

RESULTS: The differences of systolic blood pressure (SBP) and MAP between the preoperative baseline and the average during surgery strongly correlated with blood loss (SBP: R = 0.796, MAP: R = 0.692), however the correlation of SBP or MAP during surgery and blood loss was not strong (SBP: R = 0.600, MAP: R = 0.598). Pulse pressure, commonly believed to reflect the stroke volume, did not correlate with blood loss (R = 0.155, P = 0.61).

CONCLUSIONS: Our results indicated that the value of blood loss correlated with the difference between the preoperative baseline and intraoperative blood pressure, and mild hypotension to 15 - 20 mmHg below baseline was able to reduce blood loss. Appropriate mild hypotensive anesthetic management based on patient's usual blood pressure is expected to contribute for the patient's safety by reducing blood loss and avoiding hypoperfusion during spinal surgery. Further studies are necessary to conclude on clinical usefulness and limitations of mild hypotensive management.

REFERENCES:

1. Spine 1984;9:450-3
2. Eur Spine J 2004;13:S66-71
3. J Bone Joint Surg Am 1985;67:1384-7
4. Ophthalmology 2003;110:1454-57

Fig. 1 Correlation of blood loss and the differences of SBP between the preoperative baseline and the average during surgery

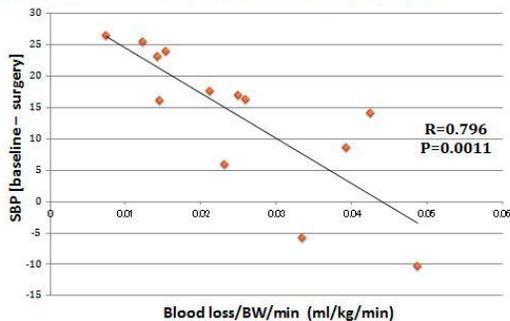


Fig. 2 Correlation of blood loss and the differences of MAP between the preoperative baseline and the average during surgery

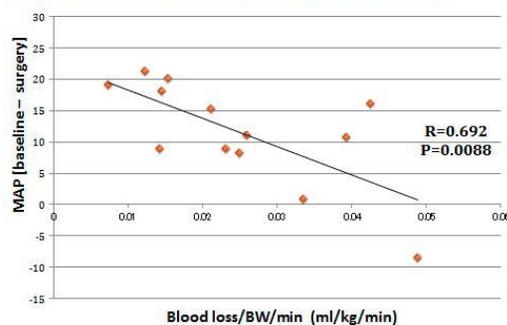


Fig.3 Correlation of blood loss and SBP during surgery

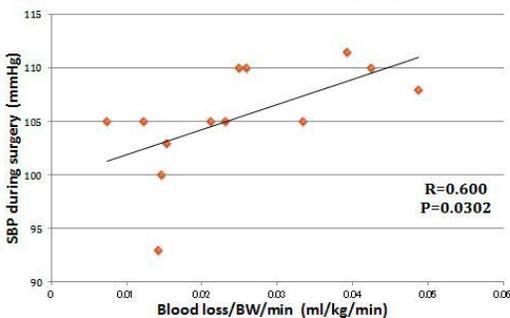
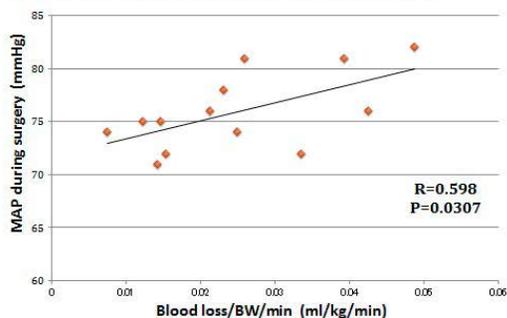


Fig.4 Correlation of blood loss and MAP during surgery



BW: body weight, MAP: mean arterial blood pressure, SBP: systolic blood pressure

S-240.

WITHDRAWN.

S-241.**INCREASED INCIDENCE OF CORNEAL ABRASIONS
AFTER ROBOTIC SURGERY****AUTHORS:** P. Ranganathan, M. K. Ritchie, A. Attaallah, M. Bennett, K. Meyers, M. Vallejo**AFFILIATION:** Anesthesiology, West Virginia University, Morgantown, WV**INTRODUCTION:** Corneal abrasion is a known but preventable complication for patients who undergo anesthesia. Robotic surgery may incur additional risk. The cause of corneal abrasions is multifactorial. The overall incidence is (<0.05%) and is the most common ocular complication of general anesthesia. Ocular injuries constitute about 3%- 8% of all claims in the ASA closed claims data¹ of which 35% represent corneal abrasions. Corneal exposure is found to be a contributing factor in up to 80% of corneal abrasions. Patient position and duration of surgery are also contributing factors. Understanding the etiology with heightened awareness regarding eye protection can decrease the incidence of corneal abrasions².

As a performance improvement project, the department of Anesthesiology and Ophthalmology collected data on all patients who had a corneal abrasion under general anesthesia in a 6-month period between 06/30/2012 - 12/30/2012 and reviewed their charts to find common denominators (risk factors).

METHODS: Medical charts of patients who had a corneal abrasion were reviewed and tabulated for gender, age, surgical duration, provider level, type of eye protection, patient position during surgery and location of surgery.

All results were recorded and entered into a spread sheet for analysis.

RESULTS: There were 7 cases of corneal abrasions in a 6-month period with an incidence of approximately 0.06%. No differences were noted with respect to gender, age, anesthesia provider level, type of eye protection, and location of surgery.

Of the 7 cases with a corneal abrasion, 4 (57%) occurred during robotic surgery in the steep trendelenburg position for an average surgical duration of 4.75 (4-5.5) hours. All patients had eye tape and lubrication for protection.

The overall average surgical duration for all patients who had a corneal abrasion was 3.75 (2.5-5.5) hours under general endotracheal anesthesia.

CONCLUSIONS: We found the onset of corneal abrasions is evident after 90 minutes of surgery and peaks after 2 hours of general endotracheal anesthesia, and of these factors, duration of surgery greater than 3.5 hours in the steep trendelenberg position were significant.

Robotic surgery performed in steep trendelenberg for longer than 2 hours along with conjunctival congestion and corneal dryness increases the risk for corneal abrasions. In procedures that have increased risk for corneal abrasions, additional eye protection with both lubrication and closure of eyes with special eye protective tape should be considered in all cases that are anticipated to last more than 2 hours and re- applied every 2 hours to prevent corneal abrasions.

REFERENCES:

1. Gild WM et al, Eye injuries associated with anesthesia. A closed claim analysis. Anesthesiology. 1992 Feb; 76(2):204-8
2. Fraser,S. Corneal Abrasion. Clinical Ophthalmology. 2010 May 6; 4: 387-90

S-242.

THE VALIDITY OF FOUR PERIOPERATIVE SLEEP APNEA SCORE QUESTIONNAIRES FOR CHINESE PATIENTS

AUTHORS: N. Lin¹, Y. Li², J. Ye², B. Zhang¹, T. Li¹

AFFILIATION: ¹Anesthesiology, Beijing Tongren Hospital, Beijing, China, ²Otolaryngology Head and Neck surgery, Beijing Tongren Hospital, Beijing, China

INTRODUCTION: The questionnaires, such as Berlin, ASA, STOP and STOP-Bang, are popularly used to screen obstructive sleep apnea (OSA) patients in USA and Canada for several years. We try to use those methods in China to evaluate those patients and find a better one for Chinese.

METHODS: After hospital ethics approval, 116 preoperative patients aged 18 yr or older and classified as being at high risk of OSA were recruited. Four questionnaires were used to screen patients for OSA. All the patients also received monitored polysomnography (PSG) before operation. The questionnaires were evaluated versus the Apnea-Hypopnea Index (AHI) from PSG. We evaluated the association between scores and the probability of OSA and try to compare the sensitivity, specificity, misdiagnosis rate and missed diagnosis rate of those questionnaires.

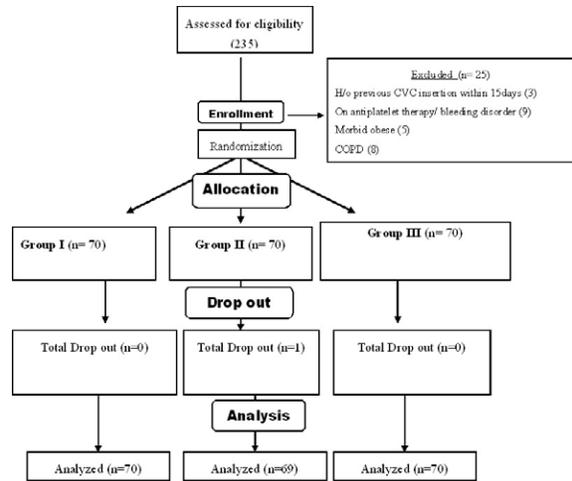
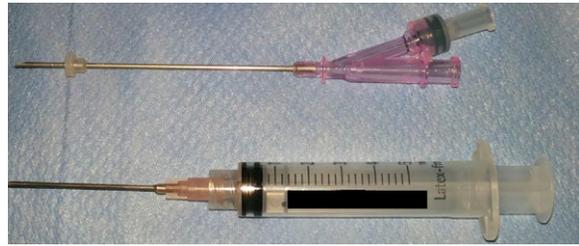
RESULTS: The average age was 39.7±9.5. The body mass index (BMI) was 29.1±3.7 kg/m². The AHI was 56.4±23.6 times/hr. Except for 2 cases, other 114 cases were diagnosis as OSA

according to AHI. All the patients received surgical treatment, such as UPPP or FESS subsequently. The sensitivity, specificity, misdiagnosis rate and missed diagnosis rate of those questionnaires were compared in table 1. The sensitivity and specificity of STOP questionnaire was the highest. While the missed diagnosis rate of Berlin and ASA questionnaires was much higher. Conclusions: The STOP questionnaire is an easy-to-use screening tool and seems fit for Chinese OSA preoperative screening. It has a high sensitivity, especially for patients with moderate to severe OSA. In anesthesiology clinic, the patients can be assessed with simple OSA questionnaire before operation and screen out possible OSA. We try to take proper perioperative management of patients at high risk of OSA in order to reduce the incidence of complications and adverse reaction.

Table 1. The results of the four questionnaires for 116 patients.

	Berlin	ASA	STOP	STOP-BANG
Sensitivity (%)	68.4	69.3	99.1	98.2
Specificity (%)	0	50	100	0
Misdiagnosis Rate (%)	100	50	0	100
MissedDiagnosisRate(%)	31.6	30.7	0.9	1.8
Total Consistent Rate (%)	67.2	69	99.1	96.6

S-243.
WITHDRAWN.



S-244.**FACTORS ASSOCIATED WITH RAPID RESPONSE ESCALATION OF CARE****AUTHORS:** M. K. Stewart¹, C. Kiernan², L. M. Weavind¹**AFFILIATION:** ¹Anesthesiology and Critical Care Medicine, Vanderbilt University, Nashville, TN, ²General Surgery, Vanderbilt University, Nashville, TN

INTRODUCTION: Though implementation of rapid response teams (RRT) has been recommended to reduce preventable in-hospital deaths, a multitude of studies have failed to support their effectiveness.¹ Other studies have shown that inclusion of clinical judgment within RRT trigger criteria have resulted in reduced mortality.² Such data suggests that current RRT structures, most of which are subjected solely on vital sign abnormalities, may not be capturing clinical deterioration in a timely manner. We sought to retrospectively analyze our institutional RRT data to determine what precursors led to escalation of care, a marker of severity of illness and need for provider intervention. By understanding such, we hope to mimic clinical judgment by creating a predictive model to identify patient decline earlier, hopefully leading to improvement in morbidity and mortality.

METHODS: RRT activations from 2009 to 2014 were reviewed. Patient demographic information (age and gender), admission service (medical vs. surgical), RRT trigger (agitation/delirium, blood pressure change, heart rate change, oxygenation change, respiratory rate change, labored breathing vs. general concern), RRT activator (patient/family/friend, nurse, physician vs. other employee), RRT responding team (surgical ICU, medical ICU, cardiovascular ICU vs. neurologic ICU) and number of prior RRT activations (0, 1 vs. >=2) were collected. Patients were stratified into two cohorts, patients transferred to higher level of care and patients who were not transferred, to test the association of the above factors with level-of-care escalation by multivariable logistic regression.

RESULTS: A total of 2,193 RRT activations were assessed. Forty percent (879/2193) of the activations led to patient transfer. There was no difference in median age of patients who were transferred compared to those who were not (62 vs. 60 years, p=0.354). Patients who were transferred were more likely to be male (43 vs. 38%, p=.023) and were more likely to be admitted to a surgical service (45 vs. 35%, p=.001). RRT activations that led to escalation of care were more likely to be activated by physicians than any other group (p=.001). On multivariable analysis controlling for multiple factors, the RRT triggers that were associated with transfer to a higher level of care included change in oxygenation (OR: 2.22, CI: 1.26-3.90) and labored breathing (OR: 3.72, CI: 1.90-7.25).

CONCLUSIONS: Evaluation of our single institution RRT experience revealed that physician activation, admission to a surgical service and respiratory abnormalities as triggers were associated with care escalation. Such information will be beneficial as we seek to create a predictive model to more expeditiously alert clinical teams of patient deterioration.

REFERENCES:

1. Chan PS, Jain R, Nallmothu BK, Berg RA, Sasson C. Rapid Response Teams: A Systematic Review and Meta-analysis. *Arch Intern Med* 2010;170(1):1-26.
2. Beitler JR, Link N, Bails DB, Hurdle K, Chong DH. Reduction in Hospital-Wide Mortality After Implementation of a Rapid Response team: a Long-Term Cohort Study. *Crit Care* 2011;15:R269.

S-245.**ARE SHORTER NPO TIMES FOR SPLIT-PREP COLONOSCOPIES “A BRIDGE TOO FAR”? A SURVEY OF ANESTHESIA RESIDENCY PROGRAMS****AUTHORS:** T. Jan, D. Hall**AFFILIATION:** Anesthesia, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ

INTRODUCTION: In 2002, over 14 million colonoscopies were performed in the US¹. In our institution, anesthesia providers currently deliver almost 100% of anesthetics for colonoscopy. Deep sedation with propofol is almost always used. Propofol deep sedation frequently results in periods of general anesthesia, rendering patients at risk for aspiration of gastric contents^{2,3}. Recently, many GI practitioners prescribe a split colonoscopy prep, which has been shown to give a better quality prep with fewer cancellations, and is preferred by patients⁴. In addition, Medicare may deny payment for colonoscopies repeated due to a previous poor prep⁵. However, patients may consume up to 2 liters of fluid up to 2 hours prior to colonoscopy with some split preps, which runs counter to the 2010 ASA NPO Guidelines⁶. Therefore, we wished to determine what similar institutions are doing with regard to colonoscopy deep sedation and split preps that may violate current national NPO guidelines.

METHODS: After IRB approval, in Sept/Oct 2014 we surveyed the 128 ACGME-approved anesthesiology residency training programs regarding the above. Questionnaires with a letter of introduction were emailed weekly for 4 weeks to the Program Director of each program. Questions focused on practice size, prep used, anesthesia providers used (if any), anesthesia techniques, NPO rules, and management of patients at high risk for aspiration. The investigators were blinded to the respondents.

RESULTS: Of the 128 programs we queried, we received 31 responses (24.2%), which is mediocre but typical for physician surveys. 15 respondents (50%) stated that anesthesia providers usually provided colonoscopy sedation, and 19 programs (63%) said propofol was the usual sedative. 16 respondents (55%) did not know whether split preps were used in their centers. Also, 6 respondents (19%) did not know how long patients were kept NPO for colonoscopy. Of the remaining 25, 18 programs (72%) kept patients NPO at least 6 hours, and 13 (55%) kept patients NPO for 8+ hours. Risk factors warranting intubation included recent vomiting (82%), aspiration history (77%), and emergency procedure (73%). However, management was unclear for swallowing difficulties (53%), nausea (44%), and pregnancy (42%).

CONCLUSIONS: There appears to be no general consensus regarding anesthesia management of patients with split preps. We were surprised how uninformed some program directors were regarding their own institutional endoscopy policies and procedures. Programs that utilize propofol with an anesthesia provider tend to have longer NPO times. Clearly, high-volume split preps for colonoscopy with propofol deep sedation and shorter NPO times may just be a “bridge too far”. Our departmental NPO policy regarding this will be reviewed and no doubt modified, as perhaps others will.

REFERENCES:

1. *Gastroenterol* 2004;127: 1670-7.
2. *Proc. (Bayl Univ Med Cent)* 2014, 27:12-5.
3. *JAMA Intern Med.* 2013, 173: 551-6.
4. *J Clin Gastroenterol* 2014, 48:47-9.
5. *Arch Int Med* 2011, 171:1335-43. 6. ASA NPO Guidelines, 2010. 7. *Health Serv Res* 2001, 35:1347-55.

S-246.

WITHDRAWN.

S-247.**UNCOVERING RESIDUAL PARALYSIS IN THE PACU: A PILOT STUDY****AUTHORS:** F. A. Wolf¹, P. R. Regan², E. W. Duggan¹**AFFILIATION:** 1Anesthesiology, Emory, Atlanta, GA, 2Nursing, Emory, Atlanta, GA**INTRODUCTION:** Residual paralysis after extubation is a patient safety concern and can be detected using quantitative train-of-four (TOF) monitoring such as acceleromyography¹. The amplitude of the fourth twitch response in a 2-Hz TOF stimulus is compared to the amplitude of the first twitch response, determining the train-of-four ratio. A TOF ratio <0.9 represents residual paralysis². At our institution, quantitative TOF monitors have not been widely available and the prevalence of residual paralysis was not known.**METHODS:** The TOF ratio was measured in postoperative surgical patients upon arrival in the PACU at a major academic hospital. All patients had received non-depolarizing neuromuscular blocking drugs and reversal with neostigmine and had no contraindications to TOF assessment. The TOF ratio was determined by ulnar nerve stimulation and acceleromyography using the TOF-Watch (Organon, Ireland). Measurements were conducted within 5 minutes of patient arrival in the PACU using a current of 30mA and increasing if needed and as tolerated up to 50mA. TOF ratio measurements were repeated and accepted if within $\leq 10\%$ agreement, up to a maximum of four measurements and were stopped if patients showed any sign of discomfort. The prevalence of residual paralysis (TOF ratio <0.9) and major residual paralysis (TOF ratio <0.7) in the PACU was determined.**RESULTS:** TOF ratio measurement was attempted in 35 patients from a variety of surgical specialties. TOF ratio measurement was successful in 27 (77%); failure to determine the TOF ratio was due to inadequate twitch height (9%), inconsistent readings (9%), and patient discomfort (6%). Twenty-six percent of patients had residual paralysis (TOF ratio <0.9) and 11% had major residual paralysis (TOF ratio <0.7). One patient with residual paralysis required immediate interventions to relieve upper airway obstruction.**CONCLUSIONS:** Measuring the TOF ratio in the PACU was feasible and well tolerated by most patients. Despite nearly universal administration of reversal agent, one quarter of patients had residual paralysis. Contributing factors may include inadequate dosing of reversal, inadequate time from reversal to extubation, and reliance on clinical signs and qualitative nerve twitch monitors for determining adequacy of recovery. Efforts to expand the use of quantitative TOF measurement are being initiated to reduce postoperative residual paralysis and improve patient safety.**REFERENCES:**

1. Anesthesia & Analgesia. 111(1):120-128, 2010.
2. Anesthesiology. 92 (977-984), 2000

S-248.**LOWER LIMB PERFUSION DURING ROBOTIC-ASSISTED RADICAL PROSTATECTOMY EVALUATED BY NEAR INFRARED SPECTROSCOPY****AUTHORS:** K. Takechi, T. Nagaro**AFFILIATION:** Anesthesia and Perioperative medicine, Ehime university graduate school of medicine, Toon, Japan**INTRODUCTION:** For the robotic-assisted radical prostatectomy (RARP), the patient is placed in the lithotomy position and the steep Trendelenburg position. The combination of these positions is considered to decrease perfusion in the lower extremities by reducing blood pressure.Lower limb compartment syndrome (LLCS) is a serious complication of the RARP¹. However, the effect of a patient's position on the lower limb perfusion during RARP is still not well understood. Since, near infrared spectroscopy (NIRS) is recommended as a method to detect perfusion deficits of LLCS², we evaluate lower limb perfusion during RARP using NIRS.**METHODS:** After obtaining institutional review board approval, 30 adult male patients scheduled for RARP were studied. Patients with peripheral vascular disease were excluded. Patient characteristics and data from the perioperative period are presented in Table 1.Anesthesia was administered and maintained with propofol, remifentanyl, rocuronium and desflurane. The ventilator was set to keep maintain an end-tidal CO₂ pressure from 30 to 40mmHg. The mean arterial pressure was maintained over 60mmHg. Regional saturation of oxygen (rSO₂) measurements were determined using an INVOS oximeter (Somanetics, Troy, MI), a continuous dual-wavelength NIRS. This NIRS sensor was positioned on the lower leg on the surface of the skin at the calf muscles (the gastrocnemius and soleus) mid-diaphyseal region, over the posterior compartment. Regional SO₂ levels were recorded before anesthesia induction (T0; baseline), 5 minutes after anesthesia induction (T1), 5 min

after pneumoperitoneum in a lithotomy position (T2), 5 min after a 25° Trendelenburg position (T3), 30/60/90/ and 120 min after the pneumoperitoneum (T4, T5, T6 and T7, respectively), after desufflation in a supine position (T8), and after tracheal extubation (T9). The changes in values over time were analyzed with one way repeated measures analysis of variance with Tukey post hoc tests, where P<0.05 considered significant.

RESULTS: The change in the lower limb rSO₂ was statistically significant (P<0.0001). Regional SO₂ was increased significantly after induction of anesthesia, pneumoperitoneum in lithotomy position, in a Trendelenburg position (at 5min, 90min, 120min) compared with the baseline (Fig 1). Compartment syndrome was not observed in all patients.**CONCLUSIONS:** The lithotomy position reportedly caused a reduction in systolic blood pressure in the lower limb to a level comparable to compartment syndrome³. On the contrary, volatile anesthetics were known to increase peripheral perfusion⁴. In our cases, we found that the effects of volatile anesthetics on lower limb perfusion can counteract and exceed the effects of the steep Trendelenburg position. From our results, we can conclude that correct patient positioning and careful assessment of patient risk factors (such as vascular morbidity) could be important to prevent LLCS during RARP.**REFERENCES:**

1. BJU Int. 2013 Aug;112(4):485-8.
2. J Emerg Med. 2013 Feb;44(2):292-8.
3. Am Surg. 1997;63:361-4.
4. Anaesthesiol Intensive Ther. 2013 Jul-Sep;45(3):138-44.

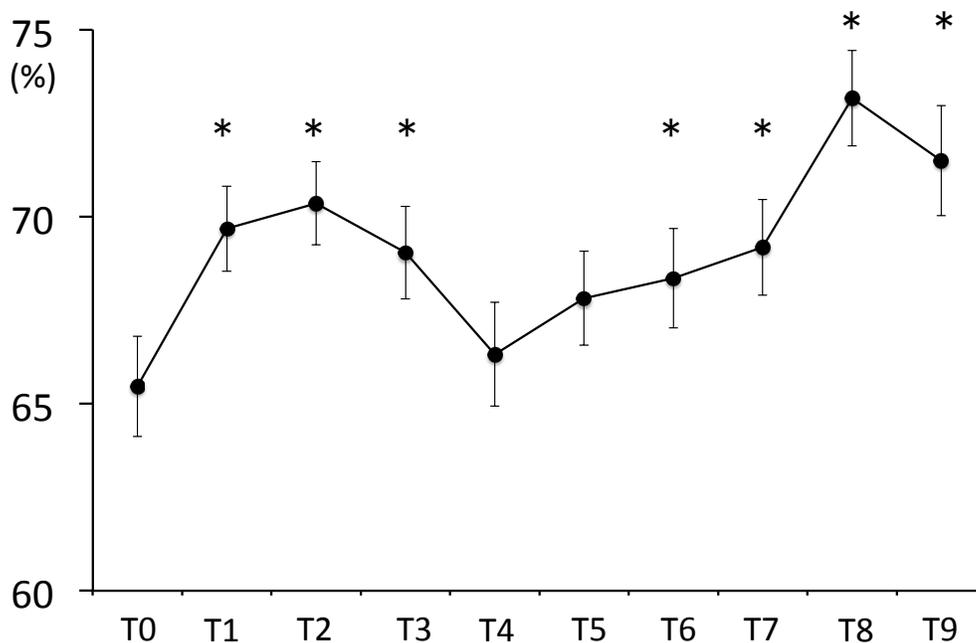


Fig1. rSO₂ of the lower leg mean±SEM, *Significantly increased compared with T0, P<0.05.

S-249.

PILOT STUDY ASSESSING EFFECTIVENESS OF REPLACING MORBIDITY AND MORTALITY CONFERENCES WITH ROOT CAUSE ANALYSIS CONFERENCES

AUTHORS: G. E. Loyd

AFFILIATION: Department of Anesthesiology, University of Florida, College of Medicine Jacksonville, Jacksonville, FL

INTRODUCTION: Morbidity and Mortality Conferences (M&M) has been used for more than 30 years in clinical departments as a technique to improve quality of care¹. In recent years, M&M has been restructured to satisfy the Systems Based Practice competency of the ACGME Outcomes Project^{2,3}. A literature review demonstrates work has been done to enhance M&M conferences to address the competencies of practice-based improvement and systems based practice^{4,5}. We have recently replaced our M&M conference with a Root Cause Analysis (RCA) Conference (as part of our Six Sigma strategy) to create actual improvements in health systems and actual practice. The basics of M&M are still covered in our RCA approach. The goal of this pilot project is to assess effectiveness of the RCA as compared to the M&M and what further analysis is necessary.

METHODS: Following IRB approval, anesthesia faculty, residents, and CRNAs were anonymously surveyed as to the effectiveness of M&M and RCA Conferences they have attended. Each subject was asked to complete a survey with the questions in Figure 1. The questions purposefully targeted witnessed changes as opposed to beliefs of future change that most other studies have utilized in their evaluation of effectiveness of M&M.

The data were analyzed with T-tests (AcaStat, Poinciana, Florida).

RESULTS: Survey response was 29% of physicians and 33% of CRNAs. The results comparing M&M to RCA is in Table 1. RCA means among CRNAs were either equal to or greater than M&M in every category, but none were statistically significant. Among physicians, RCA means also were higher than the M&M in every category with statistically significant differences for “personal practice”, “system knowledge”, and “stated system changes”. The two remaining categories were slightly underpowered to produce statistical significance.

When the scores of a clear CRNA outlier were excluded, the remaining CRNA scores demonstrated an increased difference between the means of M&M and RCA but not enough to produce any statistical significance.

CONCLUSIONS: Replacing M&M with RCA had unknown effect on practice and system change. All M&M and RCA conferences were presented by physicians with both physicians and CRNAs in attendance. The results indicate that RCA conferences were better at addressing practice improvement and systems based practice for physicians and is at least as good as M&M for CRNAs in those areas. The last question posed was made for some internal validity as none of the M&M presentations made any indication of system changes whereas system changes are the last part of every RCA presentation. Physicians appropriately scored the last question negative for M&M and positively for RCA. CRNA responders did not identify this difference, which raises the possibility that the CRNAs did not understand the question or recognize difference.

REFERENCES:

1. J Grad Med Educ. 2012 Dec;4(4):438-44.
2. J Surg Educ. 2011 Jul-Aug;68(4):303-8.
3. Crit Care Med. 2014 Oct;42(10):2306-8.
4. Anesth Analg. 2014 Jul;119(1):122-36.
5. J Surg Educ. 2010 Nov-Dec;67(6):400-5.

Please complete items 1-5 if you have attended at least one M&M conference in the past 6 months.

1	In the past 6 months, M&M has improved my permanent knowledge.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
2	In the past 6 months, M&M has changed my practice.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
3	In the past 6 months, M&M improved the knowledge about the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
4	In the past 6 months, M&M has changed the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
5	In the past 6 months, M&M has stated what changes were made within the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree

Please complete items 6-10 if you have attended at least one 6 Sigma Conference in the past 6 months.

6	In the past 6 months, 6 Sigma Conference has improved my permanent knowledge.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
7	In the past 6 months, 6 Sigma Conference has changed my practice.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
8	In the past 6 months, 6 Sigma Conference improved the knowledge about the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
9	In the past 6 months, 6 Sigma Conference has changed the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree
10	In the past 6 months, 6 Sigma Conference has stated what changes were made within the system in which I work.	Totally Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Totally Agree

	CRNAs (n=9)	M&M	RCA	p (2 tailed)
Increased personal medical knowledge		3.78 ±0.83	3.78 ±0.67	1.000
Change in personal practice		3.33 ±1.12	3.56 ±0.73	0.624
Increased knowledge of the system		3.22 ±0.97	3.78 ±0.97	0.243
Witnessed system change		3.22 ±1.09	3.44 ±0.73	0.618
System change stated		3.11 ±1.27	3.11 ±0.78	1.000
Physicians (n=10)				
Increased personal medical knowledge		3.90 ±0.57	4.40 ±0.7	0.096
Change in personal practice		3.30 ±0.67	4.20 ±0.42	0.002*
Increased knowledge of the system		3.60 ±1.17	4.70 ±0.48	0.013*
Witnessed system change		2.80 ±0.92	3.60 ±0.84	0.058
System change stated		2.40 ±1.08	3.80 ±1.03	0.008*

* = p<0.05

S-250.**RESPIRATORY RATE PROVIDES A POOR ASSESSMENT OF RESPIRATORY STATUS DURING AND AFTER UPPER ENDOSCOPY PROCEDURES****AUTHORS:** D. M. Mathews¹, K. Holley², J. Brayonov³**AFFILIATION:** ¹Anesthesiology, University of Vermont, Burlington, VT, ²Anesthesiology, University of Vermont College of Medicine, Burlington, VT, ³Research, Respiratory Motion, Inc., Morgantown, MA

INTRODUCTION: Millions of endoscopic procedures are performed annually in the US under conscious sedation, are considered generally safe and often performed in an outpatient setting. This increases the need for careful monitoring of respiratory status as an anesthesiologist may not be available to address unexpected airway compromise. Current clinical practice relies on pulse oximetry to detect hypoxia; unfortunately, oximetry is rarely able to detect early signs of hypoventilation, by the time an alarm is triggered, respiratory compromise may be significant. While capnography works in stable intubated patients, its utility during endoscopic procedures has been repeatedly questioned. Previous data has shown that using an impedance-based respiratory volume monitor (RVM) that, while MV is a function of RR ($MV=TV*RR$), RR is a poor proxy for MV. Over 80% of all Low MV (LMV) episodes ($MV < 40\% MV_{BASELINE}$) occur at RRs > 6 .¹ In this study the RVM was utilized to identify the incidence of LVM and associated respiratory rates during both the endoscopic procedure and the post-procedure recovery period.

METHODS: An impedance based RVM (ExSpirom, Respiratory Motion, Inc., Waltham, MA) used three thoracic electrodes to collect continuous respiratory data from 51 patients (age: 54 ± 5 yrs, BMI: 28 ± 2 kg/m²) undergoing upper endoscopic procedures. Baseline MV ($MV_{BASELINE}$) for each patient was defined during a 30-sec period

of quiet spontaneous ventilation prior to sedation. MV, TV & RR were calculated from 30-second respiratory segments. All patients were sedated with propofol with or without other agents (fentanyl, ketamine) with anesthesia monitoring including capnography. The predictive value of RR as a measure of inadequate ventilation ($LMV < 40\% MV_{BASELINE}$) was evaluated by comparing periods of LMV and low RR (< 6 b/min). The incidence of hypoventilation in the intra- and post-procedure periods was compared.

RESULTS: During the procedure, while anesthesia staff managed patients using capnography-based RR monitoring, the RVM recorded 323 LMV episodes in the 51 patients, (8.0% of all intra-procedure recordings (Fig. 1A). By comparison, the incidence of LMV in the post-procedure recovery period was 3.7%, corresponding to 140 LMV measurements (Fig. 1B). Across both the intra- and post-procedure periods, low RR was a poor predictor of LMV with a sensitivity $< 20\%$ (Fig. 2). Furthermore, more than half of all low RR events during and after the procedure were associated with adequate MV, indicating that patients were adequately ventilated at that time.

CONCLUSIONS: Despite the presence of anesthesia staff and use of capnography monitoring equipment, the incidence of low MV during endoscopic procedures was significant. Furthermore, over 80% of all low MV episodes would not have triggered a low RR alarm. This suggests that with current respiratory monitoring equipment, the majority of transient respiratory depression events remain undetected. RVM has the potential to provide quantitative data in the peri-procedure periods, help direct anesthesia care during endoscopic procedures and improve patient safety.

REFERENCES:

1. Holley, et al. IARS 2014

S-251.

PREDICTING POSTOPERATIVE HYPOTHERMIA AND TEMPERATURE CHANGE: IDENTIFYING PATIENT AND SURGICAL FACTORS

AUTHORS: O. Visnjevac¹, A. A. Hassani¹, R. Kocz¹, E. Jensen¹, J. W. Grande², N. D. Nader¹

AFFILIATION: ¹Anesthesiology, University at Buffalo, Buffalo, NY, ²Anesthesiology, Kaleida Health, Buffalo, NY

INTRODUCTION: Perioperative hypothermia (<36°C) has been associated with a number of complications and active patient warming has been found to be beneficial, but there is a paucity of predictive risk models.¹⁻⁷ We hypothesized a BMI:BSA ratio would be a useful predictive index for postoperative hypothermia.

METHODS: A retrospective review of perioperative temperature change was undertaken to assess the utility of a BMI:BSA ratio as a predictive index. The predictive value of other patient and surgical factors were also analyzed. Case information was obtained for all consecutive surgeries at 3 hospitals over a 2-year period and data for 15,644 adult procedures was analyzed. Univariate and multivariate analyses were utilized in a stepwise fashion to identify significant variables contributing to postoperative hypothermia and the degree of temperature change.

RESULTS: BMI:BSA was not found to be a clinically significant predictive index for perioperative hypothermia, but preoperative hypothermia was (OR 4.75, 95% CI 4.22-5.35, p<0.00001, Table 1).

CONCLUSIONS: BMI:BSA appears to be a poor predictive index for postoperative hypothermia. Preoperative hypothermia was the most significant factor associated with postoperative hypothermia (OR 4.75). In a time when patient satisfaction, safety, and healthcare reimbursement are tied to quality measures such as postoperative hypothermia, these data suggest that (1) it may be warranted to postpone elective procedures for patients with preoperative hypothermia and (2) future prospective studies focused on preoperative warming may yield outcomes with the greatest impact on prevention of postoperative hypothermia.

REFERENCES:

1. Anesthesiology. 1997 Dec;87(6):1318-23.
2. Best Pract Res Clin Anaesthesiol. 2008 Dec;22(4):645-57.
3. Acta Biomed. 2007 Dec;78(3):163-9.
4. Anesth Analg. 2012 Nov;115(5):1204-11.
5. Anaesthesia. 2012 Dec;67(12):1364-9.
6. Anesth Analg 1995;80:562-7
7. Anesthesiology 2001; 95:18-21

Table 1: Multivariate Logistic Regression for Patient and Surgical Factors Predicting Hypothermia

Variable	Odds Ratio	95% C.I.	p-value
BMI:BSA	1.01	0.99-1.02	0.36
General Anesthesia	1.06	0.92-1.21	0.43
Intraoperative IV Acetaminophen Use	0.98	0.86-1.12	0.79
Preoperative Hypothermia	4.75	4.22-5.35	<0.00001
Laparoscopic Surgery	0.57	0.29-1.14	0.11
Open Cavity	0.59	0.29-1.20	0.15
Total OR Time (minutes)	1.0006	1.00002-1.00114	0.04

S-252.

COGNITIVE MECHANISMS OF HOW NOISE INDUCES FATIGUE: A FACTOR ANALYSIS

AUTHORS: R. R. McNeer¹, C. L. Bennett², R. Dudaryk¹

AFFILIATION: ¹Anesthesiology, University of Miami Miller School of Medicine, Miami, FL, ²Music Engineering Technology, University of Miami, Coral Gables, FL

INTRODUCTION: We recently reported the results of a simulation experiment that showed operating room noise increases both perceived task load and fatigue in anesthesiology residents using two validated psychometric instruments, NASA task load assessment (TLX) and Swedish Occupational Fatigue Inventory (SOFI) (Figs 1 and 2). According to cognitive load theory¹, fatigue results when cognitive load exceeds a cognitive capacity limit (Fig 3). Here, we hypothesized that noise induces perceived fatigue by increasing cognitive load rather than decreasing the capacity limit. To test this, principle component analysis (PCA) was performed to extract components from the combined NASA-TLX and SOFI dataset. Extraction of a single component would support our hypothesis. Next, partial confirmatory factor analysis (pCFA)² was performed to reveal underlying structure or inter-variable relationships in the dataset. The results inform the decision of whether a future confirmatory study and collection of a new dataset is warranted.

METHODS: PCA was performed on a dataset combining cognitive items from NASA-TLX and SOFI responses. Significant principle components were extracted. Partial CFA was performed using Maximum Likelihood extraction to obtain KMO, Bartlett's and Goodness-of-fit test results. The following fit indices were calculated: Bentler-Bonett Normed Fit Index (NFI), Tucker-Lewis

Index (TLI), Bentler's Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), standardized root mean square residual (SRMR), and non-salient loading distribution (NSLD). Both PCA and pCFA analyses were performed using IBM SPSS.

RESULTS: Three significant components were extracted using PCA (Fig 4) with the first and second components loaded with all SOFI and four NASA-TLX items, respectively, and moderately correlated (R²=0.213). The 'Performance' NASA-TLX item was loaded itself into a third component. Partial CFA yielded KMO and Bartlett's tests and Goodness-of-fit test results are shown in Figure. These results were used to calculate NFI (0.94), TLI (0.96), CFI (0.99), RMSEA (0.068), SRMR (0.033) and NSLD (P=0.122), all considered good fit except NFI and RMSEA (Table 1). Overall, these indices indicate sufficiently good fit.

CONCLUSIONS: Cognitive load theory posits that fatigue is generated when cognitive load surpasses the cognitive capacity limit. If noise generates fatigue by way of increasing load, then subjective task load and fatigue should have a high positive correlation. Instead, our results demonstrate a low correlation that is almost orthogonal. Since we formerly showed that noise significantly increased both task load and fatigue, this low correlation suggests that noise can increase cognitive load and decrease cognitive capacity but not necessarily in the same individual or at the same time. Based on our pCFA results, we plan to conduct a confirmatory study.

REFERENCES:

1. Cognitive Load Measurement as a Means to Advance Cognitive Load Theory, Educ Psychol 2003; 38:63-71.
2. Partial Confirmatory Factor Analysis: Described and Illustrated on the NEO-PI-R, J Personality Assess 2009; 91:40-47.

	Not at all		To a very high degree				
	0	1	2	3	4	5	6
Lack of energy							
Worn out							
Spent							
Drained							
Overworked							
Physical exertion							
Palpitations							
Sweaty							
Out of breath							
Breathing heavily							
Physical discomfort							
Tense muscles							
Numbness							
Stiff joint							
Aching							
Lack of motivation							
Lack of concern							
Passive							
Indifferent							
Uninterested							
Sleepiness							
Falling asleep							
Drowsy							
Yawning							
Sleepy							

Figure 1. Swedish Occupational Fatigue Inventory psychometric instrument.

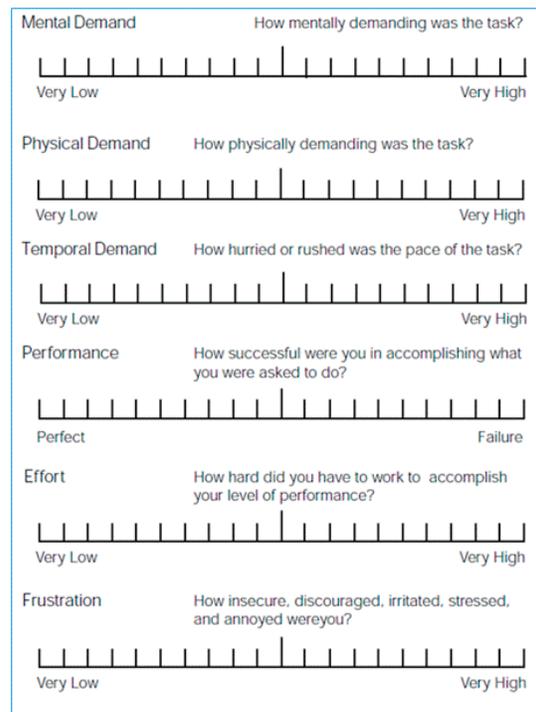


Figure 2. NASA Task Load Assessment psychometric instrument.

S-252 • continued

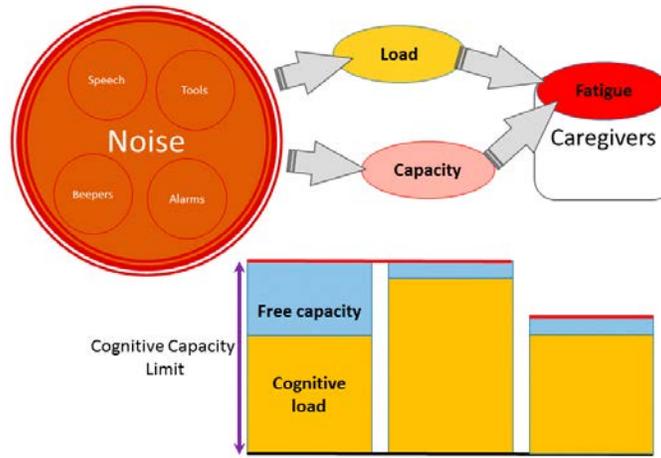


Figure 3. Cognitive load theory hypothesis of how noise can generate fatigue by increasing cognitive load or decreasing cognitive capacity limit.

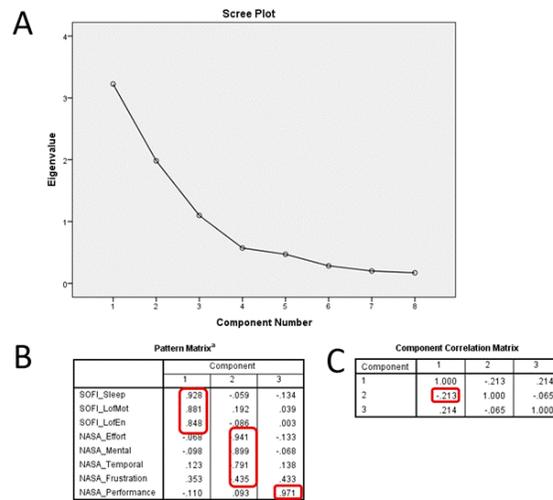


Figure 4. Principle Component Analysis of fatigue and task load psychometric items combined into a single dataset. (A) is the scree plot, (B) is the pattern matrix, and (C) shows the extracted principle component correlations.

KMO and Bartlett's Test			Goodness-of-fit Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.681	Chi-Square	df	Sig.
Bartlett's Test of Sphericity	Approx. Chi-Square	133.993	8.191	7	.316
	df	28			
	Sig.	.000			

NFI (>0.95)	TLI (>0.95)	CFI (>0.95)	RMSEA (<0.060)	SRMR (<0.08)	NSLD (>0.05)
0.94	0.96	0.99	0.068	0.033	P=0.122

Figure 5. Schematic showing the general layout of the sound sources incorporated in the quadraphonic soundscape relative to the subject, mannequin, workstation and speakers.

S-253.

PATIENT EDUCATION MATERIALS FROM 23 NATIONAL ANESTHESIA ASSOCIATIONS: AVAILABILITY, READABILITY AND LINGUISTIC MEASURES.

AUTHORS: D. Govender, E. Jacobsohn, D. Parveen, S. M. Kereliuk, A. J. Villafranca

AFFILIATION: Anesthesiology, University of Manitoba, Winnipeg, MB, Canada

INTRODUCTION: Patients must be informed for clinical consent to be valid. 59% of US preoperative patients search for medical information online¹. National anesthesiology associations (NAAs) are credible sources of patient education materials (PEM) regarding anesthesiology. To promote valid consent PEMs should be understandable. PEMs from US anesthesiology associations have poor quantitative readability^{2,3}. However, the readability of PEMs in other countries is unknown, and other important linguistic predictors of comprehension remain unexamined. Further, PEM text has not been divided thematically for analysis, which would provide theme specific estimates. Therefore, we examined the availability, readability, and linguistics of PEMs from 23 NAAs.

METHODS: We collected PEMs from the websites of NAAs in CAN, US, UK, AUS/NZ, and SA. Text from PEMs was compiled thematically by 2 technicians. Inter-rater reliability of document classification was evaluated using data from 523 sentences. PEM linguistic measures were calculated using Coh-Metrix (v. 3.0, Memphis, USA), with statistical analysis done using SAS (v. 9.2, Carey, USA). We evaluated the proportion of PEMs meeting linguistic standards⁴ associated with comprehension in the majority of adults (grade 6-8 level). The influence of association/country of origin and text theme on the discrepancy between PEM linguistics and norms was evaluated using MANOVA.

RESULTS: Only 61% of NAAs provided PEMs. Inter-rater reliability was very good ($\kappa=0.89$, CI=0.87-0.93). A large number of PEMs did not meet linguistic norms (Fig. 1), with some PEM linguistics being closer to grade 12/college level on average (Fig 2.). Overall, discrepancy between PEM linguistics and norms was influenced by association/country of origin and text theme (both $p<0.001$), with association/country affecting the discrepancies of all linguistics ($p<0.05$) and text theme affecting all but the sentence length discrepancy ($p=0.3$). Contrasts revealed a number of intergroup differences, including more acceptable linguistics for the UK, and poorer linguistics for text explaining the roles of different perioperative professionals.

CONCLUSIONS: Few NAAs provide PEMs and even fewer provide ones with appropriate linguistics. Many PEMs involve words that are unfamiliar, vague, ambiguous, and lengthy, with text that uses inconsistent terminology. This is a particular problem with text explaining roles of perioperative professionals. To inform patients and promote valid consent, PEMs must be modified to meet linguistic norms.

REFERENCES:

1. Health Online. Pew Research Center. 2013. p.4.
2. Hansberry, DR. Laryngoscope. 2014. 124(2):405-412.
3. Chinn, L. Open Anesthesiol J. 2014. 4:1-7.
4. McNamara, D. Automated Evaluation of Text and Discourse with Coh-Metrix. 2014.

Figure 1. Congruence with gr. 6-8 norms

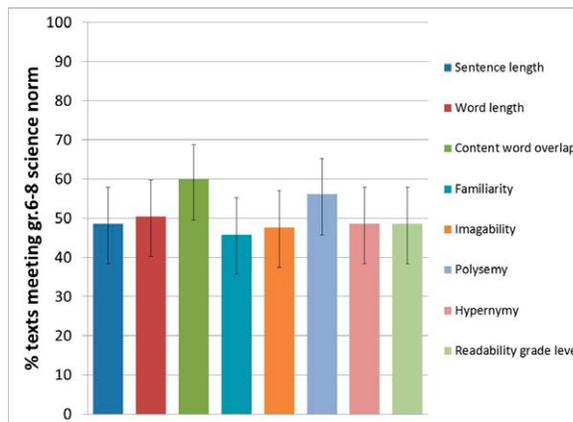
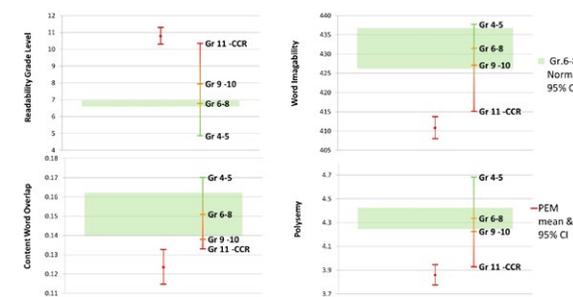


Figure 2. PEM linguistics vs. norms



S-254.

USING QUALITY IMPROVEMENT METHODS TO DEVELOP A POSTOPERATIVE HANDOFF PROTOCOL

AUTHORS: J. Tan¹, S. Carson², M. Templonuevo², S. Meyers², R. Purugganan¹, J. R. Ruiz¹

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, University of Texas MD Anderson Cancer Center, Houston, TX, ²Division of Nursing - Post Anesthesia Care Unit, University of Texas MD Anderson Cancer Center, Houston, TX

INTRODUCTION: Handoffs can be defined as the transition of care of patients from one team of caregivers to another within the same or between different institutional environments. They are a potential source of communication errors with resulting risks to patient safety. Considerable research has been conducted relating to patient transfers from the operating room (OR) to the post anesthetic care unit (PACU), including the use of handoff protocols¹. However, the successful development and implementation of such handoff protocols rely on the use of sound quality improvement principles, which are rarely described.

We aimed to create a handoff protocol for the transfer of patients from the OR to the PACU in a large academic institution.

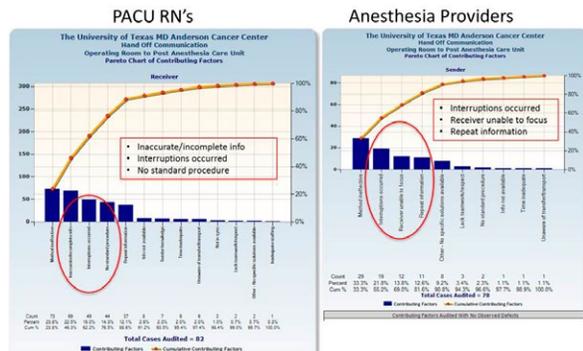
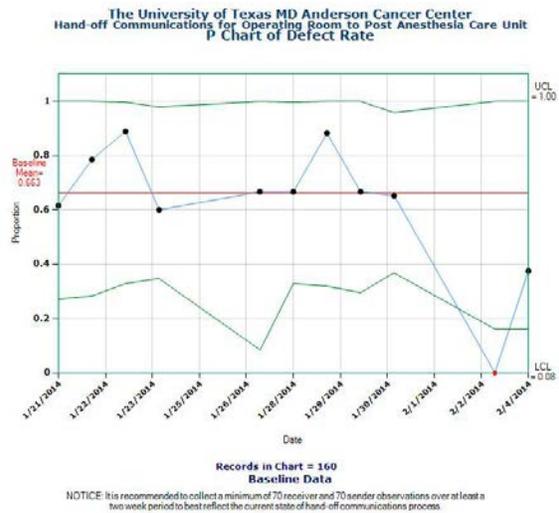
METHODS: Two faculty physician anesthesiologists, a PACU nurse manager, and a certified registered nurse anesthetist (CRNA) completed an institutional quality improvement course. Leadership support from PACU nursing and anesthesiology was obtained. Using the Joint Commission’s online Handoff Tool,² baseline data of handoff “defects” was collected. The data were organized into a p-chart and Pareto chart which were displayed to all providers. Fishbone diagrams and flow charts were created to elucidate causes of suboptimal handoffs and determine points for interventions.

RESULTS: The p-chart calculated a baseline handoff “defect” rate of 66.3% (Figure 1). The Pareto chart (Figure 2) outlined the main contributing factors to poor handoffs e.g. “interruptions occurred”, “inaccurate info”, “no standard procedure”, which were consistent with the literature. These results guided the creation of a protocol with the following features: a flow diagram outlining the overall handoff process, a step by step guide for each participant (PACU RN, Anesthesia Provider, Surgeon), environment changes (minimal interruptions, quiet during handoff) and standardized checklists to guide providers during their discussion of patient, anesthetic and surgical concerns.

CONCLUSIONS: This project demonstrates that quality improvement tools can guide the development of a new handoff protocol which aims to improve patient safety through better communication during critical postoperative patient handoffs.

REFERENCES:

1. European Journal of Anaesthesiology. 30(5):229-42. 2013.
2. Joint Commission Center for Transforming Healthcare. 2014.



S-255.

DOES ULTRASOUND GUIDANCE REDUCE COMPLICATIONS FROM CENTRAL LINE PLACEMENT

AUTHORS: G. A. Nuttall¹, D. Brown², D. J. Kor², J. T. Mueller³, J. A. Cooley¹, K. M. Langford¹, K. J. Ojalvo¹

AFFILIATION: ¹Anesthesiology, Mayo Clinic College of Medicine, Rochester, MN, ²Anesthesiology, Mayo Clinic, Rochester, MN, ³Anesthesiology, Mayo Clinic Arizona, Phoenix, AZ

INTRODUCTION: Central venous catheters (CVC) are frequently placed in the operating room for critically ill patients who require monitoring of fluid status and hemodynamics. Several complications are known to be associated with central venous catheter placement.^{1,2} In 2010, our institution mandated that ultrasound guidance (US) and pressure transduction be used in all central line placements. The primary aim of this retrospective study is to identify the impact of this policy change on CVC placement-related complications in the operating room environment.

METHODS: Analysis was completed on charts of patients with CVC placement in the operating room at Mayo Clinic in Rochester, MN during a 6 year period between 2006 and 2012. Data were collected from each 'line form' including date, time, site, type of line, observations, US usage, and occurrence of complications. Additional chart reviews were done to collect patient specific information. Multiple logistic regression analysis were performed using a single observation for each patient, with the dependent variable indicating whether or not the patient experienced a placement-related complication.

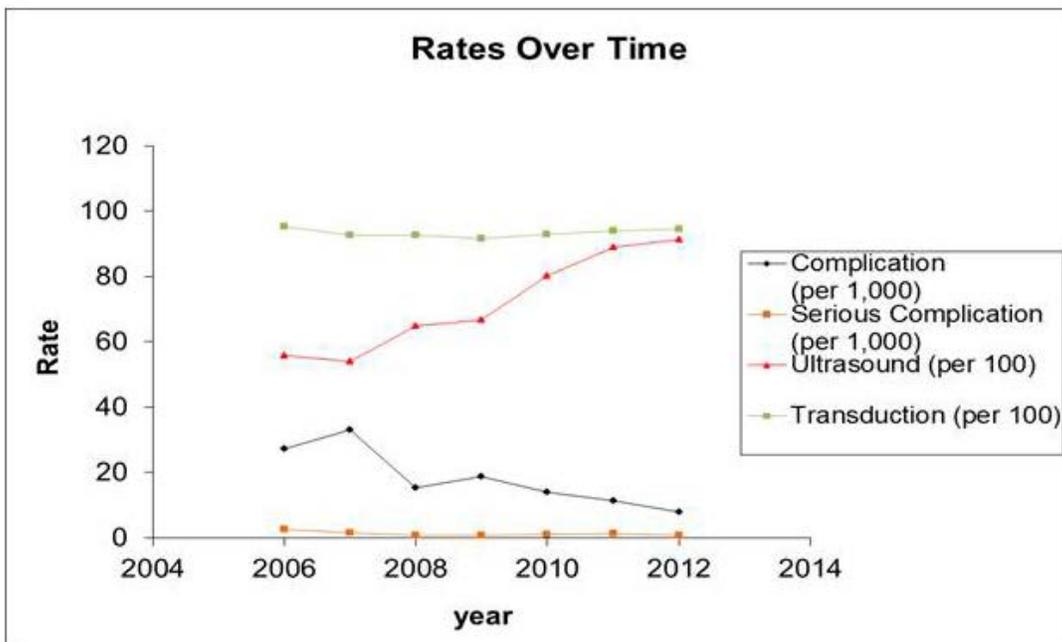
RESULTS: A total of 27,933 CVC lines were placed in 22,816 patients. The overall rate of US use increased from 55.9% in 2006 to 91.4% in 2012. There were a total of 454 placement-related complications (16.3 complications per 1000 lines, 95% C.I. 14.8 to 17.7 per 1000 lines) observed in 445 patients. Female gender (OR=1.44, p<0.001) and high ASA status (OR=1.38, p=0.032) were found to be associated with an increased risk for complications. The use of US did not result in a statistically significant reduction in the rate of complications (OR = , p =), but pressure transduction did decrease the rate of severe complications (arterial cannulation, hemothorax, pneumothorax and death) (OR=0.30, p=0.009). Pressure transduction prevented arterial cannulation in 20 cases with 14 of the patients having US guidance. The overall rate of complications declined from 2.7% in 2006 to 0.8% in 2012 (Figure 1).

CONCLUSIONS: While not statistically significant, the trend shows improvement in patient safety with the implementation of mandatory US use during CVC placement. Use of CVC transduction prior to cannulation reduced the rate of serious complications.

REFERENCES:

1. National Institute for Clinical Excellence. Guidance on the use of ultrasound locating devices for placement of central venous catheters. <http://publications.nice.org.uk/guidance-on-the-use-of-ultrasound-locating-devices-for-placing-central-venous-catheters-ta49>. Retrieved April 14, 2013.
2. Practice Guidelines for Central Venous Access: A report of the American Society of Anesthesiologist task force on central venous Access. *Anesthesiology* 2012; 116:539-73.

Figure 1: Serious complications = arterial cannulation, hemothorax, pneumothorax and death.



S-256.

QUANTIFICATION OF THE SEVERITY AND IMPACT OF SYSTEM VULNERABILITIES IN THE PERIOPERATIVE MEDICATION DELIVERY SYSTEM: COMPARING SELF-FILLED AND PREFILLED MEDICATION SYRINGES

AUTHORS: J. Abernathy¹, Y. Yang², C. Fortier³, J. Rivera⁴, W. R. Hand¹

AFFILIATION: ¹Anesthesia and Perioperative Medicine, Medical University of South Carolina, Charleston, SC, ²Industrial Engineering, Clemson University, Clemson University, SC, ³Pharmacy, Massachusetts General Hospital, Boston, MA, ⁴Human Factors Engineering, Childrens Hospital of Wisconsin, Madison, WI

INTRODUCTION: It is estimated that one medication error occurs in every 133 medication administrations in the operating room with the most common errors including incorrect doses (37.3%), substitutions (23.5), and omissions (19.6).¹ Prefilled syringes (PFS) have the potential to improve medication safety through enhanced labeling, standardization, and extended beyond use dating. But, little evidence exists that PFS contribute to a safer medication delivery system. We tested the hypothesis that the medication delivery system in an operating room could be characterized and described using human factors techniques. Specifically, we hypothesized that system vulnerabilities (SV) could be scored, ranked and used to define which system is safer.

METHODS: A work system analysis (WSA) of medication dispensing and delivery was conducted by observing pharmacists and anesthesia providers during preparation and administration of anesthetics in two groups: 1) where providers used exclusively self-filled syringes (SFS) and 2) where providers used exclusively PFS. A process map describing the medication management process before, during, and after surgery was created for both groups. Potential SV were identified from the process maps. Pharmacists and anesthesia providers participated in a proactive risk assessment focus group to score each SV according to frequency of occurrence, severity to patient if an error occurs, and disruptiveness of providers' workflow. (Table 1) These scores were multiplied together to achieve an overall risk score for each SV. SVs were then ranked according to this score. An aggregate score of 9 or greater was determined to be dangerous.

RESULTS: The WSA process maps identified 21 SVs when using SFS compared to only 8 SVs when using PFS. The mean risk score

for SFS and PFS were 15.7 and 10, respectively. (Figure 1) Fifteen SVs in the SFS process had a severity score above 9 compared to only 4 SV in the PFS process. For the SFS, the highest risks were related to the complex medication preparation process, the pharmacist's management of variable vial products, and the difficulties to ensure the correct medication name on the vial packaging. For the PFS, the highest risk was related to the increased demand on pharmacists, as the PFS required more frequent checks of expiration dates. When the same SV existed in the two systems, the PFS SV had a lower severity score compared to SFS.

CONCLUSIONS: A SV is defined as an activity or event that has the potential to reduce safety, efficiency of provider workflow, or increase drug costs and waste. Based on the number and severity of SV identified, PFS decrease the potential for medication errors and patient harm when compared to using SFS. Both SFS and PFS processes need improvement to reduce latent risks in the OR medication delivery system. However, with the implementation of PFS, many of the dangerous SVs identified in the SFS process were removed. Most of the SVs for PFS can be reduced through hospital-wide training using a macroergonomics and user-centered design approach.

REFERENCES:

1. Bmj 2011;343:d554.

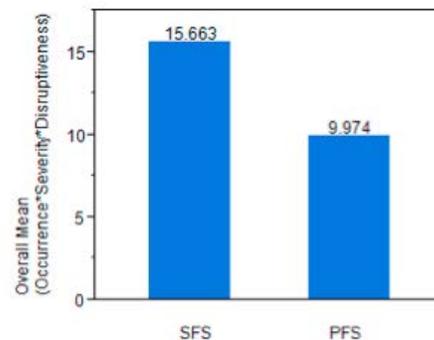


Figure 1: The overall mean risk score of SFS process and PFS process

Table 1: Rating Protocol

Ratings	Occurrence	Severity on Patient	Disruptiveness to Workflow
1	This SV rarely occurs (e.g. 0-3 times per year)	This SV results in no injury to the patient.	This SV has no influence on provider's workflow
2	This SV sometimes occurs (e.g. roughly 1-2 times per month)	This SV results in moderate injury to the patient	This SV results in a slight but recoverable disruption to provider's workflow
3	This SV often occurs (e.g. daily/weekly)	This SV results in major but recoverable injury to the patient	This SV results in a moderate but recoverable disruption to provider's workflow
4	This SV always occurs (e.g. 1-3 times per case)	This SV results in permanent loss of function or catastrophic death of the patient	This SV results in a severe and unrecoverable disruption to provider's workflow

S-257.

THE ASSOCIATION BETWEEN INTRAOPERATIVE PATIENT STATE INDEX AND POSTOPERATIVE COGNITIVE OUTCOMES

AUTHORS: X. Zhang¹, B. Rizvi², A. Shalabi², J. M. Leung²

AFFILIATION: ¹Department of Anesthesia and Intensive care, Zhongshan Hospital, Fudan University, Shanghai, China, ²Department of Anesthesia and Perioperative Care, UCSF, San Francisco, CA

INTRODUCTION: Postoperative delirium (POD) and cognitive dysfunction (POCD) are common in the older surgical population. Some recent studies suggest that deep anesthetic depth may be associated with increased incidence of POD and POCD, but results are inconclusive¹⁻³. Specifically, no study has randomized patients into receiving different anesthetic depths. Therefore, we designed a pilot prospective cohort study to determine the possible range of anesthetic depths for a future randomized controlled trial.

METHODS: The Institutional Review Board approved the study (approval number 13-12510) and all patients gave written informed consent. Inclusion criteria included patients ≥40 years scheduled for noncardiac surgery with an estimated length of hospital stay > 1 day. SEDLine™ monitor was used to measure both the baseline and intraoperative anesthetic depth by way of the patient state index (PSI). PSI is a processed parameter (range 0 - 100) with 25-50 suggested to be an optimal state of hypnosis for general anesthesia⁴. All patients were interviewed pre- and post-operatively up to the first three postoperative days for POD and POCD. Delirium was screened by the Confusion Assessment Method (CAM)⁵. In addition, the CAM-S scoring system was used to measure delirium severity⁶. Cognitive function was measured using word list, verbal fluency, and digit symbol tests. In patients who were not delirious, a decline from preoperative performance of ≥4 points on the word list, or ≥7 points on the verbal fluency or on the digit symbol test was considered a decline and patients with decline in at least two domains were considered meeting criteria for POCD for that day⁷.

RESULTS: Of the 39 patients recruited, 5 were excluded because of dropout or error of SEDLine™ monitor. Three patients (8.8%) had POD, 11 (32.4%) showed features of delirium (CAM-S>0). 13/31 (41.9%) of non-delirious patients had POCD. The total time during which PSI lower than 25 was longer in patients with features of delirium (Fig.1). Median and interquartile ranges of DHT in the group with CAM-S>0 were significantly longer than those with CAM-S=0 [111.1 (77.55 to 176.9) vs. 10.98 (2.01 to 46.27), P=0.0051] (Fig.2). The clinical characteristics of patients with vs. without delirium symptoms were not different (Table1). The duration of DHT in groups with vs. without POCD was not significantly different (Fig.3).

CONCLUSIONS: Intraoperative PSI trend varied greatly among patients who underwent a variety of surgical procedures and anesthetics. A larger randomized control trial is necessary to demonstrate whether deep hypnotic level as measured by low PSI level is associated with POD or POCD when compared to higher PSI level.

REFERENCES:

1. Br J Anaesth. 2013(110):i98-105.
2. Anesth Analg. 2006(103):633-40.
3. J Neurosurg Anesthesiol. 2011(23):12-7.
4. Anesthesiology. 2001(97):82-9.
5. Ann Intern Med. 1990(113):941-48.
6. Ann Intern Med. 2014(160):526-33.
7. Am J Geriatr Psychiatry. 2007(15): 50-9.

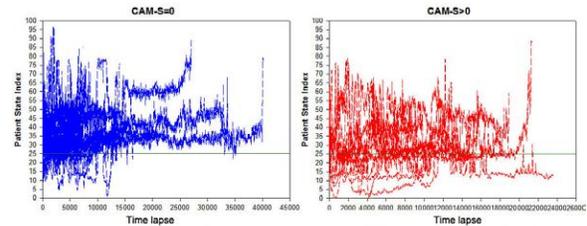


Fig.1 PSI trends for patients with vs. without presence of delirium features. CAM-S: Confusion Assessment Method Score. Transverse line stands for PSI=25, the lower range value of PSI scale for optimal hypnosis state in general anesthesia [4].

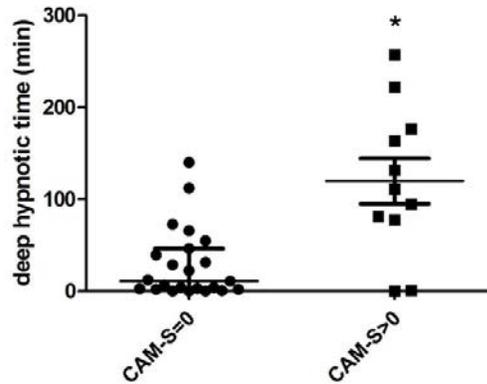


Fig.2 Deep hypnotic time (minutes) in patients with vs. without presence of delirium features. CAMS: Confusion Assessment Method Score. Solid lines represent median and interquartile ranges of deep hypnotic time. *P<0.05 compared with group with CAM-S=0

Table 1 Sample characteristics*

Characteristics	CAM-S=0 (n=23)	CAM-S>0 (n=11)
Age, yr (mean±SD)	62.0 ± 10.0	60.0 ± 6.8
Gender, Male/Female	14/9	4/7
ASA grade, 2/3	12/11	5/6
Educational level, 0/1*	3/20	3/8
Preoperative Pain level (VAS at rest, mean±SD)	3.1±2.9	4.3±3.2
CNS disorder, yes/no	10/13	8/3
Type of anesthesia, General/CGEA	16/7	9/2
Surgical risk, intermediate/high	20/3	10/1
Preoperative TICS (mean±SD)	33.4± 2.5	31.9± 3.8
PSI baseline (mean±SD)	89.3± 5.2	90.6± 6.3

* Data are numbers unless otherwise indicated; "0" represents high school or less, "1" represents incomplete college or above; CGEA: Combined General and Epidural Anesthesia; CNS - central nervous system; PSI - patient state index; SD - standard deviation; TICS- Telephone Interview for Cognitive Status; VAS - visual analog scale

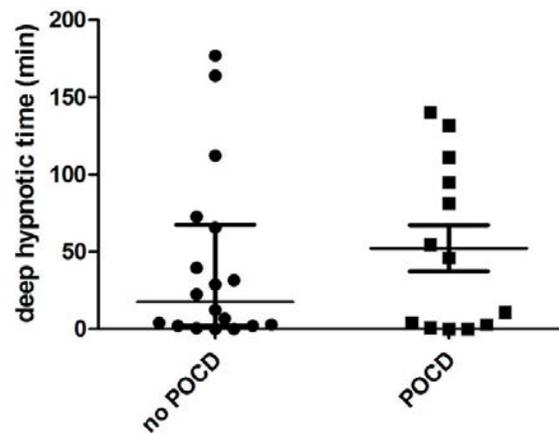


Fig.3 Deep hypnotic time (minutes) in patients with vs. without POCD. POCD: Postoperative Cognitive Dysfunction, solid lines represent median and interquartile ranges of deep hypnotic time

S-258.**IMPACT OF THE USE OF ELECTRONIC DEVICES IN THE OPERATING ROOM**

AUTHORS: D. Torres, B. Valenzuela, C. Yen, C. Rojas, C. Rojas

AFFILIATION: Anesthesiology, Clinica Santa Maria, Santiago, Chile

INTRODUCTION: Electronic devices (ED) in the operating room (OR) has been an issue of continuous debate¹. While in some level they have been considered beneficial, giving almost instant access to solve clinical problems in an emergency, they have also been associated with electronic interference, increased risk of infection and distraction that could eventually lead to patient's harm². We performed a cross-sectional study on all anesthesiologists and anesthesiology residents from Chile regarding rate of knowledge about ED and risk factors for addiction that could lead to distraction in the OR³.

Objectives

Primary: To examine the incidence of ED use among Chilean anesthesiologists and anesthesiology residents in the OR.

Secondary: To describe the frequency of use and type of different ED in the OR.

To contrast opinions concerning risks and benefits of using ED in the OR.

To determine the incidence of "very-high users of ED"

METHODS: We posted an electronic survey (surveymonkey.com) with 26 items, covering 5 topics. The survey was created based on 3 previous surveys^{1,2,3} that were translated to Spanish, adapted to national context and retranslated to English. All items were validated by consensus and by a pilot survey. The survey was emailed to 1315 anesthesiologists and anesthesiology residents with a valid medical practice license in Chile and was available for 4 weeks. Survey responses were transferred to Stata 10.0 software (StataCorp, TX, USA). Descriptive analyses used mean values \pm standard deviation (SD) and proportions for quantitative and qualitative variables, respectively.

RESULTS: Response rate was 18%. Demographic characteristics of the respondents are described on Table 1. All respondents (98%) use at least one ED in the OR, being the cell phone the most prevalent. Most people use them at least 2 times a day and 36% more than 5 times a day. Two thirds of our sample considered ED to be overall beneficial. The most common use for ED was instant messaging (97%) and 34% used it to check/post on social networks, and less than 1% usually shares patient info on these networks.

People are mostly unaware of the risks of electrical interference and/or increased risk of infection with ED (>50% did not know it posed a threat).

Roughly, 72% knew that their attitude towards ED was observed in the OR, but only 14% recognised being distracted by the use of them. Surprisingly, 71% of the polled had actually seen some other colleague distracted in the OR. Consequently, 83% considered distraction to be the principal risk of ED in the OR.

Almost 16% of the polled would be considered 'very high users of ED'

CONCLUSIONS: ED use in the OR is very prevalent, and they are used for different kinds of activities, not only clinical. Somehow, there is some discrepancies regarding self awareness of the risk of distraction and the same risk for other colleagues. A relatively high percentage are considered at risk of addiction and would merit some intervention to prevent distraction from ED use in the OR.

REFERENCES:

1. Perfusion 5: 375, 2011
2. CMAJ 184:1440, 2012
3. J Anesthe Clinic Res 4:e112, 2013

S-259.**OPHTHALMIC SURGERY MORBIDITY AND MORTALITY:1998-MAY 2014 A RETROSPECTIVE STUDY FROM AN EYE HOSPITAL**

AUTHORS: R. C. Cross¹, G. Boyd¹, R. Walters¹, M. Hull¹, J. Taylor¹, J. Skelley¹, M. A. Rozner²

AFFILIATION: ¹Department of Anesthesiology, UAB, Birmingham, AL, ²Anesthesiology, University of Texas MD Anderson Cancer Center, Houston, TX

INTRODUCTION: The purpose of this study was to retrospectively analyze morbidity and mortality(M&M) in patients undergoing ophthalmic surgery. The last M&M study for eye surgery patients was published in 1995 of patients from 1979 to 1988 in Madras, India.¹ No mention was made in it of the prevalence of diabetes, but retinal surgery was associated with 14 times the mortality of non-retinal surgery.

METHODS: Approval from the IRB was obtained for this study. All patients from March 6 1988 to May 12 2014 were reviewed that were coded to have one of three ICDM-9 codes for cardiorespiratory arrest: 997.1, 427.5 and/or 799.1. There were a total of 100,407 patients having surgery during this time period of which 28,061 were diabetic. The records were then reviewed by one of three anesthesiologists(RCC,RRW, MAR) not associated with the anesthetic.

RESULTS: 59 patients were coded with one or more of the above codes. 8 of the 59 were deemed ineligible, usually for pre-existing rather than new onset arrhythmias. Of the 9 patients that died, 8 had IDDM. All 8 had proliferative diabetic retinopathy(PDR) and known renal insufficiency with 6 on dialysis. Type of anesthesia was not related to outcome. The reviewers found the probable causes for the arrest codes were:1. New onset arrhythmia 31% 2. Brainstem anesthesia 23.5% 3. Variety of other causes including presumed cardiac autonomic neuropathy and one case of VAE during air-fluid exchange.

CONCLUSIONS: The current ACC/AHA Guidelines for assessment prior to non-cardiac surgery specifically state that eye surgery is “extremely low risk”² and quote one study³ from the 1960s of what was then considered “major ophthalmic surgery” where 90% were blepharoplasty and cataract procedures. A follow-up study of retinal surgery patients under GA found a 1% incidence of a major adverse coronary event.⁴ This current study reveals a lower incidence, but covers all ophthalmic surgeries and not just vitreo-retinal surgery. The “tripathy” of diabetes, retinopathy and neuropathy and nephropathy⁵ appears to be a significant risk factor for M&M in ophthalmic surgery patients. Approximately 80% of diabetic retinal patients are known to have severe autonomic neuropathy placing them at risk of sudden death.⁶ In addition, diabetic renal failure patients are prone to bradycardia for no apparent reason during GA and surgery and because of their cardiac autonomic neuropathy, they do not respond to atropine.⁷ Diabetic patients have poorer outcomes with CPR⁸, most likely related to their diffuse cerebral microvasculopathy. Despite the long recognized increased perioperative M&M in diabetic surgical patients, the 8 of 9 deaths occurring in PDR patients was striking.

REFERENCES:

1. Ophthalmic Surg Lasers 1995; 26:535-41
2. Circulation 2007; 116:1971-1996
3. Anesth Analg 1980; 59:257
4. Trans Am Ophthalmol Soc 2003; 101:209-16
5. Ophthalmologica 1993; 206:83-8.
6. Int Anesth Clin 2014; 52:118
7. Anesthesiology 1986; 64:283-7
8. Resuscitation 2008; 76:37-42.

Rate of cardiac events by diabetic status

Population	Total #	Cardiac Events	Annual Rate of Occurrence
Diabetic	28,061	31	6.57 per 100,000 surgeries per year
Non-Diabetic	72,346	20	1.64 per 100,000 surgeries per year
All	100,407	51	3.02 per 100,000 surgeries per year

S-260.

USE OF A COMPUTERIZED ALERT TO REDUCE ALARM DISABLING IN THE OPERATING ROOM

AUTHORS: E. Segal¹, L. Toderis², H. Binder³, D. Admon⁴, P. Shleffer⁵

AFFILIATION: ¹Anesthesiology, Intensive Care and Pain Medicine, Assuta Medical Centers, Tel Aviv, Israel, ²Clinical Computing, Division of IT, Assuta Medical Centers, Tel Aviv, Israel, ³clinical Computing, Division of IT, Assuta Medical Centers, Tel Aviv, Israel, ⁴Division of Information Technology, Assuta Medical Centers, Tel Aviv, Israel, ⁵Department of nursing, Assuta Medical Centers, Tel Aviv, Israel

INTRODUCTION: Proper use of alarms is an important patient safety issue. It has been named as the first of 10 technology risks by ECRI in 2013,¹ as well as being one of the IPSG established by the Joint Commission.

Alarms are disabled in the OR for a number of reasons, and clinicians may forget to enable them later on. Eden et al showed that an electronic alert can improve enabling of alarms following separation from cardiopulmonary bypass.² We examined the ability of a computerized alert in the automated anesthesia record to decrease episodes of disabled alarms in the operating room.

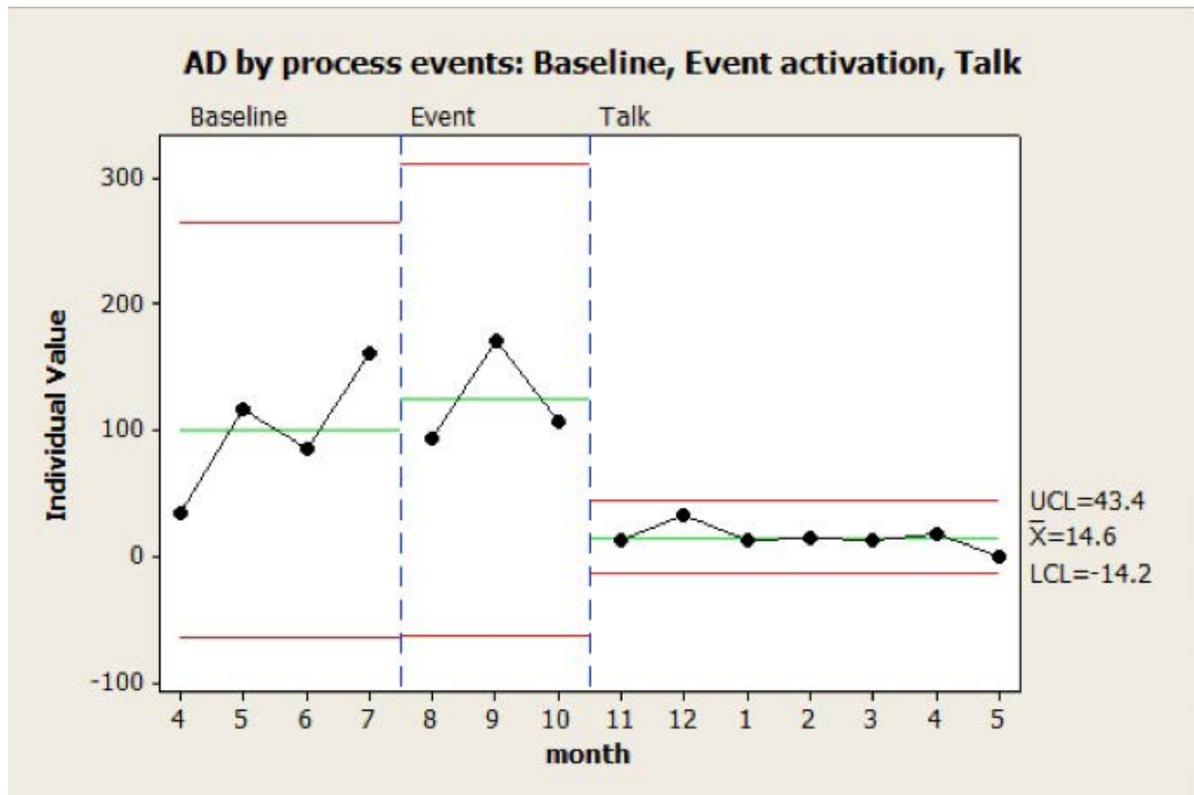
METHODS: In a 16 room OR suite of an elective surgical hospital, which performs 45,000 anesthetics a year, we introduced into the automated record keeper (Metavision, IMDsoft, Tel Aviv, Israel) an electronic alert which notified the anesthesiologist of alarm status if it had been disabled for longer than 10 minutes. We measured the incidents of disabled alarms before the introduction of the alert (baseline), following the introduction (event), and a brief training regarding the importance of not disabling alarms (talk). The data was analyzed using a control chart created with Minitab.

RESULTS: The baseline number of alarm disabling events was between 50-170 episodes/month. The alert itself without training did not impact this, but combined with the training led to complete disappearance of alarm disabling events.

CONCLUSIONS: A computerized alert combined with minimal training can impact clinical behavior and lead to decrease in episodes of disabling alarms by anesthesiologists, thus improving patient safety.

REFERENCES:

1. www.ecri.org/2013hazards
2. Anesthesia Analgesia 2009 108;4:1203-8



S-261.

INCIDENCE AND CAUSES OF PERIOPERATIVE ENDOTRACHEAL REINTUBATION IN THREE CENTERS OVER 10 YEAR PERIOD: A REVIEW OF 198 CASES FROM QUALITY IMPROVEMENT AND PATIENT SAFETY DATABASE

AUTHORS: S. G. Reddy¹, S. Qureshi², R. Banik¹

AFFILIATION: ¹Anesthesiology, Montefiore Medical Center, Bronx, NY, ²Medical School AECOM, AECOM, Bronx, NY

INTRODUCTION: Premature withdrawal of ventilatory support in postsurgical patients can be complicated by respiratory failure requiring reintubation¹. Reintubated postsurgical patients have increased morbidity, longer hospital stays, and ICU admission². Chinachoti and colleagues reported that at least half of the reintubation cases are due to inadequate reversal of neuromuscular blockade³. However, etiologies and risk factors associated with extubation failure are scarce in the literature. The objective of the present study was to estimate incidence and etiologies of perioperative endotracheal reintubation and its adverse outcomes.

METHODS: We retrospectively reviewed electronic patient charts from our electronic patient records after obtaining the reintubation cases of three affiliated medical centers from electronic quality improvement and patient safety (QIPS) database, upon approval from the Institutional Review Board. Patient characteristics such as BMI, COPD, ESRD and ASA status, individual case variables such as emergency nature of the case, ENT or airway surgery, cardi thoracic surgery, and operative time >4 h were evaluated. Also, anesthesia provider characteristics such as age, gender, years of experience, and specialty training were evaluated to determine if any of these variables are related to increased rate of reintubation.

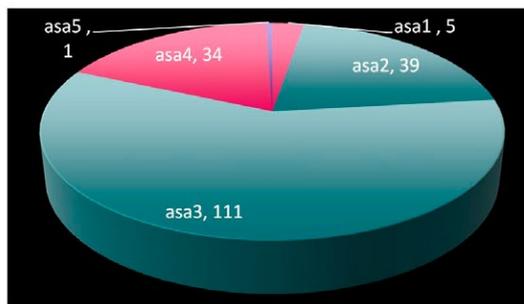
RESULTS: The number of reintubations during 7/2004- 7/ 2014 in perioperative patients who underwent general anesthesia is 198. During this time, a total of 370,215 cases were performed in the three centers. The estimated incidence of reintubation is between 0.5-1 per 1000 patients. The incidence was equally distributed between men and women. Most patients (~75%) who required reintubation were ASA physical status 3-4. There was greater incidence of reintubation among older patient age >60 years (50%). Most reintubations occurred in patients who received general anesthesia for more than three hours (~60%). Patients under 20 years of age had higher reintubation incidence compared to patients between 20-40yrs of age as shown in figure 2.

CONCLUSIONS: The study shows that the incidence of the patient developed respiratory failure requiring reintubation was 0.05-0.1%. Most of these patients were elderly, ASA 3-4, and received anesthesia >3 hours. The study provides empirical evidence for understanding etiologies of extubation failure, which may be used for investigation with stronger study designs.

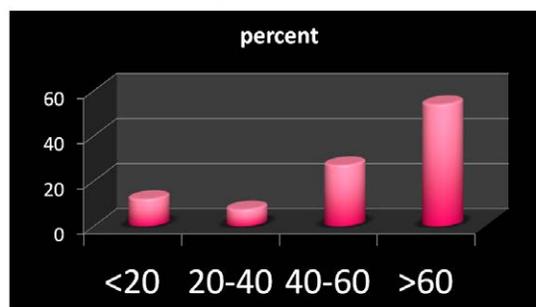
REFERENCES:

1. Chen CZ, Chu YC, Lee CH, Chen CW, Chang HY, Hsiue TR. Factors predicting reintubation after unplanned extubation. *J Formos Med Assoc.* 2002;101(8):542-6.
2. Chinachoti T, Chau-in W, Suraseranivongse S, Kitsampanwong W, Kongrit P. Postoperative reintubation after planned extubation in Thai Anesthesia Incidents Study (THAI Study). *J Med Assoc Thai.* 2005;88 Suppl 7:S84-94.
3. Chinachoti T, Poopitapab S, Buranatrevedhya S, Taratarnkoolwatana K, Werawataganon T, Jantorn P. The Thai Anesthesia Incident Monitoring Study (Thai AIMS) of post anesthetic reintubation: an analysis of 184 incident reports. *J Med Assoc Thai.* 2008;91(11):1706-13.

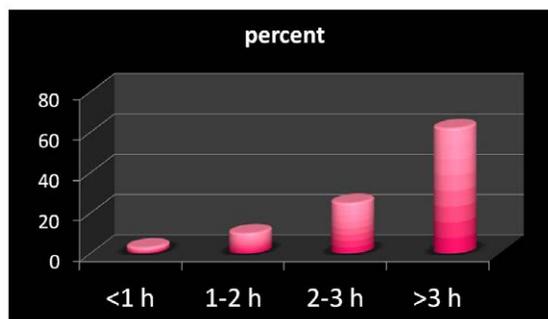
Risk factors for reintubation: ASA physical status Figure 1



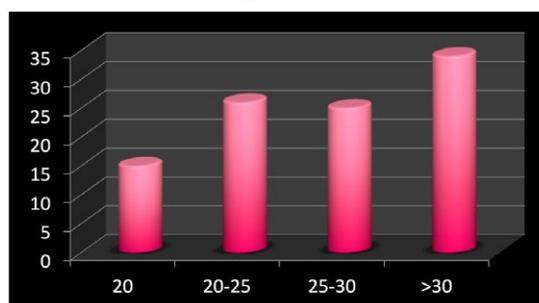
Risk factors for reintubation: age Figure 2



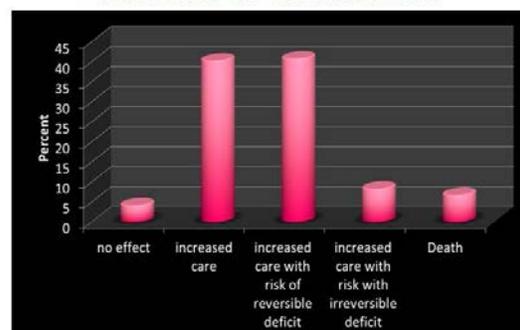
Risk factors for reintubation: operative time: Figure 3



Risk factors for reintubation: patient BMI Figure 4



Outcome of reintubation



S-262.

NON-INVASIVE RESPIRATORY VOLUME MONITORING IN THE POST ANESTHESIA CARE UNIT AND DURING THE FIRST POSTOPERATIVE NIGHT IN OBESE PATIENTS

AUTHORS: R. Schumann¹, A. Gupta¹, D. Ladd², I. Bonney¹, D. Eversole³

AFFILIATION: ¹Anesthesiology, Tufts Medical Center, Boston, MA, ²Research and Development, Respiratory Motion, Inc., Waltham, MA, ³Clinical Research, Respiratory Motion, Waltham, MA

INTRODUCTION: Obese patients have a high prevalence of obstructive sleep apnea (OSA) and are considered at risk for post-operative respiratory complications. Minute ventilation (MV), tidal volume (TV) and respiratory rate (RR) measurements using a non-invasive respiratory volume monitor (RVM; ExSpirom, Respiratory Motion, Inc., Waltham, MA) have been used to risk-stratify patients in the postanesthesia care unit (PACU).¹ In this study the monitoring with the RVM was continued after PACU discharge to include the first post-operative night (PON1) on the general hospital floor (GHF). The goals of the study were to quantify the incidence of Low MV (LMV) and to determine whether RR alone could identify LMV episodes in obese post-operative patients.

METHODS: Following IRB approval and written informed consent, RVM data from obese patients (BMI ≥ 35 kg/m²) undergoing bariatric or orthopedic surgery were collected in the PACU and during PON1. OSA prevalence was assessed using the STOP-Bang questionnaire with a cut-off point of 5 to identify high risk. Adequate MV (AMV) was defined as MV ≥ 40% of predicted MV (MV_{PRED}) based on a composite formula combining ideal body weight and body surface area,² and LMV as MV < 40 % of MV_{PRED}. We tracked AMV and LMV periods of ≥ 30 sec duration and recorded RR, TV during each such period. The paired t-test was used to compare differences in RR and TV between AMV and LMV periods. A p < 0.05 was considered significant. Data are reported as

means ± SEM or ranges.

RESULTS: Ten patients, aged 40 (20–65) years, with a BMI of 44.0 (35.9–59.6) kg/m² were monitored in the PACU and on the GHF for an average of 9.2±1.9 hrs (3.0±0.4 in PACU and 6.1±2.1 hrs on GHF). 3/10 (30%) had a STOP-Bang score ≥ 5. Thirty-two LMV episodes were identified: 0 in 3, 1-6 in 6 and 12 episodes in one patient respectively (Fig.1). The average number of LMV episodes was 3.2 ± 1.1 per patient with an average duration of 181.6 ± 68.6 sec. 1.6 ± 0.7 episodes per patient occurred in the PACU and on the GHF respectively. RR did not decrease significantly between AMV and LMV periods (19.2 ± 1.3 b/min vs 15.5 ± 1.2 b/min, p>0.13) and no LMV episodes were due to a sustained low RR (< 6 b/min). TV significantly decreased during LMV episodes from 518 ± 57 ml to 126 ± 6 ml (p<0.001, Fig 2).

CONCLUSIONS: Despite a STOP-Bang score ≥ 5 in 3 of the 10 patients, a mean of only 3.2 low minute ventilation episodes with a mean duration of 181 seconds were observed in this cohort. LMV episodes were characterized by a significant decrease in TV, but not RR, suggesting that RR monitoring alone may be insufficient to detect inadequate MV in postoperative patients. Future correlation of postoperative opioid and sedative administration with respiratory monitoring to identify patients at risk in a larger cohort is warranted. Postoperative continuous, monitoring of MV has the potential to improve patient safety.

REFERENCES:

1. J Trauma Acute Surg. 2014; 77: S208-S215
2. Schumann et al. ASA 2014

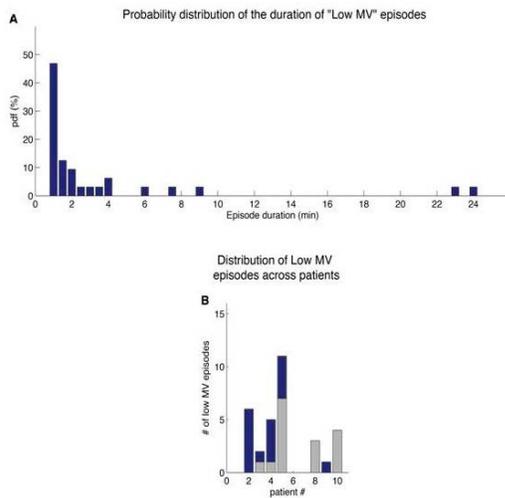


Figure 1: Low MV episodes across the cohort. (A) Probability density function of the likelihood (y-axis) that a Low MV (LMV) episode of a given duration (x-axis) would occur. More than 2/3 (66%) of the LMV episodes are ≤ 2 min. (B) Distribution of LMV episodes of 10 patients in the PACU (grey bars) and on the floor (dark blue).

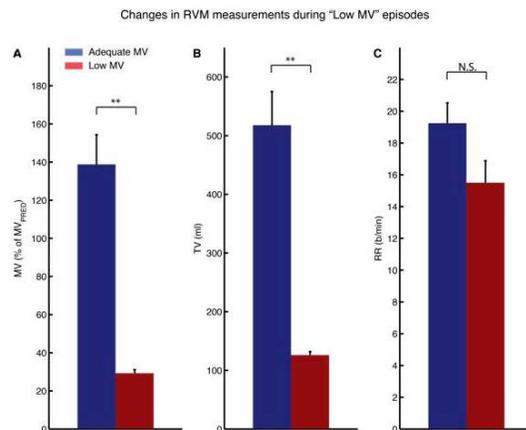


Figure 2: A = Adequate (blue) and Low (red) MV. B = Changes of tidal volume (TV) during AMV and LMV. C = Changes of respiratory rate (RR) during AMV and LMV. ** p < 0.001 and N.S. = not significant, p > 0.05. Whiskers represent SEM.

S-263.

EVALUATION OF THE RELATIONSHIP BETWEEN NON-INVASIVE MINUTE VENTILATION AND END-TIDAL CO₂ IN INTUBATED AND NON-INTUBATED PATIENTS

AUTHORS: C. Voscopoulos¹, C. MacNabb², E. George³

AFFILIATION: ¹Anesthesiology, Duke University, Durham, NC, ²Research, Respiratory Motion, Inc., Waltham, MA, ³Anesthesiology, Massachusetts General Hospital, Boston, MA

INTRODUCTION: Continuous respiratory monitoring is necessary both for intubated & non-intubated patients. Capnography (EtCO₂), an adequate solution for confirming ET tube placement & monitoring adequacy of ventilation in intubated patients, has proven impractical & unreliable in non-intubated patients¹. A novel, noninvasive respiratory volume monitor (RVM) can now provide accurate measurements of minute ventilation (MV), tidal volume & respiratory rate in non-intubated patients. Here we studied the relationship between EtCO₂ & MV in 3 separate groups: intubated surgical patients under general anesthesia (GA), non-intubated surgical patients under spinal anesthesia (SA) & awake, spontaneously breathing volunteers.

METHODS: Continuous RVM data (ExSpirom, Respiratory Motion, Inc., Waltham, MA) were collected from 153 patients in 3 groups. Group 1, 54 patients (age: 65.2 ±12.1 yrs, BMI: 31.2 ± 6.3 kg/m²) undergoing elective joint replacement surgery with GA; Group 2, 60 patients (age: 68.9 ±9.0 yrs, BMI: 30.5±5.8 kg/m²), undergoing joint replacement surgery with SA; Group 3, 39 volunteer subjects (age: 48.5 ±13.8 yrs; BMI: 27.9 ±8.6 kg/m²) coached to breathe at varying RRs for 33 min. In Groups 1 & 2 EtCO₂ data were collected from a ventilator (Draeger Apollo, Andover, MA). In Group 3 EtCO₂ data were collected from a dedicated capnograph (Capnostream 20, Covidien, Mansfield, MA). In Group 1 (GA) EtCO₂ data was collected from the ET tube, in Groups 2 & 3 from a sampling nasal cannula. A Deming regression was used to quantify the relationship (sensitivity) between EtCO₂ & MV for each patient. The slopes of the regression were presented as angles from the x-axis. EtCO₂ sensitivity & mean EtCO₂ values were compared across cohorts using un-paired t-tests.

RESULTS: Across all groups, EtCO₂ was negatively correlated with MV: as MV increased, EtCO₂ generally decreased (Fig 1). The EtCO₂ sensitivity was significantly higher in the intubated patients than in volunteers (-83.5° ±9.7° vs -30.1° ±16.1°, p<0.001, Fig 2A). In the non-intubated patients the sensitivity was not normally distributed & a t-test was not performed, however, it spanned the range of both intubated patients & volunteers (Fig 3). Measured EtCO₂ values were systematically higher in Group 1 than Groups 2 & 3 (37.2 ±4.4mmHg v 23.0 ±5.2 mmHg v 31.0 ±4.0 mmHg, respectively, p<0.001, Fig 2B). EtCO₂ measurements were normally distributed in all 3 groups (Fig 4).

CONCLUSIONS: Our results show that EtCO₂ is suboptimal for monitoring non-intubated patients, both lacking adequate sensitivity to changes in MV & introducing measurement bias when collected via a nasal cannula. The systematic underestimation of EtCO₂, due to measurement bias is compounded by an additional time lag between the onset of respiratory compromise & EtCO₂ changes. The inaccuracy & time lag in EtCO₂ reporting can compromise patient safety. Given the risks present in delayed reporting of respiratory status & availability of direct respiratory monitoring via RVM, the use of RMV monitoring should be considered over secondary respiratory measures (EtCO₂) in this patient population.

REFERENCES:

1. Van Loon K, A&A 2014;119

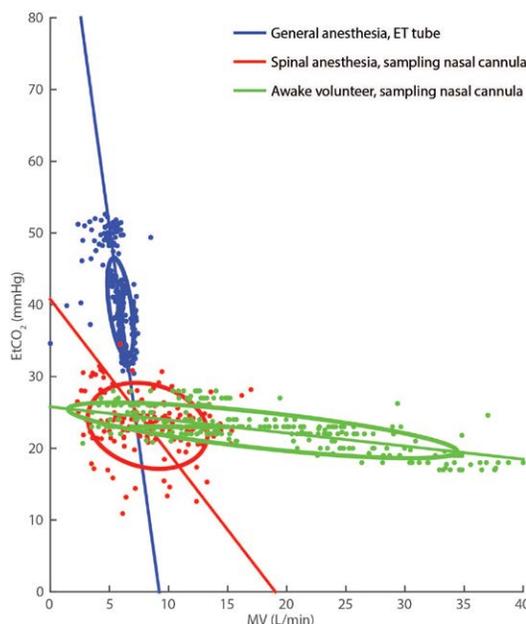


Figure 1: Example correlations between MV and EtCO₂ in anesthetized and awake patients. Each data point corresponds to a single 30-sec measurement pair (MV and EtCO₂) and the line and confidence ellipse show the best-fit (Deming regression) +/- 1 SD to the data. Steep lines (with slope angles near -90°) correspond to high sensitivity, i.e. small changes in MV result in large changes in EtCO₂. Flatter lines (angles near 0°) correspond to low sensitivity, i.e. small changes in MV would not change EtCO₂ much. In a Group 1 patient (general anesthesia with an ET tube, blue) large changes in EtCO₂ (95% CI from 32 to 52 mmHg) are triggered by relatively small changes in MV (95% CI from 4.5 to 8.3 L/min). In contrast, in a Group 3 patient (spontaneously breathing with a sampling nasal cannula, green) a 7-fold greater change in MV (2.7 to 37.8 L/min) leads to only half the variation in EtCO₂ (17 to 27 mmHg). The Group 2 patients (spinal anesthesia with a sampling nasal cannula, red) falls in-between the Group 1 and Group 3: changes in MV from 1.5 to 14.4 L/min (95% CI) lead to changes in EtCO₂ from 14.1 to 32.1 mmHg

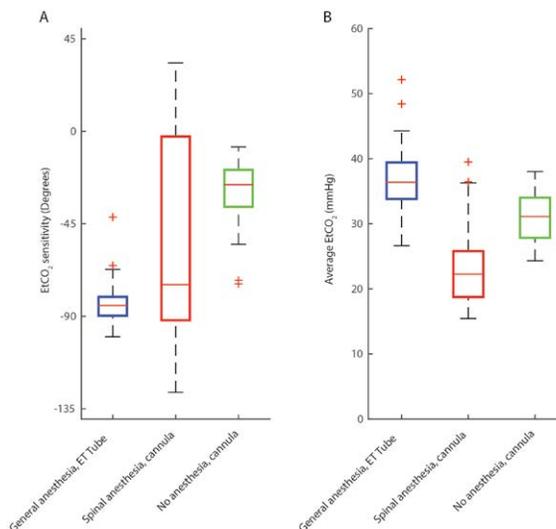


Figure 2: (A) Summary of the sensitivity of EtCO₂ to changes in MV. Each box-plot shows the median slope of the correlation between EtCO₂ and MV (red line), the box extends from the 25th to 75th percentile, the whiskers extend to the most extreme non-outlier data points, and statistical outliers (outside of ±3SD) are plotted individually with red "plus" signs. Left box (Group 1, general anesthesia, ET tube): -83.5° ±9.7° (mean ± SD); Middle box (Group 2, spinal anesthesia, sampling nasal cannula): -50.7° ±48.6°; Right box (Group 3, awake volunteers, sampling nasal cannula): -30.1° ±16.1°. (B) Average EtCO₂ values across the 3 groups. The measured EtCO₂ values were systematically higher in the intubated patients (left box) than in the sedated but not intubated patients (middle) and the awake volunteers (right) monitored by the sampling nasal cannula, 37.2 ± 4.4mmHg vs. 23.0 ±5.2mmHg vs. 31.0 ±4.0 mmHg, respectively, p<0.001 for both comparisons.

S-263 • continued

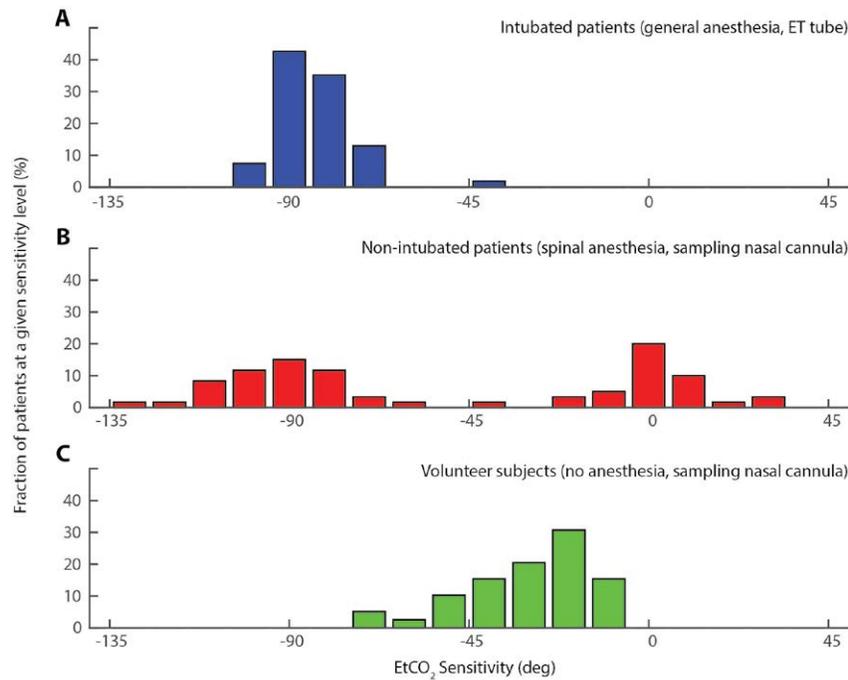


Figure 3: Distribution of the EtCO₂ sensitivity across groups. (A) Group 1, intubated patients. A unimodal distribution shows a high EtCO₂ sensitivity in majority of patients. (B) Group 2, anesthetized and non-intubated patients. The bimodal distribution illustrates the lack of uniformity in EtCO₂ in this group. (C) Group 3, awake volunteers. Similar to Group 1 the distribution is unimodal, suggesting uniformity across the group, however, as seen in Figure 2A, the overall sensitivity is much lower in Group 3 than in Group 1.

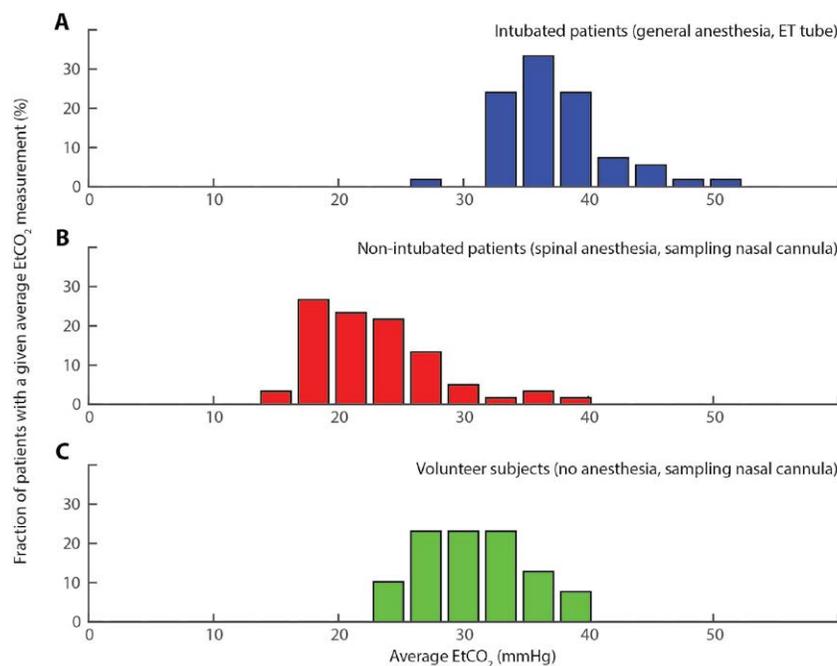


Figure 4: Distribution of the average EtCO₂ across groups. (A) Group 1, intubated patients, (B) Group 2, anesthetized and non-intubated patients and (C) Group 3, awake volunteers. EtCO₂ values in all groups are systematic and the distributions are unimodal, suggesting group uniformity. As shown in Figure 2B, the average EtCO₂ in the intubated patients is significantly higher than in the other 2 groups.

S-264.

NON-INVASIVE RESPIRATORY VOLUME MONITORING PROVIDES ADVANCED WARNING OF RESPIRATORY DEPRESSION AND CAN BE USED TO REDUCE FALSE ALARMS

AUTHORS: C. Voscopoulos¹, J. Freeman², E. George³

AFFILIATION: ¹Anesthesiology, Duke University, Durham, NC, ²Research, Respiratory Motion, Waltham, MA, ³Anesthesiology, Massachusetts General Hospital, Boston, MA

INTRODUCTION: In the post anesthesia care unit (PACU), patient monitoring can be compromised both by alarm fatigue and by measures to reduce alarm fatigue. Pulse oximetry (SpO₂) is associated with significant false alarms and to address this, increasingly lower & lower SpO₂ alarm limits have been set. However, SpO₂ alarms are more often triggered by sensor displacement than by actual respiratory events. Rather than alerting staff to a patient’s deteriorating respiratory condition, SpO₂ alarms are often only triggered once the patient is in respiratory distress.¹ The respiratory volume monitor (RVM) accurately measures minute ventilation (MV), tidal volume and respiratory rate in non-intubated patients. Its ability to capture respiratory depression in advance of low SpO₂ and with fewer false alarms was assessed.

METHODS: RVM and SpO₂ data were collected from 240 patients (130 females, age: 66.8±10.3yrs, BMI: 29.6±5.7 kg/m²) at 1-min intervals. “Predicted” MV (MVPRED) and “Percent Predicted” (MV_{MEASURED}/MV_{PRED} ×100%) were calculated for each patient. “Low SpO₂” (alarm condition) was defined as SpO₂ < 90%; “desaturation event” was defined as “Low SpO₂” for ≥ 2min; “false alarm” was defined as “Low SpO₂” for < 2min. “Un-Safe MV” was defined as MV < 40% MV_{PRED}. Multifactor analysis of variance (MFANOVA) was used to evaluate differences in clinical populations, and

unpaired one-sided t-tests were used to compare measurements across groups; Pearson correlations were used to evaluate intra-variable dependencies.

RESULTS: 80 “Low SpO₂” alarm conditions were recorded of them 62 (78%) were false alarms (<2min). The remaining 18 events (≥ 2 min) occurred in 15 patients (longest 12 min (Figure 1A)). The RVM showed that 11/18 desaturation events coincided with excessive patient motion and high MV & only 7 events (1 per patient) were “true desaturation” events, (true indications of respiratory depression; Figure 1B). Each real desaturation event was preceded by “Un-Safe MV” by an average of 16.7±4.6 min (mean ±sem) and the level of “Un-Safe MV” was strongly correlated with the time before an SpO₂ alarm sounded (r=0.77, p<0.05, Figure 2). While MFANOVA found no difference in the demographics of the populations with real desaturation events versus false alarms (p>0.2 for height, weight, age, BMI, sex), the length of stay in the PACU for the group with real desaturations was significantly longer (176±9min v. 134±18min, p<0.05).

CONCLUSIONS: Improvements in SpO₂ monitoring equipment and conservative use of alarm limits have decreased false alarms; yet, this study showed that >90% of SpO₂ alarm conditions in the PACU were most likely false. Continuous MV monitoring gives advanced warning of developing respiratory depression due to opioids, apnea, or other factors and provides early point-of-care data for caregivers to modify opioid dosing or other interventions to prevent progression of respiratory depression to the point of true desaturation and severe compromise. The RVM has the potential to improve patient safety and satisfaction and reduce the length of stay in the PACU associated with a true desaturation event.

REFERENCES:

1. Overdyk. A&A 2007;105

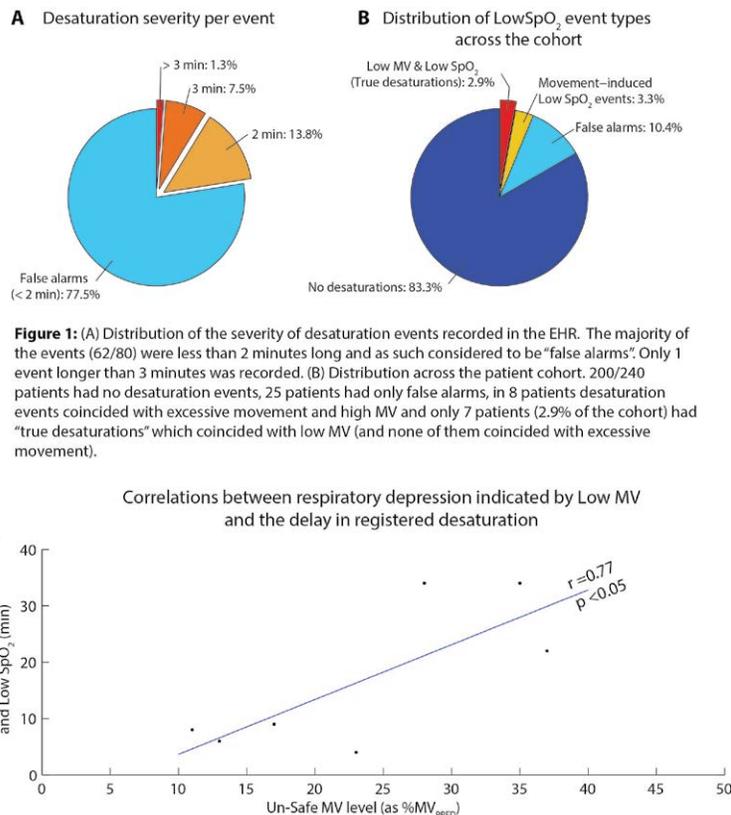


Figure 1: (A) Distribution of the severity of desaturation events recorded in the EHR. The majority of the events (62/80) were less than 2 minutes long and as such considered to be “false alarms”. Only 1 event longer than 3 minutes was recorded. (B) Distribution across the patient cohort. 200/240 patients had no desaturation events, 25 patients had only false alarms, in 8 patients desaturation events coincided with excessive movement and high MV and only 7 patients (2.9% of the cohort) had “true desaturations” which coincided with low MV (and none of them coincided with excessive movement).

Figure 2: Correlation between the severity of respiratory depression and the delay in registered desaturation. The lower the recorded MV (x-axis) the sooner the patient desaturates (y-axis).

S-265.

EXAMINING ADVERSE EVENT REPORTING IN CLINICAL TRIALS OF INTERVENTIONAL PAIN TREATMENTS: AN ACTION SYSTEMATIC REVIEW

AUTHORS: M. R. Williams¹, S. M. Smith¹, I. Gilron², D. Turk³, R. Dworkin¹

AFFILIATION: ¹Anesthesiology, University of Rochester School of Medicine, Rochester, NY, ²Anesthesiology, Queen’s University, Kingston, ON, Canada, ³Anesthesiology, University of Washington, Seattle, WA

INTRODUCTION: Adverse event (AE) assessment in clinical trials plays a vital role in evaluating a treatment’s risk-benefit profile. The CONSORT 2004¹ statement consists of 10 recommendations regarding AE reporting in clinical trials, providing a template for thorough AE transparency. Adherence to these recommendations has been shown to be inadequate², with minor improvement seen since publication³. We explored whether AE reporting had improved following the 2004 CONSORT recommendations for interventional analgesic treatments in the anesthesia and pain literature.

METHODS: Three major anesthesiology journals (A&A, Anesthesiology, BJA) and 3 major pain journals (EJP, Journal of Pain, Pain) over 2 periods (epoch 1: 2000-2003; epoch 2: 2008-2012) were selected for review. Eligible studies were randomized, double-blind trials of interventional treatments with pain as a principal outcome. 165 qualifying RCTs were identified in the specified journals and years. Interventional pain treatments were considered to be those that involved administration of a pharmacologic therapy, device, or procedure that necessitated penetrating the skin.

Each RCT was double-coded using a coding manual developed from descriptors of the 10 CONSORT harms reporting recommendations (Table 1). Study characteristics were also collected.

RESULTS: Overall, no significant improvement was found in AE reporting since publication of the CONSORT recommendations. Only recommendation 6 (reporting withdrawals due to AEs by treatment group) showed significant improvement from epoch 1 to epoch 2 (48% vs 69%, P = 0.007). On average, 5 of the 10 recommendations were fulfilled. The cumulative distribution of trials fulfilling CONSORT harms reporting recommendations was similar across epoch 1 and 2 (Figure 1). Multiple regression analysis found epoch was not significantly associated with AE reporting (Table 2), however study design, intervention type, and sponsor were. Industry-sponsored studies were significantly more likely to report AE information than non-industry studies, as were trials of intravenous medications vs. other treatments, and parallel trials vs. crossover studies.

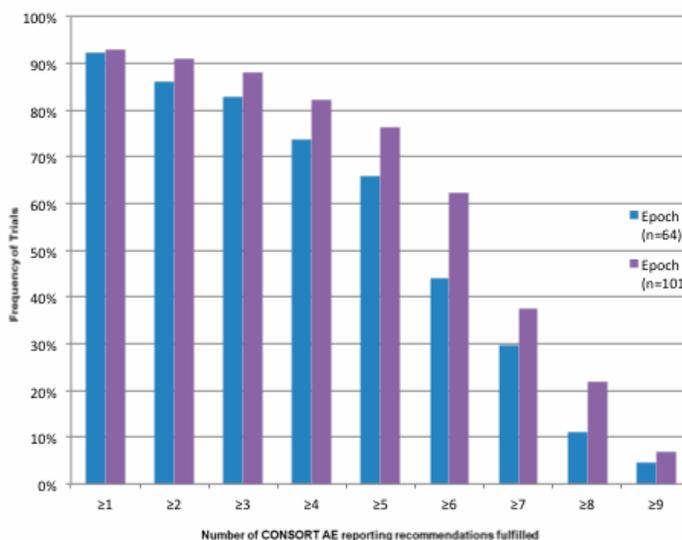
CONCLUSIONS: Accurately assessing an intervention’s risk-benefit profile is hindered by inadequate AE reporting. Improvement is needed in this area to capture important, clinically relevant information related to the potential harm of an intervention to patients. Greater awareness of the CONSORT harms reporting recommendations and others such as the ACTION AE reporting checklist⁴ may assist investigators and editors in improving AE reporting and championing patient safety.

REFERENCES:

1. Better reporting of harms in randomized trials. *Ann Intern Med.* 2004; 141:781-8.
2. Reporting of safety results in published reports of randomized controlled trials. *Arch Intern Med.* 2009; 169:1756-61.
3. Adherence to CONSORT harms-reporting recommendations in publications of recent analgesic clinical trials. *Pain.* 2012; 153:2415-21.
4. Adverse event assessment, analysis, and reporting in recent published analgesic clinical trials. *Pain.* 2013; 154:997-1008

Figure 1

Cumulative distribution of trials fulfilling CONSORT AE reporting recommendations



S-265 • continued

Percentage of trials fulfilling each CONSORT harms reporting recommendation

CONSORT RECOMMENDATIONS	All trials (n=165)	Epoch 1 (n=64)	Epoch 2 (n=101)	P(Epoch 1 vs. 2)
(1) If the study collected data on harms and benefits, the title or abstract should so state	77 (46.7%)	29 (45.3%)	48 (47.5%)	0.783
(2) If the trial addresses both harms and benefits, the introduction should so state	38 (23.0%)	11 (17.2%)	27 (26.7%)	0.158
(3) List addressed adverse events with definitions for each (with attention, when relevant, to grading, expected vs. unexpected events, reference to standardized and validated definitions, and description of new definitions)	122 (73.9%)	44 (68.8%)	78 (77.2%)	0.229
(4) Clarify how harms-related information was collected (mode of data collection, timing, attribution methods, intensity of ascertainment, and harms-related monitoring and stopping rules, if pertinent)	126 (76.4%)	48 (75.0%)	78 (77.2%)	0.745
(5) Describe plans for presenting and analyzing information on harms (including coding, handling of recurrent events, specification of timing issues, handling of continuous measures, and any statistical analyses)	42 (25.5%)	15 (23.4%)	27 (26.7%)	0.638
(6) Describe for each arm the participant withdrawals that are due to harms and their experiences with the allocated treatment	101 (61.2%)	31 (48.4%)	70 (69.3%)	0.007
(7) Provide the denominators for analyses on harms	126 (76.4%)	44 (68.8%)	82 (81.2%)	0.068
(8) Present the absolute risk per arm and per adverse event type, grade, and seriousness, and present appropriate metrics for recurrent events, continuous variables, and scale variables, whenever pertinent.	140 (84.8%)	52 (81.3%)	88 (87.1%)	0.308
(9) Describe any subgroup analyses and exploratory analyses for harms. (10) Provide a balanced discussion of benefits and harms with emphasis on study limitations, generalizability, and other sources of information on harms.	6 (3.6%) 102 (61.8%)	1 (1.6%) 39 (60.9%)	5 (5.0%) 63 (62.4%)	0.2600.854

Multiple linear regression analysis for transformed CONSORT harms total score

	B (95% CI)	P
Epoch	0.07 (-0.02 – 0.16)	0.108
Journal type (0=anesthesia journals; 1=pain journals)	-0.08 (-0.19 – 0.02)	0.122
Study design (0=crossover; 1=parallel)	-0.22 (-0.38 – -0.06)	0.008
Participant type (0=pain patients; 1 = healthy)	-0.02 (-0.17 – 0.13)	0.798
Pain type (0=acute; 1=all others)	0.10 (-0.05 – 0.24)	0.092
Frequency of treatment administration (0=Infusion; 1=single/multiple administration)	-0.06 (-0.15 – 0.03)	0.208
Treatment administration method (0=Intravenous; 1=all others)	-0.10 (-0.19 – -0.01)	0.035
Sponsor (0=industry; 1=all others)	-0.14 (-0.24 – -0.03)	0.009
Transformed randomized N	0.01 (0.00 – 0.02)	0.148

S-266.**ENGAGING PHYSICIANS AND EXECUTIVES IN PATIENT BLOOD MANAGEMENT: EDUCATION, SELECTION AND REPORTING OF OUTCOMES**

AUTHORS: P. E. Greilich¹, M. McBroom¹, J. Benuzillo², A. Tricinella¹, M. S. Peters³, S. Hill¹, S. Ring⁴

AFFILIATION: ¹Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX, ²Cardiovascular Clinical Program, Intermountain Institute for Healthcare Research and Delivery, Salt Lake City, UT, ³Surgical Services Clinical Program, Intermountain Institute for Healthcare Delivery and Research, Salt Lake City, UT, ⁴Cardiovascular and Thoracic Surgery, University of Texas Southwestern Medical Center, Dallas, TX

INTRODUCTION: The American Medical Association, Joint Commission, American Heart Association and Choosing Wisely Campaign have all identified inappropriate use of red blood cell (RBC) transfusions as a “Top 5” priority. Education and selection of clinically meaningful outcome measures are central to engaging physicians and executives in quality improvement. We hypothesize that education, selection and reporting of service-specific measures of RBC utilization reduces transfusion in cardiac surgical patients.

METHODS: The DMAIC method was used to guide this initiative from July 2012 to December 2014. Data were categorized into four groups: pre-intervention, following public reporting of RBC utilization, following education of frontline providers on appropriate use and following determination of transfusion (hemoglobin) triggers and targets by service-line physicians. Multidisciplinary conferences, small group and individual forums, as well as

electronic content-sharing, were used to disseminate information to frontline providers, managers and executives. Rates of RBCs transfused per 100 patients were compared to measure the effect of our three rapid cycle process improvement interventions over time and were expressed using a Shewhart process control chart. Estimated cumulative cost savings were calculated using year-over-year savings. Data were analyzed using Stata 12 statistical software (StataCorp, College Station, TX, USA).

RESULTS: Demographic and outcome data are summarized in the TABLE. The baseline rate of RBC transfusion was 302 RBC units (U) per 100 patients. Following public reporting of service-specific RBC utilization, the observed rate was 283U (RR 1.07; 95%CI 0.90-1.26; p=ns). The impact of educating frontline providers on appropriate use resulted in a 27% reduction in the rate of transfusion (237U) compared to baseline (RR 1.27; 95%CI 1.07-1.52; p = 0.003). Physician participation in establishing service-line specific transfusion triggers and targets further reduced the rate of transfusion to 165U per 100 patients (RR 1.83; 95%CI 1.51-2.23; p<0.001; compared to baseline). The later transfusion rate represents a 43% (p<0.001) reduction of that observed following education alone (FIGURE 1). An estimated cumulative (total RBC) cost savings of \$587,625.00 was realized between Q4/2012 and Q4/2014 (FIGURE 2).

CONCLUSIONS: Engaging physicians and executives in a process of education, selection and reporting of relevant measures of RBC utilization is an effective method for reducing blood transfusion. Institutional investment is essential for building an effective patient blood management program. The estimated cost savings from this project will be used to make this appeal to our administrative leadership.

Subspecialty Abstracts

Pediatric Anesthesiology

S-267.

WITHDRAWN.

S-268.**DIAGNOSTIC PERFORMANCE OF INDICES OF ADIPOSITY TO IDENTIFY CHILDREN WITH PERIOPERATIVE RESPIRATORY COMPLICATIONS****AUTHORS:** O. Nafiu, H. Tuckwell**AFFILIATION:** Anesthesiology, University of Michigan Health Systems, Ann Arbor, MI

INTRODUCTION: Childhood obesity prevalence has reached epidemic proportions in the United States. This secular trend has produced an increase in the number of overweight/obese children undergoing surgery and anesthesia. Several reports indicate that high body mass index (BMI) in children is a risk factor for perioperative respiratory adverse events (PRAE)^{1,2}. Despite the popularity of BMI for profiling obesity-related acute and chronic complications, it is not a good indicator of total body adiposity and hence does not accurately predict the risks associated with excess body fat³. Consequently, other indices of adiposity, particularly measures of central obesity have been shown to better predict obesity-associated complications. Indeed measures such as waist circumference (WC), neck circumference (NC) and waist-to-height ratio produce more precise estimates of obesity-related cardiovascular and metabolic risks⁴. Given the recent upsurge of interest in other measures of adiposity as predictors of obesity-related risks, the purpose of this study was to determine which index of adiposity in children is most closely associated with PRAE.

METHODS: This was a cross-sectional, observational study of 756 children aged 6-18yr who underwent elective, non-cardiac operations. Clinical and anthropometric variables were prospectively collected by trained research assistants in all patients. BMI was calculated as weight in kilograms divided by the square of the height in meters ($BMI = kg/m^2$). PRAE was defined as the occurrence of one or more of the following: laryngospasm, bronchospasm and post-induction desaturation. The diagnostic accuracy of BMI, NC, WC and body weight to correctly identify children who developed PRAE was assessed with receiver operating characteristic (ROC) curves. Corresponding area under the curve (AUC) were calculated for each measure of adiposity. Furthermore, logistic regression analysis using PRAE as outcome and above indices of adiposity as predictors was used to calculate adjusted odds ratios for the occurrence of PRAE.

RESULTS: The incidence of PRAE was 10.9%. All the indices of adiposity were significantly positively correlated (Pearson's $r = 0.39-0.87$; $p < 0.001$). ROC curve analysis (Fig 1) indicated that all the measures of adiposity performed well on average in identifying children with PRAE ($AUC > 0.6$). The ROC performance of BMI showed the highest discriminant accuracy in predicting PRAE. Logistic regression analyses showed that BMI and WC were positively and significantly associated with PRAE while weight and NC showed significant, negative coefficients

CONCLUSIONS: BMI showed better accuracy at identifying children with PRAE than other indices of adiposity. Body weight had the lowest accuracy for PRAE in children. Given the established familiarity with BMI as well as the additional training needed and difficult logistics of measuring the other indices of adiposity in the preoperative setting, we encourage anesthesia providers to focus solely on BMI measurement for pediatric perioperative risk stratification. Weight measurement alone is insufficient.

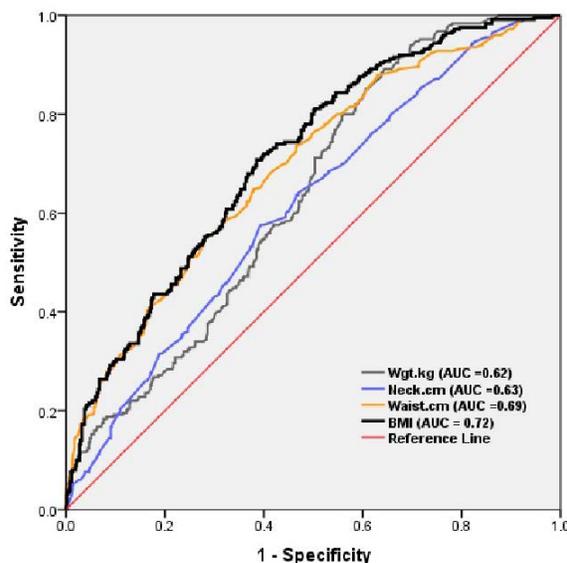


Fig 1. Comparison of ROC curves of indices of adiposity and their respective AUC for predicting perioperative respiratory adverse events

S-269.**KETAMINE AND DEXMEDETOMIDINE FOR PEDIATRIC SEDATION DURING CEREBRAL ANGIOGRAPHY****AUTHORS:** S. Obara, K. Ishibashi, R. Akutsu, N. Kuratani**AFFILIATION:** Department of Anesthesia, Saitama Children's Medical Center, Saitama, Japan**INTRODUCTION:** Sedation of pediatric patients undergoing cerebral angiography is challenging^{1,2}. In Japan, use of dexmedetomidine was approved additionally for the provision of procedural sedation without any artificial airway devices in 2013. Then our institution started use of a combination of ketamine and dexmedetomidine for pediatric sedation during cerebral angiography through our protocol after IRB approved. This present study was performed to evaluate the hypothesis that the combination of ketamine and dexmedetomidine can be safely and effectively used for pediatric patients undergoing cerebral angiography without significant adverse events.**METHODS:** Our sedation protocol with use of ketamine and dexmedetomidine for pediatric cerebral angiography over 13-months period between July, 2013 and August, 2014 was retrospectively reviewed. A dexmedetomidine bolus of 2 µg/kg and a ketamine bolus of 1 mg/kg intravenous followed by a dexmedetomidine of 1 µg/kg/h infusion was used as sedation protocol without any premedication. Our sedation protocol efficacy, additional use of medications, and side effects were analyzed.**RESULTS:** During the study period, fourteen patients (age: 5-17 years) underwent cerebral angiography under our sedation protocol with use of ketamine and dexmedetomidine. The underlying diseases for the cerebral angiographies were Moyamoya disease(n = 7), arteriovenous malformation(n = 5), vein of Galen malformation(n = 2). All the cerebral angiographies were completed successfully. Median cerebral angiography time was 100 min (range: 35-150 min). Four patients(29%) required additional ketamine boluses and 4(29%) required propofol boluses for adequate sedation during the procedures. Vital sign changes from baseline showed that transient hypertension (systolic BP increase of >25%) during sedation-induced phase were observed in 7 patients(50 %) and transient bradycardia (HR decrease of <25%) in 1 patient(7%). These side effects were resolved spontaneously. There were no apneas or respiratory depression requiring any artificial airway devices.**CONCLUSIONS:** The combination of ketamine and dexmedetomidine caused transient hypertension in a significant number of pediatric patients undergoing cerebral angiography, which resolved spontaneously. However, the combination did not result in significant respiratory depression. The combination may be useful for pediatric patients who require cerebral angiography because of few respiratory adverse events.**REFERENCES:**

1. Anesthesia and Analgesia 2011; 113(5): 1129-1142.
2. Journal of Research in Medical Sciences 2014; 19(6): 549-554.

S-270.**WITHDRAWN.**

S-271.

TAKING THE STING OUT OF PROPOFOL: A PROSPECTIVE OBSERVATIONAL STUDY OF PAIN EXPERIENCE IN CHILDREN DURING PROPOFOL ADMINISTRATION

AUTHORS: T. Chambers-Little¹, S. Nair¹, M. Kahana¹, N. Shaparin¹, L. Singer²

AFFILIATION: ¹Anesthesiology, Albert Einstein College of Medicine/Montefiore Med, Bronx, NY, ²Pediatric Critical Care, Albert Einstein College of Medicine/Montefiore Med, Bronx, NY

INTRODUCTION: Propofol, an intravenous sedative-hypnotic agent, is commonly used for the induction and maintenance of general anesthesia. Pain and discomfort upon the injection of propofol through a peripheral IV line is a well-known adverse effect. In pediatric patients, pain due to propofol infusion is reported in 85% of cases¹. It has been shown that a mixture of lidocaine and propofol can decrease pain upon injection². Practitioners at our medical center primarily use a lidocaine-propofol mixture in varying ratios to minimize pain upon injection or administer propofol without any other medications. The primary objective of this study is to compare the pain experienced by pediatric patients who receive differing mixtures of propofol and lidocaine in order to establish a ratio that will consistently produce minimal pain upon injection. We hypothesize that a propofol 1% lidocaine mixture in a 1:1 ratio will more effectively reduce pain on injection in children when compared to all other combinations of administering propofol.

METHODS: Propofol was administered in at least two formulations: 50% propofol/50% 1%lidocaine and 90% propofol/10% 1%lidocaine to a total of 50 pediatric patients undergoing deep sedation for a variety of procedures. The maximum dose of propofol given to any patient was 1mg/kg. An independent observer, blinded to the precise mixture of propofol and lidocaine made all patient observations: (a) FLACC (Faces, Legs, Activity, Cry and Consolation) score upon injection (b) the duration of the movement of the forearm, need for additional support to hold the arm fixed (c) any adverse events locally or systemically that is directly related to the administration of propofol.

RESULTS: Fifty children who received propofol injection were observed. Of the patients in the propofol:lidocaine 1:1 ratio group (N=36) the mean FLACC pain scale was 0.00 whereas in the standard ratio group (N=14) the mean FLACC pain scale was 2.00 (P=0.029). Movement of forearm/holding arm fixed were 36.1% in the propofol group and 50% in the standard group (p =0.368). There were no adverse events noted during or after administration of any formulation.

CONCLUSIONS: Although this data is preliminary, the results of the study support the hypothesis that children receiving propofol and lidocaine in a 1:1 mixture had statistically significant reductions in their median FLACC scores compared to those who received the more traditional formulation. In fact, once the study was ongoing, the 50% lidocaine preparation was so effective at mitigating the pain of the initial propofol injection it was difficult to convince the practitioners to use other concentrations. Future data must include a larger sample size of patients receiving propofol and lidocaine in a variety of concentrations.

REFERENCES:

1. Kain ZN, Wang SM, Mayes LC, et al. Distress during the induction of anesthesia and postoperative behavioral outcomes. *Anesth Analg.* 1999; 88(5):1042-7.
2. Morton NS. Abolition of injection pain due to propofol in children. *Anaesthesia* 1990; 45:70

Baseline Patient Characteristics

	Ratio 1:1 N=36	AllOtherRatiosN=14
Age(years)	12 (3.8, 16.5)	13 (7.0, 16.5)
BMI	19 (16.7, 26.0)	23 (16.9, 29.9)
Overall Time of procedure (min)	42 (30.0, 60.0)	75 (37.7, 149.0)
Male (%)	50	43
Female (%)	50	57
Sedation Team Cases	35	5
OR Team Cases	1	9

S-272.

AN ANALYSIS OF 35,000 PEDIATRIC OUTPATIENT CONTROLLED SUBSTANCE PRESCRIPTIONS

AUTHORS: M. Yaster, P. S. Park, E. White, B. H. Lee

AFFILIATION: Anesthesiology and Critical Care Medicine, Johns Hopkins University, Baltimore, MD

INTRODUCTION: Prescription errors are the most common type of iatrogenic errors and include incorrect dosing, dose calculation and dosage forms, failure to use “best prescription writing practice”, and handwriting legibility. Because of a 70% error rate¹, we developed a computerized, web-based, controlled substance prescription writer that included weight-based dosing logic and alerts to reduce this rate to virtually zero. Over the past 7 years, more than 35,000 prescriptions have been created by hospital providers using this platform. We sought to determine the prescribing patterns of controlled substances given to children and young adults (ages 0-23 years) upon hospital discharge.

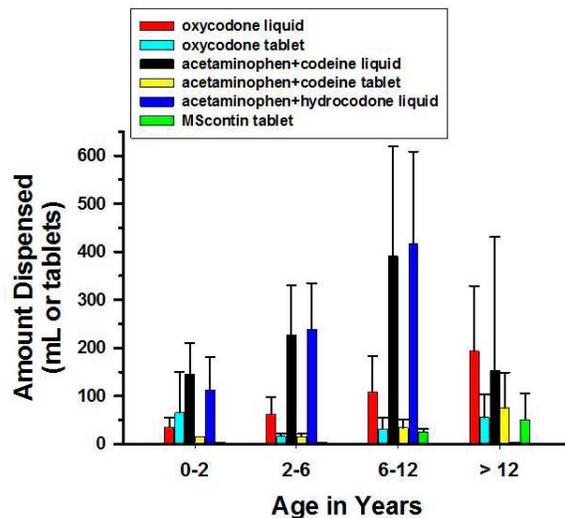
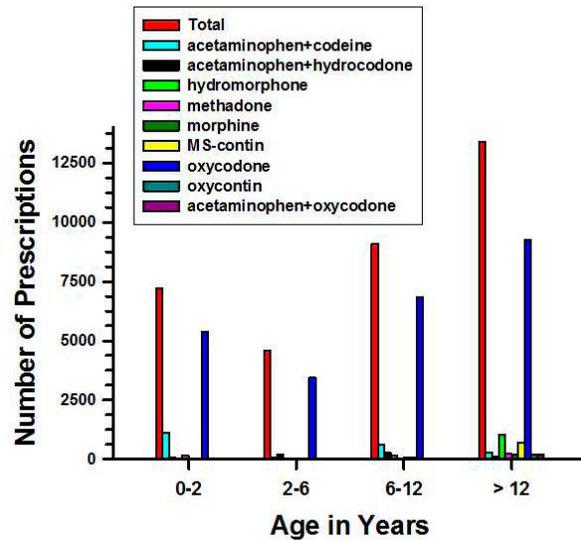
METHODS: After obtaining IRB approval to examine the prescription database, we examined 35,280 controlled substances discharge prescriptions from 1/1/2007 to 2/14/2014 written by our institutional providers. We removed 1,045 prescriptions due to incorrect age and/or weight entered into the database leaving 34,235 prescriptions for analysis. We examined demographic information including patients’ age, gender, and weight; type of medication prescribed based on patient age; form of dispensed medication (liquid/patch/tablet); and amount of drug to be dispensed at the time of hospital discharge. Data were analyzed using Microsoft Excel®, SPSS®, and Sigma Plot®.

RESULTS: Patients averaged 9±6.1 (range 0-23) years and 36.7±29.4 (range 1-195) kg. Regardless of age, the most commonly prescribed controlled substance was oxycodone (72.8%) (figure 1). Liquid formulations predominated in children < 6 years of age (98%) but were still required in 16% of children >12 (the remaining 84% received tablet formulations). The amount of drug dispensed by type and age is seen in figure 2.

CONCLUSIONS: Oxycodone has supplanted codeine as the most commonly prescribed oral opioid in current pediatric pain practice and, independent of formulation, is dispensed in large quantities. This study underscores the need for liquid opioid formulations in the pediatric population and, because of their abuse potential, the urgent need to determine how much medication is actually utilized by patients at home.

REFERENCES:

1. J Pain. 2009;10:160-6.



S-273.

QUANTITATIVE PUPILLOMETRY AS A BEDSIDE PREDICTOR OF POSTOPERATIVE RESPIRATORY DEPRESSION IN CHILDREN

AUTHORS: S. Sadhasivam¹, R. Venkatasubramanian¹, X. Zhang², L. Ding³, A. Vinks⁴

AFFILIATION: ¹Anesthesia, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH, ²Human Genetics, Cincinnati Children’s Hospital, Cincinnati, OH, ³Epidemiology and Biostatistics, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH, ⁴Clinical Pharmacology, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH

INTRODUCTION: Opioids are most commonly used analgesics to manage severe pain following surgery in children. Several deaths and life-threatening adverse effects such as respiratory depression have been caused by opioids in children. This is because of narrow therapeutic indices and large and unpredictable inter-patient variability in responses to opioids. Safe and effective analgesia following surgery is an unmet clinical need in children as a result of our incomplete understanding of central nervous system (CNS) effects of opioids in terms of pharmacokinetics and predictive tools of opioid-induced respiratory depression. Quantitative Pupilometry (QP) is a non-invasive bedside tool for monitoring CNS effects of opioids (Figure 1). The objective is to determine how serial non-invasive objective QP measures correlate with morphine’s pharmacokinetics and postoperative respiratory depression in children.

METHODS: After obtaining IRB approval and informed consents, 300 children 6 - 15 years, ASA physical status 1 or 2 scheduled for tonsillectomy were enrolled. Children who have problems with pupil or pupillary reaction due to disease or on medications influencing pupillary size were not recruited. All participants received standardized anesthesia, surgical and postoperative care. NeuroOptics PLR-100 QP was used to measure pupil re-sponse dynamics (Figure 2). Data Collected: Clinical: postoperative pain scores, total opioid requirement, incidences of postoperative respiratory depression, the following data were collected: Pharmacokinetic (PK): serial blood levels of morphine and metabolites; Pharmacodynamic (PD): serial QP measures (Table 1).

RESULTS: Pupillary sizes and reaction pattern followed a consistent pattern perioperatively (Figure 3). Pupillary Maximum Constriction Velocity (MCV) correlated with blood morphine concentrations: MCV decreased as blood morphine concentration increased. Highest morphine concentration and lowest MCV were observed immediately after morphine administration followed by at the end of surgery. The effect of anesthesia on MCV was negligible and was similar to baseline MCV values with no detectable morphine levels (Figure 4). QP measures as biomarkers of opioid-induced respiratory depression (OIRD): OIRD was associated with: 1) MCV differences obtained 3 minutes after morphine and baseline ($p=0.006$) and 2) pupillary constriction difference at the end of surgery and baseline measure ($p=0.009$).

CONCLUSIONS: Opioids exert their CNS effects including analgesia, respiratory depression and miosis with mu-opioid agonism, making QP as a potential early bedside non-invasive tool to assess respiratory depression. Handheld pupillometers are safe, non-invasive, well tolerated by children, and relatively easy to use. Serial QP measures correlate with morphine’s pharmacokinetics and identify children at risk of postoperative respiratory depression. Early QP measures could potentially help predict and stratify their respiratory depression risk upon arrival to PACU and choose targeted interventions with non-opioid analgesics if needed.

Quantitative Pupillometry as a Bedside Predictor of Postoperative Respiratory Depression

Table 1. Clinical, Pharmacokinetic and Quantitative Pupillometry Data Collection

	Before Surgery Baseline	During Surgery Under Anesthesia in Operating Room (OR)	After Surgery Recovery Room- PACU
PK		Blood draw for morphine and metabolites, M3G and M6G levels, immediately following IV insertion (pre-morphine baseline), 3 minutes and 15 minutes after morphine bolus.	Blood draw for morphine, M3G and M6G levels 30-45 minutes after morphine bolus
PD	Quantitative Pupillometry (QP) at baseline	QP at beginning of anesthesia; 3 minutes after initial morphine bolus (before surgical incision) and at the end of surgery (typically 20 minutes from initial morphine bolus)	- QP in recovery room - Pain Scores & Opioid Use - Respiratory depression %

Figure-1: Pupillary Reflex and Opioids

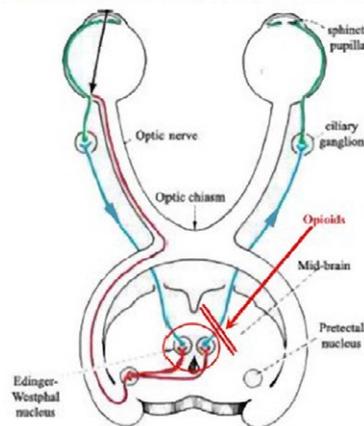
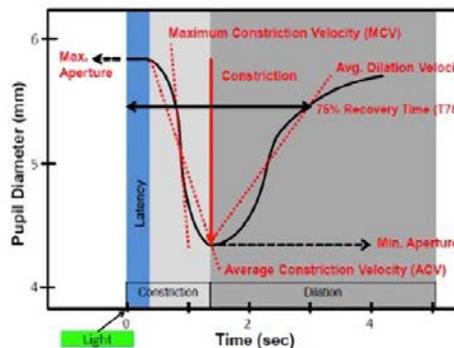


Figure-2: Quantitative Pupillometry Measures



S-274.

ABCC3 GENOTYPES ARE ASSOCIATED WITH RESPIRATORY DEPRESSION, PONV AND MORPHINE'S PHARMACOKINETIC VARIATIONS IN CHILDREN

AUTHORS: S. Sadhasivam¹, R. Venkatasubramanian¹, X. Zhang², V. Chidambaram¹, A. Vinks³

AFFILIATION: ¹Anesthesia, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, ²Human Genetics, Cincinnati Children's Hospital, Cincinnati, OH, ³Clinical Pharmacology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

INTRODUCTION: Large inter-individual variability in morphine pharmacokinetics could contribute to variability in morphine analgesia and adverse events. We recently showed that children with ABCC3 -211C>T polymorphism C/C genotype had 40% higher Morphine-6-Glucuronide formation than C/T+T/T genotypes (Figure 1). The aim of the study is to identify association between common ABCC3 genotypes and clinically important postoperative opioid-related outcomes. We further investigated if any of these outcomes were mediated by underlying variations in morphine's pharmacokinetics.

METHODS: After obtaining IRB approval and informed consents, 316 children 6 - 15 years, ASA physical status 1 or 2 scheduled for tonsillectomy that received standardized anesthesia, surgical and postoperative care were recruited. Data Collected: Clinical: postoperative pain scores, total opioid use, incidences of postoperative nausea vomiting (PONV) and respiratory depression (RD); Pharmacokinetic (PK): serial blood levels of morphine and metabolites up to 40 min post initial morphine dose were obtained in a subset (n=219) and were described by a PK model with allometric scaling using NONMEM (Figure 2). The time profile for M3G and M6G was modelled using mass balance equations accounting for formation of each metabolite from morphine and its respective first order elimination clearance. (Figure 2); Genetic: Common genotypes of ABCC3 gene using Illumina Omni5 GWAS array.

RESULTS: ABCC3 rs4148412 AA genotype had higher incidences of RD leading to prolonged stay in PACU (Odds ratio >2.2, p=0.008). ABCC3 kgp8560677 AA genotype had higher incidences of PONV leading to prolonged stay in PACU (Odds ratio >3.1, p=0.008). Children with rs4148412 A/A genotype was a significantly covariate (dOFV =-6.76) for M3G formation (~40%) than AG+GG genotypes and a similar trend was observed for M6G; similarly, kgp8560677 GG genotype had a trend of lower morphine clearance (Figure 3).

CONCLUSIONS: ABCC3 genotypes are associated with postoperative respiratory depression and PONV leading to prolonged hospital stay. These associations can be partly explained by underlying pharmacokinetic variations of intravenous morphine and its metabolites in children. Once validated, ABCC3 genetic associations with higher postoperative morphine adverse effect explained by underlying PK variations can guide personalized dosing or use of analgesics.

Figure-1: Schematic of hepatic metabolism of morphine within the hepatocyte.

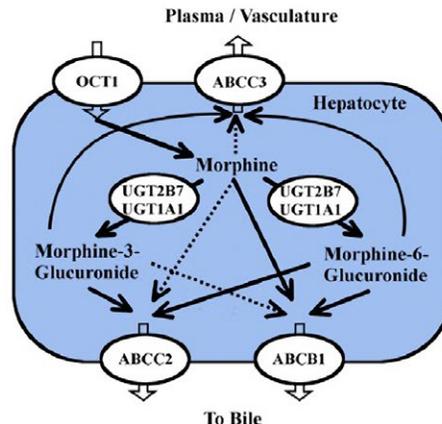
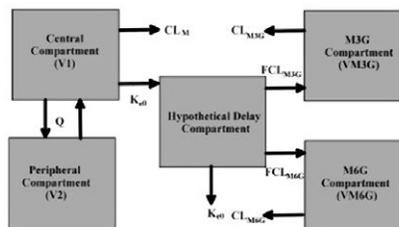


Figure-2: Compartmental Model Structure for Morphine and Morphine metabolites.



S-275.**IMPAIRED ACQUISITION AT LATE STAGES AFTER SINGLE EXPOSURE TO ISOFLURANE IN MICE****AUTHORS:** Y. Murase¹, K. Uchimoto², T. Goto², M. Yuzaki¹**AFFILIATION:** ¹Physiology ¹, Keio University, Tokyo, Japan, ²Anesthesiology, Yokohama City University, Yokohama Kanagawa, Japan**INTRODUCTION:** In rodent models, exposure to general anesthetics induces widespread damages in the developing brain. Subsequently, abnormalities in brain functioning often remain into adulthood. These abnormalities include not only impaired learning performance but also altered social adaptation. However these reports were mostly based on behavioral analyses in non-homecage apparatus. To assess behavioral changes in more natural environment, we adopted homecage-like apparatus.**METHODS:** Neonatal (P7) and juvenile (P21) C57BL/6 female mice were exposed to isoflurane (1.5%) for 6hours and returned to their homecage. At 10 weeks, they were introduced into “IntelliCage” (TSE system GmbH) with control (sham-anesthetized) mice . IntelliCage is a large plastic cage equipped with four computer-controlled operant learning chambers that fit into each corner of the cage. Water bottles are placed in each corner chamber. All mice were identified by a transponder with unique ID codes. (Datamars SA) Access to the chambers and action to access the water bottle (nosepoke) were recorded automatically and used as an index to analyze spontaneous behaviors and a spatial memory formation with minimal experimenter intervention for group-housed mice. Each individual mouse was assigned with two correct corners and drinking behavior was available only in the “correct” corner. Once they drink water at a correct corner, the correct corner was switched to a “neutral” corner. They need to move to another correct corner to get more water.**RESULTS:** Learning performance tended to be impaired in isoflurane exposed group, but it did not reached statistic significance. (p=0.08) Although they can access to the water bottle only once in their each visit to the “correct” corner, they spent longer duration for the action to access water bottle (nosepokes) than control group significantly. (p=0.014) These results suggest that isoflurane exposed group presented perseverative behavioral pattern compered with control group.**CONCLUSIONS:** Our results suggest that prolonged single exposure to isoflurane in juvenile mice could trigger adverse effects on cognition at late stages after the exposure.

S-276.

ANTICHOLINERGIC PREMEDICATION INDUCED FEVER IN PEDIATRIC AMBULATORY ANESTHESIA WITH KETAMINE

AUTHORS: W. Choe¹, K. Kim², J. Kim¹, J. Kim¹, K. Kim¹

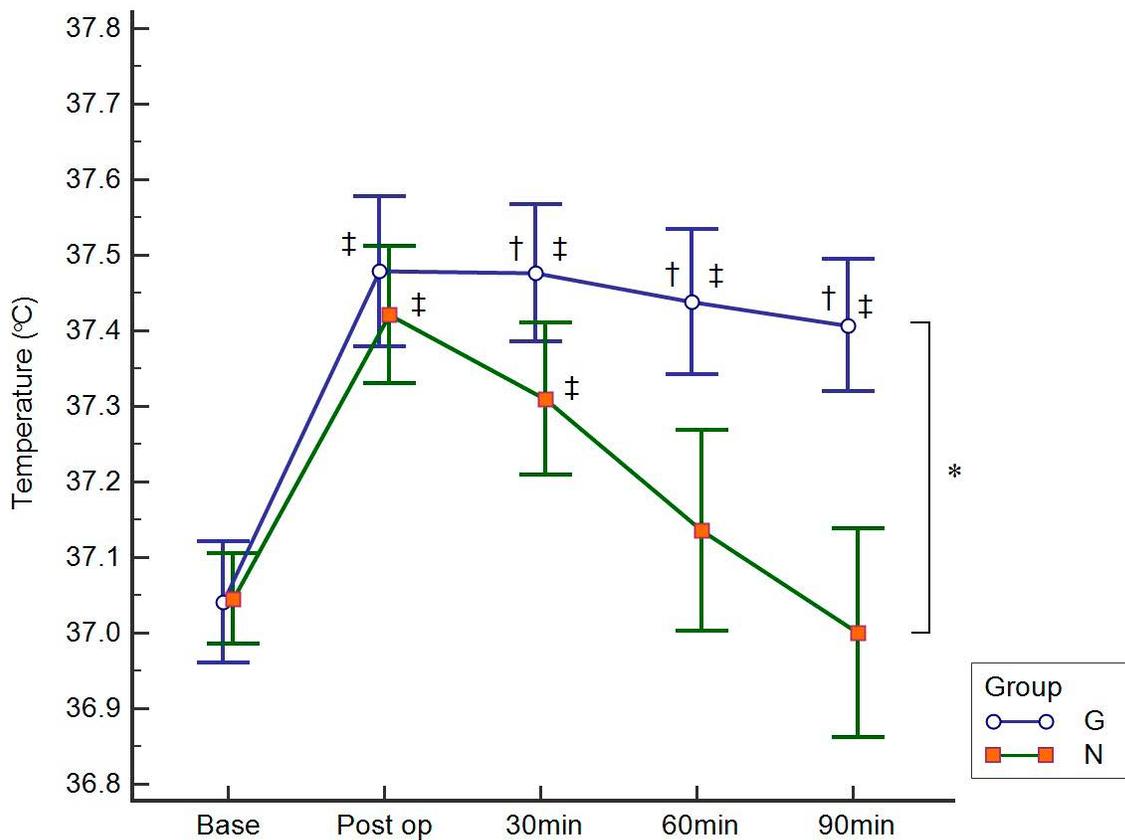
AFFILIATION: ¹Anesthesiology and Pain medicine, Inje University Il san paik hospitals, Go-yang, Korea, Republic of, ²Anesthesiology and Pain medicine, Inje University Seoul paik hospitals, Seoul, Korea, Republic of

INTRODUCTION: Anticholinergic drugs (e.g., atropine, glycopyrrolate,) have traditionally been used for their antisialagogue and vagolytic properties. But use of anticholinergic drugs can interfere with thermoregulation via inhibition of the parasympathicomimetically mediated sweat secretion. Sweating inhibition can reduce heat elimination, and children's thermoregulation depend more on sweating than adults and they can become hyperthermic when given these agents.

METHODS: We studied 84 pediatrics undergoing ambulatory anesthesia with ketamine. Patients received glycopyrrolate (0.005/kg; n=42), or placebo (same dose normal saline; n=42) IV before the induction in a randomized, double-blinded fashion. We recorded the temperature at base, post op, 30min, 60min, 90min in both group. Quantity of patient's oral secretion were recorded on a quantitative visual analogue scale using a 100 mm long straight line.

RESULTS: There was a significantly difference in temperature between glycopyrrolate and placebo group.(P=0.001, rmANOVA) The temperature was significantly higher than placebo at 30min, 60min, 90min. In the glycopyrrolate group, a post op, 30 min, 60min and 90min is significantly higher than the base. But the placebo group, a post op, 30min is significantly higher than the base. The incidence of fever was higher in glycopyrrolate than placebo group.(33%, 10%, p=0.02) The secretion of patients, 35.3 mm in glycopyrrolate and 44.8 mm in placebo group.(p=0.02)

CONCLUSIONS: Anticholinergic premedication in pediatrics ambulatory anesthesia with ketamine may induce a fever.



S-277.

SUBGLOTTIC DIAMETER MEASURED BY COMPUTED TOMOGRAPHY IN PEDIATRIC PATIENTS WITH PULMONARY HYPERTENSION AND CONGENITAL HEART DISEASE

AUTHORS: N. Ohashi, H. Imai, H. Baba

AFFILIATION: Anesthesiology, Niigata University Medical & Dental Hospital, Niigata, Japan

INTRODUCTION: Choosing an appropriate endotracheal tube (ETT) size is essential in pediatric anesthesia to prevent leakage of anesthetic gas and postoperative subglottic edema^{1,2}. However, ETT size determination based on age^{3,4} and height⁵ is often inaccurate in pediatric patients with congenital heart disease (CHD), especially those with concurrent pulmonary hypertension (PH). Thus, in the present study, we retrospectively compared the tracheal diameter measured by computed tomography (CT) between CHD pediatric patients with and without PH.

METHODS: CHD patients aged from birth to 6 yr requiring general anesthesia and tracheal intubation between 2012 and 2013 at our hospital were included. Patients with a mean pulmonary artery pressure > 25 mmHg on cardiac catheterization were allocated into the PH group; the rest were placed in the non-PH group. The primary outcome was subglottic longitudinal and transverse diameter measured on transverse CT images performed within 2 weeks pre- and postoperatively. The secondary outcome was the intraoperative ETT size compared to the ETT size predicted by a formula based on height (height × 0.045 + 0.8)⁵. The ETT size was considered clinically optimal by the trained anesthesiologist when a small tracheal leak occurred at 20 cmH2O of lung inflation.

RESULTS: Each group initially comprised 30 patients. Two patients in the PH group were diagnosed with congenital subglottic stenosis and excluded, resulting in 28 patients in group PH and 30 patients in group non-PH in the final analysis. The mean age was similar between the groups. However, the mean height and weight were smaller in group PH than in group non-PH (P < 0.01). The mean subglottic longitudinal diameter in group PH was significantly larger than that in group non-PH (8.3 ± 2.3 mm vs. 6.7 ± 1.2 mm, P < 0.01, Figure 1). The mean subglottic transverse diameter in group PH was also significantly larger than that in group non-PH (7.4 ± 2.3 mm vs. 6.4 ± 1.3 mm, P < 0.05, Table 1). Furthermore, 27 patients in group PH (96.4%) were intubated with an oversized tube compared to the size predicted by the formula. By contrast, only 16 patients in group non-PH (53.3%) were intubated with an oversized tube compared to the predicted size (P < 0.01, Table 1). No case of subglottic stenosis after tracheal extubation was observed.

CONCLUSIONS: The mean height and weight in CHD pediatric patients with PH were less than those in patients without PH, but the subglottic diameters measured by CT were significantly larger. Furthermore, our data suggests that it is needed for the most CHD pediatric patients with PH to select the larger ETT size than that predicted by the formula based on the patients' height.

REFERENCES:

1. J Pediatr 1983; 102: 582-4.
2. Anesthesiology. 2010; 113: 819-24.
3. Paediatr Anaesth. 2008; 18: 113-8.
4. Anesthesiology. 1997; 86: 627-31.
5. Anaesthesia. 1974; 29: 181-5.

Figure 1. Subglottic diameter measured by computed tomography in pediatric congenital heart disease patients with (group PH) and without (group non-PH) pulmonary hypertension.

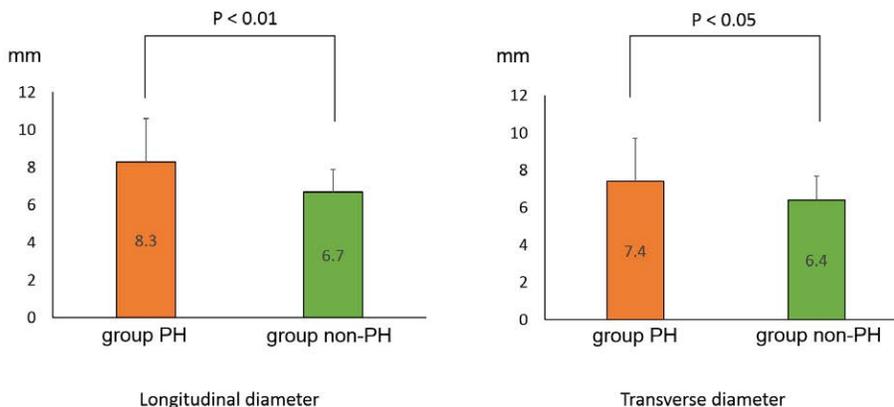


Table 1. Comparison between endotracheal tube size used intraoperatively and that predicted by the formula based on height.

n	Intraoperative size > predicted size (%)	Intraoperative size ≤ predicted size (%)
Group PH	27 (96.4%)	1 (3.6%)
Group non-PH	16 (53.3%)	14 (46.7%)

Group PH: pediatric congenital heart disease (CHD) patients with pulmonary hypertension (PH)
Group non-PH: pediatric CHD patients without PH

S-278.**ASSOCIATION OF HIGH BMI AND INCIDENT BRONCHIAL ASTHMA WITH PEDIATRIC PERI-OPERATIVE LARYNGOSPASM****AUTHORS:** H. Tuckwell¹, O. Nafiu²**AFFILIATION:** ¹Anesthesiology, University of Michigan Health Systems, Ann Arbor, MI, ²Anesthesiology, University of Michigan Health Systems, Ann Arbor, MI

INTRODUCTION: Childhood overweight/obesity and bronchial asthma (BA) are quintessential public health problems in contemporary United States (US). Approximately 23million US children are overweight or obese, a quadrupling of the rates from 30yr ago¹. Correspondingly, BA has shown dramatic increase. In the US, BA affects 7-15% children², particularly those with high body mass index (BMI). The concomitant increase in the prevalence of obesity and BA makes them important public health problems and increases the likelihood that they may occur concurrently in the same patient. This increases the likelihood that children undergoing anesthesia and surgery will have one or both disorders with the implicit potential to increase the risk of perioperative complications.

Laryngospasm is a serious perioperative complication with potentially devastating consequences³. Indeed, occurrence of laryngospasm in children is frequently associated with rapid escalation of care in the perioperative period.

Although high BMI and BA are frequently cited as risk factors for perioperative pulmonary complications⁴, it is presently unknown whether overweight/obese children with concurrent diagnosis of BA have increased rates of perioperative laryngospasm. Therefore, we tested the hypothesis that children with high BMI and incident diagnosis of BA at the time of surgery would have higher rates of perioperative laryngospasm compared to their peers without these conditions.

METHODS: Data for this report were derived from an (IRB approved) prospective observational study in 1102 children aged 6-18yr, undergoing elective, non-cardiac operations. Patients were then classified into two groups (normal and high BMI) based on sex-specific BMI \geq 85th percentile for age. Further stratification based on history of asthma was done to yield two groups: high BMI asthmatic and normal BMI /non-asthmatic. Rates of laryngospasm were compared between the two groups. Clinically relevant risk factors were entered into a logistic regression model to calculate the adjusted OR for laryngospasm.

RESULTS: The overall prevalence of high BMI (overweight/obese) was 37.7% while 20.4% of children had a diagnosis of asthma. There were 107 (9.7%) children with high BMI and incident asthma. Laryngospasm occurred in 45 (4.1%) subjects.

Children in the high BMI/asthma group had 2.8 times higher odds of developing laryngospasm (OR = 2.8; 95% CI = 1.35-5.88.7, p = 0.004). After adjusting for several relevant covariates (age, gender, intubation yes/no, OSA history, induction method) in a logistic regression model, high BMI/asthma remained the most consistent risk factor for intraoperative laryngospasm in these patients (OR = 2.9; 95%CI = 1.36-6.1, p = 0.005).

CONCLUSIONS: Children with high BMI and incident BA are at increased risk of intraoperative laryngospasm. Mechanisms underlying these increased risks deserve further elucidation but could include increased airway sensitivity and possible sub-clinical airway inflammation.

REFERENCES:

1. JAMA 2008;2401-05.
2. GINA 2004:1-12.
3. Paed Anaesth. 2008:289-96.
4. Paed Anaest 2007:426-30.

S-279.

A COMPARISON BETWEEN TWO VIDEO-LARYNGOSCOPES, THE TRUVIEW PCD AND THE GLIDESCOPE COBOLT AVL, IN SUCCESSFULLY INTUBATING PEDIATRIC MANIKINS WITH AND WITHOUT DIFFICULT AIRWAYS

AUTHORS: H. K. Hippard¹, K. Govindan¹, O. Olutoyin², D. Mann¹, M. F. Watcha¹

AFFILIATION: ¹Department of Pediatric Anesthesia, Baylor College of Medicine, Houston, TX, ²Pediatric Anesthesiology Texas Children’s Hospital, Baylor College of Medic, Houston, TX

INTRODUCTION: Patient safety concerns and productivity pressures limit training with new videoscopic equipment in managing children with difficult airways. These skills can be learnt in a less stressful situation using commercially available pediatric infant manikins simulating¹ normal airway;² anterior larynx; and³ Pierre Robin Sequence. This study compared the performance of 30 pediatric anesthesia practitioners in tracheal intubation of these manikins after standardized video and individualized hands-on training with 3 devices (standard Miller blade, the Glidescope Cobolt AVL or the Truview PCD video-laryngoscope).

METHODS: Subjects were observed using the 3 devices in all 3 manikins in 2 scenarios, first with a normal neck and then an unstable cervical spine. The order of devices and manikins was determined by a 3X3 Latin Square design to minimize carry over effects of the model and the device. The instructor provided constructive advice and criticisms after each attempt or failure to intubate by 120 seconds. Kaplan Meier survival analysis curves for the time to intubation were constructed with censoring at 120 seconds (Fig 1).

RESULTS: All subjects had prior experience of >500 intubations with the Miller blade, and more limited and varied experience with the other devices. The time to successful intubation was shorter and success rates higher with the Miller blade compared to the other two devices (table 1). In the normal neck scenario the success rates and intubation time did not differ for Glidescope and Truview.

Improved intubation times and success rates in the unstable spine scenario compared to the normal neck were due to learning effects with practice. There was a significant interaction between manikin and airway device indicating different rates of learning. In the normal airway model, learning was faster with the Truview device as subjects were already proficient with the Miller blade. In the anterior larynx model, subjects learned faster with the Truview compared to the Glidescope and Miller blade. In the Pierre Robin model participants learned faster with the Glidescope compared to the Miller and Truview. There was no interaction between years of previous anesthesia experience and performance.

CONCLUSIONS: Intubation time with the Miller#1 blade was faster and more successful than either video laryngoscope in all 3 manikins in both scenarios. In the second scenario of an unstable cervical spine, the degree of improvement with each device was related to the quantity of previous experience indicating rapid learning. Additional studies are required to see if these findings are replicated in actual patients and if intubation skills learned in simulation improve the clinical management of children with difficult airways.^{1,2}

REFERENCES:

1. Anesth Analg 2011; 113: 791-800
2. Anesth Analg 2009; 108: 1783-6

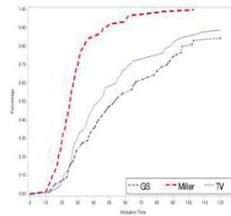


Figure 1: Kaplan Meier curve for time to intubation with the three devices in the normal neck scenario

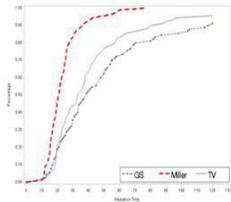


Figure 2: Kaplan Meier curve for time to intubation with the three devices in the unstable cervical spine scenario

Table 1.

Time to intubation in seconds and success rates of 30 subjects with first use of each device in each manikin. (90 attempted intubations).						
Device	Previous experience		Normal Neck		Unstable cervical spine	
	Number of participants	Cases Median (25-75 percentile)	Time to intubation	Success rates	Time to intubation	Success rates
Miller blade	30 (100%)	>500	26 (20 - 32)	90 (100%)	21 (16 – 26)	90 (100%)
Glidescope	30 (100%)	20 (5 – 37)	53.5 (32 – 92)	76 (84.4%)	39 (24 – 65)	82 (91.1%)
Truview	16 (57%)	Some experience	43.5 (28 - 80)	80 (88.8%)	33.5 (22-49)	86 (95.5%)

S-280.**IMPACT OF GENERAL ANAESTHESIA ON
NEUROCOGNITIVE OUTCOMES IN EARLY CHILDHOOD****AUTHORS:** C. L. Bong¹, J. Allen², J. S. Tan³, A. Rifkin-Graboi⁴**AFFILIATION:** ¹Department of Paediatric Anaesthesia, KK Women's and Children's Hospital, Singapore, Singapore, ²Office of Clinical Sciences, Duke-NUS Graduate Medical School, Singapore, Singapore, ³Paediatric Anaesthesia, KK hospital, Singapore, Singapore, ⁴Paediatric Anaesthesia, Singapore institute for clinical sciences, singapore, Singapore**INTRODUCTION:** Several retrospective studies have suggested that exposure to general anaesthesia below 4 years of age is associated with poorer neurocognitive and behavioural outcomes later in life¹⁻⁴. These studies have generated worry, controversy and questions about the safety of paediatric anaesthesia.**METHODS:** We analyzed data on anaesthesia exposure and neurodevelopmental outcomes using information from our country's largest and most comprehensive birth cohort study with 1176 subjects. Pregnant mothers are prospectively recruited from the normal population and followed up from the second trimester of pregnancy. Maternal and intrauterine factors that might influence epigenetic change at birth such as intra-uterine growth measures, diet, lifestyle and metabolic predictors are measured prospectively. Fetal growth scans are conducted at regular intervals and peripartum data prospectively collected. Metabolic and neuropsychological outcomes of the infants are closely monitored. Prospective neurocognitive and behavioural testing of infants and mothers are conducted at regular intervals. Infants undergo a rigorous standardized battery of neurocognitive assessments, including deferred imitation, relational binding, habituation, event-related potential at 6 and 18 months, Bayley Scales of Infant Development (BSID-III) at 24 months and child behavior checklist at 36 months.

During the 36 month visit, parents answered a questionnaire on details of surgical and anaesthesia exposure during the infants' first 3 years of life. This information was verified against the infant's medical records. We compared the neurocognitive scores of infants who were exposed to general anaesthesia at 6, 18, 24 and 36 months with infants who had no anaesthesia exposure.

RESULTS: 646 subjects were recruited in the neurocognitive arm of the study. Detailed verified information on previous anaesthesia exposure was available for 446 of these subjects. 26 of these subjects have had exposure to some form of anaesthesia (local anaesthesia or GA) or sedation. Of these, 14 subjects received GA before the age of 2, mostly for minor surgeries. After adjusting for differences in gender, race, gestational age, mode of delivery, APGAR scores, maternal education and socioeconomic status, the GA-exposed group had statistically significantly lower BSID-III at 24 months in 3 out of 7 domains compared to the unexposed group. Analyses of their BSID-III scores at 24 months are shown in Table 1.

There were no statistically significant differences in deferred imitation, relational binding or event related potential between the GA-exposed and unexposed groups at 6 and 18 months. Data are shown as LS-mean (pooled standard deviation). Corrected for gender, race, mode of delivery, gestational age, APGAR scores, maternal education and socioeconomic status.

CONCLUSIONS: Exposure to general anaesthesia below age 2 is associated with a significantly lower BSID-III scores in general adaptability, social and practical domains.**REFERENCES:**

1. Ing, Paediatrics 2012
2. Wilder Anaesthesiology 2009;
3. Kalkman Anesthesiology 2009.

Table 1: Composite Bayley Scores (BSID-III) at 24 months from GUSTO Cohort

	Exposed to GA (n=14)	Unexposed group (n=412)	p-value
Cognitive	92.30 (12.12)	96.54(12.12)	0.215
Language	85.07 (13.20)	92.09 (13.20)	0.060
Motor	102.09 (11.96)	105.58 (11.96)	0.302
Socio-Emotional	89.60 (14.77)	92.88 (14.77)	0.488
GAC	83.56 (17.52)	96.41 (17.52)	0.028*
Conceptual	89.25 (16.88)	99.81 (16.88)	0.061
Social	82.94 (17.55)	95.54 (17.55)	0.032*
Practical	82.16 (17.57)	94.56 (17.57)	0.035*

S-281.**DEXMETOMIDINE SEDATION AND CAUDAL ANAESTHESIA FOR INGUINAL HERNIA REPAIR IN INFANTS****AUTHORS:** C. L. Bong, J. S. Tan, A. S. Yeo**AFFILIATION:** Department of Paediatric Anaesthesia, KK Women's and Children's Hospital, Singapore, Singapore**INTRODUCTION:** There has been recent concern regarding adverse effects of early anaesthesia exposure on neurocognitive outcomes in children¹⁻³ All the commonly used anesthetic agents have been shown to induce developmental neurotoxicity in animal models. Dexmedetomidine is a notable exception and has been shown to be neuroprotective in in-vitro models.⁴⁻⁶**METHODS:** We describe a retrospective case series of 36 neonates and infants who underwent inguinal hernia repair using dexmedetomidine sedation with single shot caudal anaesthesia with 1.25ml/kg of levopupivacaine. The majority of patients are ex-premature infants with a median gestational age of 31.9 (IQR 28.7, 38.2) weeks. The median post-conceptual age at time of surgery was 39.7 (IQR 37.8, 45.7) weeks.**RESULTS:**80% of the patients underwent surgery successfully without the need for airway intervention or additional sedatives. 7 patients who required additional sedatives or conversion to general anaesthesia, 1 had a failed caudal block and required conversion to general anaesthesia with endotracheal intubation at the start of the surgery, 4 had technically difficult or prolonged surgery (including one patient who required orchidopexy) and required general

anaesthesia towards the end of the surgery and 2 patients had inadequate caudal block towards the very end of the surgery, one of whom required nitrous oxide and the other nitrous oxide with 0.5% sevoflurane for skin closure. Up to 20% of the patients developed hypoventilation or apnea, most of which which improved with stimulation alone. No patient required post-operative intubation or ICU care.

CONCLUSIONS: Dexmedetomidine sedation with caudal anaesthesia is a feasible alternative to general anaesthesia in selected infants undergoing uncomplicated hernia surgery and may offer the added advantages of avoiding the risks of endotracheal intubation and, possibly avoid the potential risks of GA-induced developmental neurotoxicity. With appropriate patient selection and support from our surgical colleagues as they become more familiar with this technique, our success rate is expected to increase. We will continue to develop, refine and audit this technique, which may eventually alter our standard of care in providing anaesthesia for hernia repair in neonates and young infants.**REFERENCES:**

1. *Ing Pediatrics* 2012; 130(3):e476-85. doi:10.1542/peds.2011-3822.
2. *Wilder Anesthesiology* 2009;110:796-804
3. *Sprung Anesthesiology*. 2009;111(2):302- 310
4. *Sanders Acta Anaesthesiol Scand*. 2010 Jul;54(6):710-6.
5. *Sanders Anesthesiology* 2009; 110:1077- 85.
6. *Schoeler BMC Neurology* 2012, 12:20

S-282.

THE PEDIATRIC BRAIN: AGE-DEPENDENT EFFECTS OF PROPOFOL ON FRONTAL ELECTROENCEPHALOGRAPH POWER AND COHERENCE

AUTHORS: J. M. Lee, K. Terzakis, K. J. Pavone, O. Akeju, P. Firth, P. Purdon, E. N. Brown

AFFILIATION: Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA

INTRODUCTION: Frontal electroencephalogram (EEG) patterns observed in adults during propofol-induced unconsciousness consist of a combination of large amplitude slow-delta oscillations (0.1-4 Hz) and coherent alpha oscillations (8-13 Hz). However, our current knowledge of anesthesia-induced EEG oscillations in the pediatric population is limited. Given that the nervous system undergoes significant changes from birth to adulthood, anesthesia-induced EEG oscillations in children may differ significantly from those in adults. Therefore, we sought to investigate the impact of age on frontal EEG power spectra and coherence during propofol-induced unconsciousness.

METHODS: We recorded 4-channel EEG data (SEDLine, Masimo, Irvine, CA) during propofol-induced unconsciousness in patients between 0 and 21 years of age (n=106). We analyzed the EEG using multitaper spectral and coherence analysis. Age-dependent changes were visualized by plotting mean spectra and coherence as a function of age. The relationship between power and age was characterized with a non-linear regression analysis, using a gamma function model.

RESULTS: For patients greater than 1 year old, the spectra and coherence show an EEG structure that is qualitatively similar regardless of age, featuring slow-delta and coherent alpha oscillations. The non-linear regression analysis showed a significant model fit for all frequency bands analyzed (total power, $R^2=0.616$, $p<0.001$; slow-delta, $R^2=0.313$, $p<0.001$; alpha, $R^2=0.313$, $p<0.001$; gamma, $R^2=0.641$, $p<0.001$). Total EEG power (0-40 Hz) peaked at approximately 3 years old and subsequently declined with increasing age (Fig 1I). Gamma oscillation power (31-40 Hz) exhibited a similar pattern with a peak at about 3 years old (Fig 2C). In contrast, alpha oscillation power peaked at approximately 6 years old (Fig 2A-B). For patients less than 1 year of age, we found that the EEG consisted mainly of slow-delta oscillations, with alpha oscillations appearing at approximately 5 months of age. However, these frontal alpha oscillations were not coherent until after 1 year of age (Fig 3).

CONCLUSIONS: Neurodevelopmental processes that occur throughout childhood and adolescence, including thalamocortical development, myelination, and neural pruning, may underlie age-dependent changes in EEG power and coherence during general anesthesia. Present-day depth-of-anesthesia monitors, which calculate indices designed to reflect level of unconsciousness, have been unreliable in assessing the brain states of children. Increased EEG power, particularly in gamma oscillations, may cause monitors to have inappropriately high readings, predisposing children to receive larger doses of anesthetic than necessary and thus increasing their risk for neurotoxicity. The identified changes in EEG power and coherence suggest a more principled approach to monitoring brain states in pediatric patients. Such an approach would facilitate more precise targeting of anesthetic drug dosing to desired brain states and could improve patient outcomes.

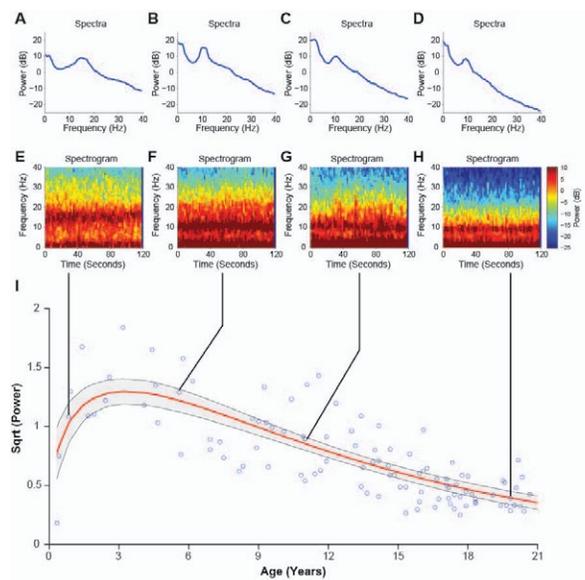


Figure 1. Total frontal electroencephalogram (EEG) power during propofol-induced unconsciousness exhibits age dependent variations. (A-H) Representative spectra and spectrograms from the frontal EEG of individual patients show age-related differences in total power (0-40 Hz), as well as differences in slow-delta oscillation power (0.1-4 Hz) and alpha oscillation power (8-13 Hz). (I) Total EEG power exhibited an increase over the neonatal period, peaked at approximately 3 years old, and subsequently declined with increasing age. The red line represents the gamma fit of the data, and the shaded bounds represent the 95% confidence interval of this fit.

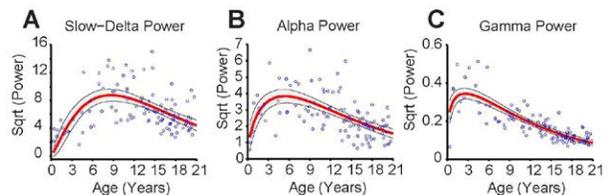


Figure 2. Slow-delta, alpha, and gamma oscillation power during propofol-induced unconsciousness exhibit age dependent variations. (A) Slow-delta oscillation power (0.1-4 Hz) exhibited a peak at approximately 8 years old. (B) Alpha oscillation power (8-13 Hz) exhibited a peak at approximately 6 years old. (C) Gamma oscillation power (31-40 Hz) exhibited a peak at approximately 3 years old. The red line represents the gamma fit of the data, and the shaded bounds represent the 95% confidence interval of this fit.

S-282 • continued

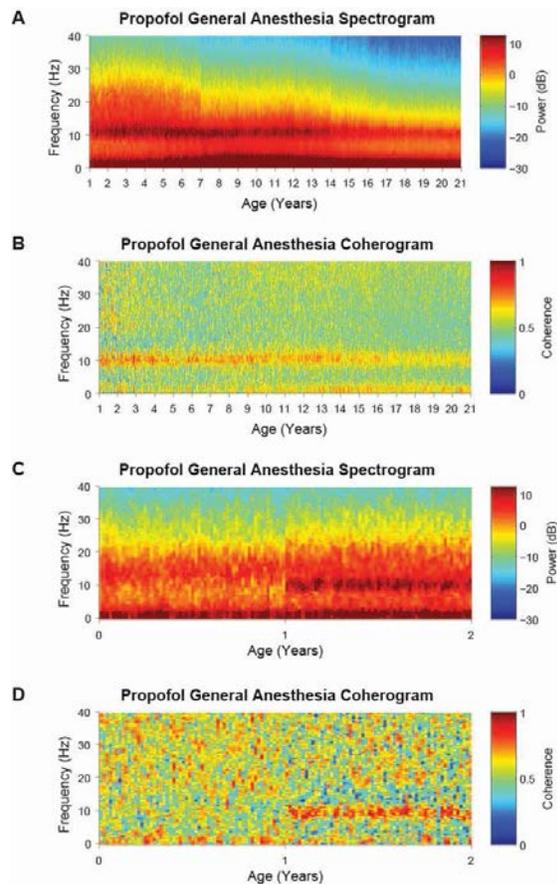


Figure 3. Spectrograms and coherograms during propofol-induced unconsciousness show similarities and differences in power and coherence characteristics with age. (A-B) In patients between 1 and 21 years old, the frontal EEG consists of prominent slow-delta oscillations and coherent alpha oscillations, consistent with previous literature. (C-D) In patients less than 2 years old, the frontal EEG consisted of prominent slow-delta oscillations and alpha oscillations, but alpha oscillation coherence was absent in patients less than 1 year old. These early changes in EEG structure and coherence may reflect ongoing neurological development in infants.

S-283.

ANALYSIS OF RHABDOMYOLYSIS IN PEDIATRIC SURGICAL INPATIENT ADMISSIONS USING THE KIDS DATABASE

AUTHORS: D. T. Maduram, L. Sun, T. Pinyavat

AFFILIATION: Department of Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Rhabdomyolysis, the breakdown of striated muscles, can occur during the perioperative period in association with the use of anesthetic agents. It is one of the clinical signs of malignant hyperthermia and propofol infusion syndrome. We previously examined the epidemiology of rhabdomyolysis in pediatric inpatients using the 2006 KID Inpatient Database (KID). In this follow-up study, we examined rhabdomyolysis in pediatric surgical patients in the KID in 2006 and 2009.

METHODS: The KID is a national database that contains inpatient records of pediatric discharges from US community, non-rehabilitation hospitals. We searched the 2006 and 2009 KID to identify pediatric admissions (patients 18 years old or younger, excluding neonates and patients with an OB diagnosis) with a diagnosis of rhabdomyolysis (ICD-9 728.88). Pediatric surgical patients are those who underwent a major surgical procedure, as defined by a Class 3 or 4 procedure code according to the HCUP Procedure criteria. Demographic data, hospital and admission type, length of stay, and mortality were calculated. We conducted a univariate analysis using the Statistical Analysis System 9.2 (SAS). Data are reported as means ± standard deviations (SD).

RESULTS: Of a total 3,026,564 admissions, 3,904 had a documented diagnosis of rhabdomyolysis. Thus, the incidence of rhabdomyolysis was 1.29 in 1,000 in pediatric inpatient admissions. There were a total of 618,879 admissions that had a major operative procedure. Of these, 415 pediatric surgical inpatient admissions had a diagnosis of rhabdomyolysis which yielded an incidence of 0.67 in 1,000. The age of pediatric surgical inpatients with rhabdomyolysis was 13.7 ± 5.1 years (means± SD). 75% were males (312/415), and 14.5% (51/415) were elective admissions. Length of stay was 21.7 ± 22.0 days (means±SD). The most common group of procedures associated with rhabdomyolysis was orthopedic procedures (103/415 or 24.8%), including soft tissue biopsy, fasciotomy, and open reduction internal fixation of femur. The most common diagnoses associated with rhabdomyolysis were closed fracture of shaft of femur (ICD-9 821.01), generalized sepsis (ICD-9 038.9), and complications of trauma (ICD-9 958.8). Mortality of rhabdomyolysis in pediatric surgical inpatient admissions was 5.6%, and in all pediatric inpatient admissions was 0.32%.

CONCLUSIONS: We confirmed that the incidence of rhabdomyolysis remained essentially unchanged in all pediatric inpatient admissions compared to our previous report, and it occurred mostly in adolescent males. The majority of procedures associated with rhabdomyolysis were orthopedic. Mortality of rhabdomyolysis in pediatric surgical inpatient admissions was 5.6%, which was much higher than that of mortality associated with rhabdomyolysis in all pediatric admissions. Our results can be used to further elucidate the relationship between rhabdomyolysis, surgery, and mortality.

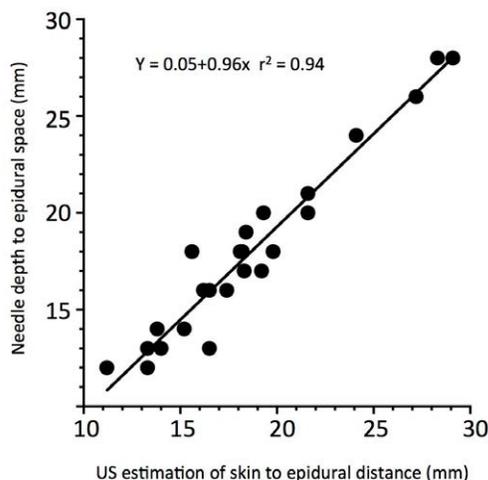
S-284.**PREDICTING THE DEPTH OF THE EPIDURAL SPACE BY USING ULTRASONOGRAPHY IN CHILDREN****AUTHORS:** S. Kawasaki, J. Yoshino, N. Fujimura**AFFILIATION:** Anesthesia, St.Mary's Hospital, Fukuoka, Japan

INTRODUCTION: Epidural anesthesia has been performed under general anesthesia in children. Various methods have been discussed to predict the distance between skin and epidural space in children undergoing epidural anesthesia to avoid dural puncture and/or nerve injury. We measured the distance from the skin-to-ligament flavum by using ultrasonography before epidural anesthesia and investigated the correlation of distance from skin to epidural space. The purpose of this study was to clarify whether ultrasound-measured skin-to-ligament flavum distance would reflect the needle depth during epidural puncture in children.

METHODS: After approval by the research committee, 25 children aged <12 years undergoing inguinal surgery were enrolled in this study. These children were scheduled for inguinal surgery. After general anesthesia was administered, the children were placed in the left lateral position. The T12-L1 space was identified by using ultrasonographic imaging. The distance between the skin and the ligament flavum was measured using prepuncture ultrasonographic imaging in transverse view with a linear probe of 8 MHz (S-nerve, FUJI FILM Sonosite). A 22G Touhy needle was aseptically inserted for epidural puncture. The loss of resistance method with 0.9% saline was used to identify the epidural space, and then, the needle depth from the skin-to-ligament flavum was recorded. Demographic data are presented as mean \pm SD. Simple linear regression analysis was performed using the least-squares method.

RESULTS: None of the cases reported dural puncture, blood tap, or postoperative neurological complication. The patients' mean age was 5.0 ± 3.4 years (range, 1-11 years), height was 105 ± 19 cm (74-145 cm), and weight was 18.3 ± 9.0 kg (9.4-45 kg). The distance from the skin to the epidural space showed greater correlation with distance measured using ultrasound imaging ($r = 0.94$) than did height ($r = 0.85$), weight ($r = 0.84$), and age ($r = 0.83$).

CONCLUSIONS: There are several mathematical formulas (e.g., formulas based on weight) for predicting the depth of epidural space in children, but these formulas do not always reflect the individual differences. Our results show a high correlation between the measurements of the distance between skin-to-ligament flavum by using ultrasonography. Epidural anesthesia could safely be performed, especially by beginner technicians, in children after measurement of the distance between skin-to-ligament flavum on the basis of prepuncture ultrasonographic images.

**S-285.****ALTERED MITOCHONDRIAL DYNAMICS CONTRIBUTES TO PROPOFOL-INDUCED CELL DEATH IN HUMAN STEM CELL-DERIVED NEURONS****AUTHORS:** Anesthesiology, Medical College of Wisconsin, Milwaukee, WI

AFFILIATION: ¹Anesthesiology and Pain Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ²Anesthesiology and Critical care, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ³Department of Clinical Pharmacy, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Islamic Republic of, ⁴School of Pharmacy, Islamic Azad University, Tehran, Iran, Islamic Republic of

INTRODUCTION: Every year millions of children are administered anesthetic agents for imaging or surgical purposes. Exposure to anesthetics such as propofol during the period of rapid synaptogenesis in the brain has been shown to induce neuronal cell death and long-term learning and memory deficits in young animal models. The animal studies conducted thus far raise significant safety concerns regarding the use of anesthetics in pediatric patients. Human embryonic stem cells (hESCs) are capable of differentiating into any cell type including neurons and represent a promising model to study mechanisms governing anesthetic-induced neurotoxicity in humans. We have developed the methodology to derive neurons from hESCs which has provided us with an in vitro human model by which to study anesthetic-induced neurotoxicity. Mitochondria are key regulators of a variety of cellular processes and continuously undergo cycles of fusion and fission. Under normal conditions, these processes are balanced and increases in mitochondrial fission have been shown to induce cell death in many models. In this study, we evaluated the changes in mitochondrial dynamics induced by propofol exposure in hESC-derived neurons and the role that these changes play in propofol-induced neurotoxicity.

METHODS: hESCs were differentiated into neurons following a four step differentiation protocol. The cells were characterized and the differentiation efficiency was assessed using neuron-specific immunofluorescence staining and confocal microscopy. Cell death was assessed using TUNEL staining. Changes in mitochondrial dynamics (fusion and fission) were assessed using TOM20 immunofluorescence staining and electron microscopy and expression of proteins of interest was assessed by Western blot. Mitochondrial permeability transition pore (mPTP) opening time was assessed using confocal microscopy.

RESULTS: Propofol dose and exposure number-dependently induced cell death in the hESC-derived neurons and exposure to 20 $\mu\text{g/mL}$ propofol for 6 hours significantly increased mitochondrial fission. Propofol exposure also induced changes in the expression of dynamin-related protein 1 (Drp1) and cyclin dependent kinase 1 (CDK1), which are key mediators of mitochondrial fission. Additionally, the mPTP opened earlier in cells exposed to propofol. Increases in mitochondrial fission, cell death and mPTP opening time were attenuated by pretreatment with mdivi-1, a mitochondrial fission blocker. Cell death and activation of Drp1 were also attenuated by blockade of CDK1 with Roscovitine.

CONCLUSIONS: These data suggest that: (1) exposure to propofol induces cell death in hESC-derived neurons; (2) propofol exposure induces changes in mitochondrial dynamics and alters the expression of key mediators of mitochondrial fission and (3) propofol-induced cell death is attenuated by pretreatment with the mitochondrial fission blocker, mdivi-1 or the CDK1 blocker, Roscovitine. Taken together, these data indicate that increases in mitochondrial fission and mPTP opening play an important role in propofol-induced neurotoxicity in developing human neurons.

S-286.

A PRELIMINARY COMPARISON OF COGNITIVE OUTCOME AFTER EXPOSURE TO GENERAL ANESTHESIA OR SPINAL ANESTHESIA DURING INFANCY

AUTHORS: R. Williams¹, G. Reimer², A. Taenzer³, D. M. Mathews⁴, D. Howard⁵, A. Friend⁴, I. Black⁴

AFFILIATION: ¹Department of Anesthesia, Vermont Children’s Hospital University of Vermont, Burlington, VT, ²Department of Anesthesia, Dartmouth Hitchcock Medical Center, Lebanon, NH, ³Department of Anesthesia, Children’s Hospital at Dartmouth Dartmouth Hitchcock Medical Center, Lebanon, NH, ⁴Department of Anesthesia, University of Vermont, Burlington, VT, ⁵Center for Clinical and Translational Science, University of Vermont Center for Clinical and Translational Science, Burlington, VT

INTRODUCTION: Analysis of infants exposed to either general anesthesia (GA) or spinal anesthesia (SA) should help to understand if cognitive dysfunction seen in previous studies is related to the effects of GA. We evaluated the academic performance of a cohort of elementary school children who had been exposed to a single surgery under the age of one year with either GA or SA.

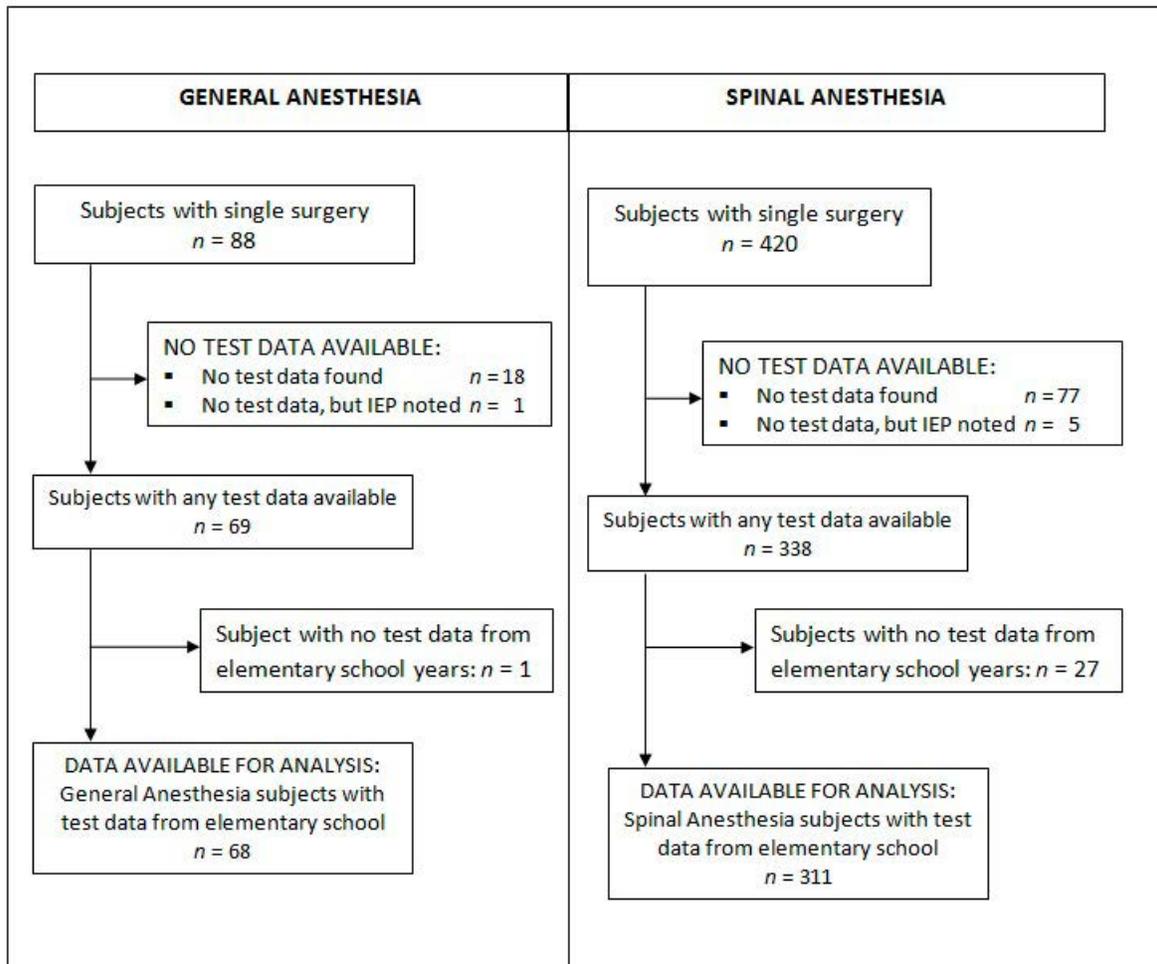
METHODS: SA is the anesthetic choice for infants undergoing hernia repair, circumcision or pyloromyotomy at one Children’s Hospital. A nearby Children’s Hospital uses GA for these procedures. We examined medical records for residents from the same state who had these surgeries in the years 2000-2013. Patient

records were cross matched with achievement test scores from the state Agency on Education (AOE). Students were evaluated for effects of anesthetic duration on test score performance as well as performance below the fifth percentile (Very Poor Academic Achievement (VPAA)). Exposed students were also compared to a control population matched by grade, gender, year of examination and socioeconomic status (free school lunch).

RESULTS: 88 infants had a single exposure to GA. 68 students had elementary school test data recovered. 420 infants had a single exposure to SA. 311 students had test data recovered.

CONCLUSIONS:

1. There was no statistically significant relationship between duration of exposure to GA or SA and test performance.
2. Although 9.4% of GA exposed children scored below the fifth percentile on reading examinations, when compared to children exposed to SA there was no significant increase in VPAA. This illustrates the importance of evaluating exposed groups with an appropriate comparison group.
3. This study examines the implications of exposure to only a single, relatively brief exposure to anesthesia and surgery. This methodology could be utilized to examine larger numbers of children exposed to repeated episodes of anesthesia and surgery.



S-286 • continued

Demographics are shown in Table 1. The two groups were similar in socioeconomic status and gender. Children exposed to SA had a higher likelihood of prematurity and birth weight <2500g.

Table 1: Demographic Characteristics of Children Exposed to General and Spinal Anesthesia

	General Anesthesia	Spinal Anesthesia	p value (Chi square)
Gender: Male	90% (61/68)	88% (273/311)	0.66
Free/Reduced Lunch	49% (33/68)	51% (159/311)	0.70
Surgery Type	41% Circumcision 15% Inguinal Hernia Repair 44% Pyloromyotomy	6% Circumcision 75% Inguinal Hernia Repair 19% Pyloromyotomy	<0.001
Prematurity:	16% (11/67)	29% (89/311)	0.04
Birth Weight <2500g	10% (7/67)	29% (89/311)	<0.002

Duration of exposure to GA was longer than exposure to SA. (Table 2.)

Table 2: Age and Duration of Exposure to Anesthesia: General vs. Spinal

	General Anesthesia		Spinal Anesthesia		p value
	Mean ±SD	Median (min.,max)	Mean ±SD	Median (min.,max)	
Age at surgery (months)	3.7 ±3.7	1.5 (0,12)	2.5 ±1.9	2 (0,10)	0.94
Duration of Anesthetic (hours)*	1.1 ±0.4 (n = 67)	1 (0.5, 2.0)	0.6 ±0.2	0.6 (0.2, 1.3)	<0.001

*For spinal anesthesia=duration of surgery
**p value from Wilcoxon Rank Sum test (comparing medians)

There was no statistically significant relationship between duration of exposure to GA and test score performance. There was a weak relationship between younger age at time of surgery for GA patients and diminished mathematics test performance. (r=-0.29, p=0.02) There was no relationship between duration of exposure to SA or age at exposure with test score performance. There was no difference in VPAA when students exposed to GA were compared to students exposed to SA. (Table 3)

Table 3: Students scoring below the 5th percentile on a standardized test: GA vs. SA

	General Anesthesia	Spinal Anesthesia	p value (chi2)	P-value adj. for Gender & SES
Total Math	4.7% (3/68)	6.8% (21/308)	0.46	0.52
Total Reading	9.4% (6/64)	7.4% (22/297)	0.59	0.57

There was no significant relationship with VPAA when students exposed to either SA or GA were compared with a matched control population. (Tables 4,5)

Table 4: GA exposed students scoring below the 5th percentile on a standardized test

	GA Exposed Patients	Controls	p value (chi2)
Total Math	4.4% (3/68)	6.9% (14/204)	0.47
Total Reading	9.4% (6/64)	5.2% (10/192)	0.23

Table 5: SA exposed students scoring below the 5th percentile on a standardized test

	SA Exposed Patients	Controls	p value (chi2)
Total Math	6.8% (21/308)	4.8% (44/924)	0.16
Total Reading	7.4% (22/297)	6.5% (58/891)	0.59

S-287.**INCIDENCE AND ASSOCIATED MORBIDITY AND MORTALITY OF PERIOPERATIVE ASPIRATION IN PEDIATRIC INPATIENTS****AUTHORS:** L. Eisler¹, M. Sun², C. Ing¹**AFFILIATION:** Anesthesiology, Columbia University Medical Center, New York, NY, ²Biostatistics, Columbia University Medical Center, New York, NY**INTRODUCTION:** Perioperative pulmonary aspiration of gastric contents is a major concern of pediatric anesthesiologists given its contribution to perioperative morbidity and mortality.^{1,2} Prior publications using quality assurance (QA) databases have found aspiration rates to range from 1 in 1000 to 1 in 5000 procedures^{3,4}, but QA databases have also been found to underreport complications.⁵ The purpose of this study was to evaluate overall and procedure specific risk of inpatient pulmonary aspiration for all children and infants undergoing operative procedures using a national inpatient database.**METHODS:** All non-newborn admissions of children under age 18 from the Kids Inpatient Database (KID) from 2003, 2006, and 2009 were evaluated. ICD-9 codes were used to identify operative procedures and diagnoses of pulmonary aspiration. Associations between aspiration and demographic risk factors as well as length of hospital stay and inpatient mortality were assessed. Continuous outcomes were evaluated using t-tests and categorical outcomes using chi-square. Multivariate logistic regression was used to calculate an odds ratio for mortality and adjust for demographic covariates.**RESULTS:** A total of 1106928 admissions with primary surgical procedures performed within 3 days of admission were evaluated. Children with aspiration were likely to be younger, emergently admitted and male, compared to children who did not aspirate.

(Table 1) The overall rate of inpatient pulmonary aspiration was 1 in 431 admissions and resulted in a longer mean length of stay (6.8 ± 16.1 vs. 3.9 ± 6.8 days) as well as a higher rate of mortality (6 vs. 0.4%). The odds of in-hospital death after aspiration was found to be greater even after adjusting for covariates (OR: 11.3; 95% CI: 9.4 - 13.6). Compared to the overall pediatric population, subset analysis of infants found that those who aspirated were also likely to be admitted emergently, however they were more commonly older and female.(Table 1)

Aspiration rates varied by procedure, with the highest rates associated with tonsillectomy/adenoidectomy and cardiac surgery (1 in 185 and 1 in 392 admissions respectively). Lower rates of aspiration were associated with hernia repair and appendectomy (1 in 649 and 1 in 1639 admissions respectively). Rates of aspiration in infant pyloromyotomy were found to be 1 in 952 admissions.

CONCLUSIONS: While aspiration is a rare complication during inpatient surgical admissions, our finding of a rate of 1 in 431 admissions using administrative data from the KID database suggests that it may be more common than previously described. While QA data may underestimate complications, administrative data may overestimate them, so these results should be interpreted with care. However, this analysis supports our concerns regarding pulmonary aspiration given its association with significantly increased length of stay and mortality.**REFERENCES:**

1. Anesth Analg. 103:941-7, 2006.
2. Acta Anaesthesiol Scand. 30:84-92, 1986.
3. Journal of Clinical Anesthesia. 10:95-102, 1998.
4. Pediatric Anesthesia. 23:702-711, 2013.
5. Annals of Surgery. 251 (4):766-771, 2010.

S-287 • continued

Table 1

	All Age		Infants	
	Non-Aspiration(n=1104361)	Aspiration (n=2567)	Non-Aspiration (n=143772)	Aspiration (n=297)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age in years	12.08 ± 7.16	7.16 ± 10.83	-	-
Age in months	-	-	2.09 ± 3.17	4.45 ± 3.59
	n (%)	n (%)	n (%)	n (%)
Race				
White	492665 (52.9)	1239 (55.6)	70333 (48.9)	116 (39.1)
Black	136441 (14.7)	369 (16.6)	13606 (9.5)	48 (16.2)
Hispanic	224905 (24.2)	424 (19)	25821 (18)	60 (20.2)
Asian	23919 (2.6)	56 (2.5)	7339 (5.1)	9 (3)
Native American	6335 (0.7)	21 (0.9)	656 (0.5)	1 (0.3)
Other	46640 (5)	120 (5.4)	8210 (5.7)	21 (7.1)
Missing	173456 (15.7)	120 (5.4)	17807 (12.4)	42 (14.1)
Total	930905 (100)	2229 (100)	143772 (100)	297 (100)
Gender				
Boys	485307 (43.9)	1596 (62.2)	109620 (76.2)	171 (57.6)
Girls	588297 (53.3)	966 (37.6)	33285 (23.2)	126 (42.4)
Missing	30757 (2.8)	5 (0.2)	867 (0.6)	0 (0)
Total	1104361 (100)	2567 (100)	143772 (100)	297 (100)
Admission Type				
Emergent	313900 (28.4)	914 (35.6)	24437 (17)	76 (25.6)
Urgent	191914 (17.4)	380 (14.8)	23356 (16.2)	64 (21.5)
Elective	353849 (32)	735 (28.6)	38415 (26.7)	103 (34.7)
Other	244698 (22.2)	538 (21)	57564 (40)	54 (18.2)
Total	1104361 (100)	2567 (100)	143772 (100)	297 (100)

S-288.**FENTANYL MITIGATES NEUROTOXICITY INDUCED BY PRENATAL PROPOFOL EXPOSURE IN RATS****AUTHORS:** J. Li, M. Xiong, A. Patel, J. H. Ye, A. Bekker**AFFILIATION:** Anesthesiology, Rutgers New Jersey Medical School, Newark, NJ**INTRODUCTION:** Our recent studies suggest that gestational exposure to propofol could cause apoptosis activation, learning and memory deficits and retardation in physical and neurological reflex development in the offspring rats. Fentanyl, a synthetic opioid analgesic, does not cause neuroapoptosis in the neonatal pig brain. Fentanyl and propofol are often combined in the clinical setting. The purpose of this study is to explore whether fentanyl combined with propofol mitigates neurotoxicity induced by prenatal propofol exposure in rats.**METHODS:** With IACUC approval, 40 pregnant Sprague-Dawley rats on gestational day 20 were randomly assigned to receive 1) Propofol anesthesia for 1 hour; 2) Propofol anesthesia combined fentanyl (bolus: 5.0 $\mu\text{g}\cdot\text{kg}^{-1}$, infusion rate: 30 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$; 3) Fentanyl alone and 4) Control condition (no infusion). In order to avoid hypoxia and hypercapnia, the dams (group 1 and 2) undergoing propofol general anesthesia were intubated and supported with controlled mechanical ventilation and 1.0 L/minute oxygen supply. Vital signs including heart rate, arterial oxygen saturation, and pulse distension, were continuously monitored by a pulse oximeter. End-tidal CO₂ (EtCO₂) was continuously monitored by an Ohmeda CO₂ monitor. The temperature was maintained by a heating lamp and temperature controller. Caesarean sections were performed 6 hours after propofol or fentanyl infusion. The brain tissues of fetal rats

were harvested and subjected to Western analysis to assess cleaved caspase-3 levels. In a separate cohort, dams were allowed to deliver their pups after propofol or fentanyl infusion. On postnatal day 28, the offspring were evaluated for learning and memory function in 8-arm radial maze.

RESULTS: The maternal vital signs and EtCO₂ monitoring indicated that the dams undergoing propofol general anesthesia with or without fentanyl were stable. Propofol anesthesia in pregnant rats augmented caspase-3 activation by 450% in the brain tissues of fetal rats. The combination of 30 $\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$ fentanyl significantly attenuated maternal propofol anesthesia-induced caspase-3 activation in the fetal brains (Propofol: 506 \pm 30% vs. Propofol + fentanyl: 143 \pm 37%; $P < 0.001$). Furthermore, the administration of fentanyl attenuated learning and memory impairment induced by prenatal propofol exposure, indicated as juvenile rats exposed to propofol combined with fentanyl in utero took shorter time and made less errors in the radial arm maze than the juvenile pups exposed propofol in utero. Moreover, fentanyl alone administered pregnant rats did not affect the levels of cleaved caspase-3 in the fetal brain and learning and memory function in the offspring.**CONCLUSIONS:** Fentanyl mitigates caspase-3 activation and neurocognitive deficits in the offspring induced by maternal propofol anesthesia.**REFERENCES:**

1. Li J, et al. Neurotoxicol Teratol 2014, 43:51-58.
2. Xiong M, et al. Brain Sci. 2014, 4(2):356-75.
3. Sabir, H., et al. Anesthesiology, 2013, 119(2):345-57.

S-289.

ACADEMIC PERFORMANCE AFTER ANESTHESIA AND SURGERY DURING CHILDHOOD: A LARGE-SCALE NATION-WIDE STUDY

AUTHORS: P. Glatz¹, R. H. Sandin¹, N. L. Pedersen², A. Edstedt Bonamy³, L. I. Eriksson¹, F. N. Granath³

AFFILIATION: ¹Department of Physiology and Pharmacology, Section for Anesthesiology and Intensive Care Medicine, Karolinska Institutet, Stockholm, Sweden, ²Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden, ³Department of Clinical Epidemiology, Karolinska Institutet, Stockholm, Sweden

INTRODUCTION: While preclinical studies strongly suggest that exposure to general anesthetics during infancy leads to increased neuronal apoptosis and later neurocognitive impairment¹, there is contradictory information from human studies aiming to translate preclinical findings into outcome studies of children exposed to anesthesia and surgery before age 4 yrs².

METHODS: After IRB approval we investigated a cohort of all, approximately 2 million children, born 1973-93. Data were collected from national health care and population registers to explore the association between pediatric exposure to anesthesia and surgery and ninth grade school results.

Among the 107,460 children with at least one surgical procedure before age 4 yrs, the primary analysis was restricted to those 34,480 children with only one exposure at age 0-4 years, followed by no hospitalization or further surgery. Five unexposed controls matched on sex, parity, year and month of birth were selected for each exposed child. Neuro- and cardiac surgery as well as cancer and diagnoses of malformations were excluded in the analyses. Primary outcome was average school marks at age 16 yrs.

RESULTS: Children having one exposure at 0-4 yrs had 0.47%

lower average marks at age 16 yrs (CI -0.75%, -0.18%, p< 0.001). More importantly, there was no detectable difference in school results at age 16 with one exposure at any of the younger age intervals 0-6 months, 7-12 or 13 - 24 months. Children exposed two or ≥3 times had 1.68%, and 1.69% lower average marks, respectively (Fig 1).

To put the minimal difference in the 0-4 age group into context, we compared our findings to other variables known to affect school results such as gender, month of birth and parents' educational level. Males have 9.87% lower school marks, and children born in December have 5.31% lower school marks compared to those born in January (Fig 2). Children whose mothers lack university education have 9.92% lower school marks (Fig 2).

CONCLUSIONS: In this large, nation-wide outcome study we demonstrate a minimal risk of lower school marks at age 16 in children after one exposure to anesthesia and surgery at age 0-4 yrs compared to unexposed children, and no indication of increased vulnerability at younger ages. Among 4,552 children having 2 or more surgical procedures we found a minimal worsening of school achievements by approximately 1.5 %. Importantly, we cannot distinguish between the potential effects of anesthesia per se, and the effects of surgery or other factors such as stress response to surgery and comorbidities driving the need for surgery. Even if a very small effect in exposed children indeed was identified, this was several orders of magnitude less than that from socioeconomics, gender, and month of birth.

Based on these findings, early exposure to anesthesia and surgery does not constitute a public health problem and there is no reason to postpone imperative surgery during early childhood due to fear for potentially negative impact on later school achievements.

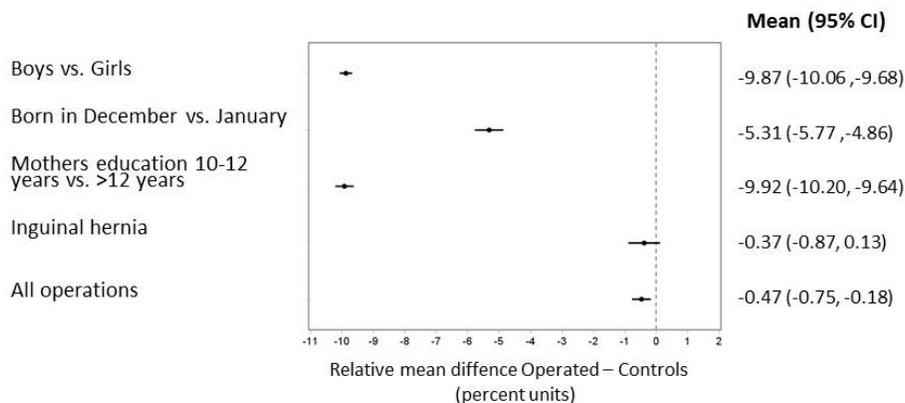
REFERENCES:

1. J Neurosci 2003 Feb 1;23(3):876-82
2. Curr Anesthesiol Rep (2013) 3:175-183

Fig. 1



Fig 2



S-290.**MULTIMODAL ANESTHESIA WITH THE ADDITION OF METHADONE IS SUPERIOR TO EPIDURAL ANALGESIA - A RETROSPECTIVE COMPARISON OF INTRAOPERATIVE ANESTHETIC TECHNIQUES AND PAIN MANAGEMENT FOR 124 PEDIATRIC PATIENTS UNDERGOING THE NUSS PROCEDURE**

AUTHORS: N. R. Singhal¹, J. Jones¹, R. Cotugno², J. Semenova², K. McCollum², A. Williamson², J. Jerman¹

AFFILIATION: ¹Pain Service, Valley Anesthesiology, Phoenix, AZ, ²Pain Service, Phoenix Children's Hospital, Phoenix, AZ

INTRODUCTION: The Nuss procedure is performed for cosmetic improvement and optimization of cardiopulmonary function in patients with pectus excavatum, and results in significant postoperative pain¹⁻³. Optimal pain management reduces complications and improves outcomes, which increases patient satisfaction⁴.

METHODS: A retrospective chart review was conducted on 124 children who underwent the Nuss procedure in a tertiary children's hospital. Patients were separated into four groups: traditional opioid analgesia during general anesthesia (GA), epidural analgesia with general anesthesia (GA+E), multimodal anesthesia (MA), and multimodal anesthesia with a single dose of methadone (MA+M). Data collection included opioid use, pain scores, length of stay, and adverse effects from therapy.

RESULTS: The multimodal anesthesia groups showed lower opioid use and shorter hospital length of stay when compared to the GA and GA+E groups. The MA+M Group showed the lowest opioid use (GA=193.49mg, GA+E = 198.05 mg, MA=177.02mg, vs. MA+M=108.00mg; P=0.001) and shortest length of stay in days (GA=4.87, GA+E=5.49, MA=4.50, MA+M=3.83; P=0.001).

CONCLUSIONS: This study demonstrates that multimodal anesthesia with a single dose of methadone on induction of anesthesia decreases postoperative opioid use and length of stay better than three other anesthetic techniques and pain management strategies evaluated.

REFERENCES:

1. European Journal of Cardiothoracic Surgery, 37:833-839. 2009
2. European Journal of Cardiothoracic Surgery, 8:203-209. 2010
3. British Journal of Anesthesia, 98:677-681. 2007
4. Pharmacological Research, 50:551-559. 2004

Subspecialty Abstracts

Perioperative Anesthesia

S-291.**INCIDENCE OF HYPOTHERMIA DURING GASTROINTESTINAL SURGERY WITH ACTIVE WARMING; PROSPECTIVE OBSERVATIONAL STUDY**

AUTHORS: T. Ichimaru¹, T. Uno¹, M. Arakida², M. Nagai¹, N. Morioka¹, M. Ozaki¹, Y. Sakuyama¹

AFFILIATION: ¹Anesthesiology, Tokyo Women's Medical University, Tokyo, Japan, ²Perioperative Nursing, Tokyo Women's Medical University, Tokyo, Japan

INTRODUCTION: The importance of intraoperative temperature management has been stressed by many studies as low body temperatures are associated with the development of postoperative complications and worsening prognosis. For these reasons, active warming is often performed. However, active warming alone is not enough to solve all temperature management problems, because, despite the application of active warming, some patients still develop hypothermia. A retrospective study found that, in nearly 30% of all cases investigated, the patient's temperatures had not been measured for monitoring, or even if measured, no particular attention had been paid to the values obtained. Herein, we studied a prospective observational study on the incidence of hypothermia and the types of patients who tend to develop hypothermia during gastrointestinal surgery, including laparoscopy.

METHODS: In 170 patients undergoing gastrointestinal surgery, we began measuring each patient's temperature with a tympanic thermometer upon their entry into the operating room and then with a bladder thermometer after anesthetic administration, such that the patient's temperature was measured at two different sites. Room air temperature and humidity were also measured at the same time. The method of anesthetization was left entirely to the anesthesiologist, and we observed only the changes in body temperatures. A forced-air warming device was used upon the patients' entry into the operating room. The following parameters were measured: the lowest intraoperative body temperature; the highest intraoperative body temperature; and body temperature at the time of the patient's departure from the operating room. As to patients' characteristics and intraoperative factors, we collected data on the operative time, the duration of anesthesia, use of laparoscopy, gender, age, height, body weight, and blood loss.

RESULTS & DISCUSSION: Patients with a lowest intraoperative temperature of no more than 36°C accounted for 61%, but only 17.7% of the entire patient group left the operating room with a temperature of 36°C or lower. We found that there was a higher risk of developing hypothermia among patients who entered the operating room with a low body temperature, those who had laparoscopic surgery. However, we also found that, even if a patient's temperature drops temporarily during surgery, provided that active warming has been in use since the patient's entry into the operating room, it is still possible to restore the temperature to a value above 36°C by the end of the operation through re-warming. Additionally, keeping the body temperature relatively high upon the patient's entry into the operating room can prevent the occurrence of hypothermia during surgery. We believe that intraoperative hypothermia is preventable by pre-warming, which is also considered to be essential in preventing patients from entering the operating room with a temperature of 36.5°C or lower.

CONCLUSION: The incidence of hypothermia was 61% during surgery and 17% at the time of departure from the operating room.

S-292.

PULSE PRESSURE AS A PREDICTOR OF POSTOPERATIVE RENAL FUNCTION IN PATIENTS UNDERGOING LOWER EXTREMITY BYPASS GRAFTING

AUTHORS: Y. Hua, N. Odo, S. Wu

AFFILIATION: Anesthesiology and Perioperative Medicine, Georgia Regents University, Augusta, GA

INTRODUCTION: Elevated arterial pulse pressure (PP) is a predictor of cerebrovascular accident (CVA), major adverse cardiac events, renal failure and mortality among patients having coronary artery bypass graft (CABG) surgery. However, the relationship between PP and these adverse events among patients undergoing non-cardiac surgery is less known.

METHODS: We conducted a retrospective study of patients undergoing elective lower extremity bypass surgery between January 2010 and March 2013. Three separate blood pressure readings (from the preoperative clinic evaluation, preoperative holding, and immediately prior to induction) were obtained and PP was calculated. The mean PP was used to determine if there is a correlation between elevated PP (>70 mmHg) and worsened postoperative renal function. Perioperative characteristics including comorbidities, medications, preoperative vital signs and pre- and postoperative renal function were recorded. The relationship between elevated PP and perioperative renal function was assessed using the Chi Square test.

RESULTS: Baseline characteristics of the elevated PP (>70mmhg) and normal PP (<70 mmHg) groups were similar except for vasodilator use (8/16 in elevated PP group vs 4/34 in normal group) (see Table 1).

CONCLUSION: We didn't detect any significant difference in renal function (GFR or CC) preoperatively or postoperatively between patients with PP>70 and those with PP <70 who underwent lower extremity bypass surgery, although we did see a trend of decreased GFR postoperatively in the elevated PP group. More data may be needed to detect a significant difference.

REFERENCES:

1. Preoperative Arterial Pulse Pressure Has No Apparent Association with Perioperative Mortality After Lower Extremity Arterial Bypass, Volume 114, Page 1170-1175, 2012.
2. Pulse Pressure index (pulse pressure/systolic pressure) may be better than pulse pressure for assessment of cardiovascular outcomes, Volume 72, Pages 729-731, 2009.
3. Heart Rate and pulse pressure at rest are major prognostic markers of early postoperative complications after coronary bypass surgery, Volume 33, pages 971-976

	PP< 70mmHg n=34	PP≥70mmHg n=16	P value
Age (mean)	61.4 ± 8.7	62.9 ± 9.1	0.588
Gender (% male)	79%	62%	0.301
Race (B/W)	15/19	10/6	0.364
BSA	1.89 ± 0.3	2.05 ± 0.3	0.089
CAD, n (%)	13 (38.2%)	6 (37.5%)	1
HTN, n (%)	30 (88.2%)	14 (87.5%)	1
DM, n (%)	12 (35.2%)	6 (37.5)	1
Pulmonary disease, n (%)	10 (29.4%)	4 (25%)	1
CVA, n (%)	4 (11.7%)	2 (12.5%)	1
Smoker, n (%)	16 (47%)	9 (56.2%)	0.762
β blocker, n (%)	22 (64.7%)	10 (62.5%)	1
ACEI, n (%)	17 (50%)	7 (43.7%)	0.767
Ca blocker, n (%)	9 (26.4%)	8 (50%)	0.121
Diuresis, n (%)	14 (41.1%)	8 (50%)	0.761
Vasodilator, n (%)	4 (11.7%)	8 (50%)	0.01*
Statin, n (%)	18 (52.9%)	8 (50%)	1

Table 2 Pulse Pressure and Preoperative GFR and CC

	GFR	CC
Odds Ratio	1.806	0.9286
95% Confidence Interval	0.4208 to 7.747	0.2002 to 4.308
P Value	0.4277	0.9246
P Value summary	not significant	not significant

Table 3 Pulse Pressure and Postoperative GFR and CC

	GFR	CC
Odds Ratio	2.200	1.362
95% Confidence Interval	0.6284 to 7.703	0.3849 to 4.819
P Value	0.2128	0.6312
P Value Summary	Not Significant	Not Significant

S-293.**PERIOPERATIVE MANAGEMENT OF PATIENTS WITH LEFT VENTRICULAR ASSIST DEVICES UNDERGOING REPAIR OF HIP FRACTURE**

AUTHORS: J. Alexander, R. Ivie, R. Maniker, J. Sobol

AFFILIATION: Department of Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Thousands of patients have received left ventricular assist devices (LVADs) as therapy for heart failure, with an increasing number designated as destination therapy¹. A growing number of patients are surviving with their LVADs and require noncardiac surgery unrelated to their device. While a number of single-center studies have detailed individual experiences with noncardiac surgery in patients with LVADs^{2,3}, none has examined a homogeneous population undergoing one type of noncardiac surgical procedure. Our aim was to illustrate the unique concerns and perioperative management of patients with LVADs undergoing hip fracture repair at our institution.

METHODS: After Institutional Review Board approval, we used electronic medical records to retrospectively examine the perioperative care of four patients undergoing surgical repair of hip fractures after LVAD placement at our institution.

RESULTS: Four patients with a history of ischemic cardiomyopathy requiring continuous-flow LVAD placement underwent open reduction and internal fixation (ORIF) of hip fractures between January 2004 and June 2014. The average age of these patients was 72.7 years (range 59 - 83 years). LVAD devices were placed on average 1124 days (range 164 - 3038 days) prior to the hip ORIF. All patients were admitted to an outside hospital on the day of their fracture and were transferred to our institution the following day, with subsequent ORIF 2 - 5 days post-fracture. Three of the four patients were on warfarin preoperatively, which was stopped on admission. The International Normalized Ratio (INR) immediately prior to surgery was 1.3-1.4 in all patients. Preoperatively, three patients received an ultrasound-guided femoral nerve block. All cases were staffed with a noncardiac anesthesiologist, and all patients received general anesthesia with an endotracheal tube after placement of a pre-induction radial arterial line. There were no major intraoperative events and no major hemodynamic instability in the operating room. All patients received phenylephrine intraoperatively, but no other vasopressors or inotropes were administered. Estimated blood loss ranged from 100 to 400 ml; two patients received intraoperative blood transfusion. Postoperative complications were common, with infection occurring in three patients (urinary tract infection in two patients, and tracheobronchitis in one patient). One patient also exhibited signs of right ventricular dysfunction and volume overload on postoperative day 2. Postoperative hospital stay ranged from 8 - 25 days, and all patients were subsequently discharged to rehabilitation facilities.

CONCLUSIONS: While multidisciplinary care is essential for patients with LVADs, general anesthesiologists should broaden their knowledge of the distinct challenges these patients present in the perioperative period. With these considerations in mind, management of hip ORIF in this patient population can be relatively straightforward.

REFERENCES:

1. J Heart Lung Transplant 2013; 32(2): 141-56.
2. J Heart Lung Transplant 2012; 31(7): 757-63.
3. Mayo Clin Proc 2013; 88(7): 674-82.

S-294.**INTRAOPERATIVE VASOPRESSIN WOULD FACILITATE RADICAL PROSTATECTOMY**

AUTHORS: T. Kikuchi

AFFILIATION: Anesthesiology & Pain Medicine, Juntendo Univ. Hospital, Tokyo, Japan

INTRODUCTION: In radical prostatectomy, the narrowness of the surgical field and the outflow of urine obstruct the field of vision and hinder the progress of surgery. In June 2014, we began to administer a small amount of vasopressin during this surgery with the aim of reducing the outflow of urine in the surgical field and facilitating the procedure.

METHODS: Participants comprised 10 male patients without renal dysfunction who were scheduled for radical prostatectomy due to prostate cancer. In all patients, surgeries were performed under general anesthesia combined with epidural anesthesia. During surgery, just before bladder incision, 0.1 units of vasopressin were administered intravenously (Group V). The amount of bleeding, the urine volume, and the operation time were then assessed and compared with a control group (n=10) composed of patients operated on before June (from January to May) 2014 who did not receive vasopressin (Group C). Unpaired t-test was used for inter-group comparisons and a P value <0.01 was considered significant.

RESULTS: No significant differences were evident between the two groups in terms of background factors. In Group V, the amount of bleeding, the urine volume, and the operation time were 613.8±331.7 g, 329.1±215.2 ml, and 231.8±20.7 min, respectively. In Group C, these values were 999.3±310.7 g, 277.9±127.9 ml, and 273.1±39.9 min, respectively. The amount of bleeding and operation time in Group V were significantly lower than those in Group C (P=0.0076, P=0.0047). In all Group V cases, re-outflow of urine was recognized at the end of surgery, with no postoperative renal dysfunction.

CONCLUSION: Our results suggest that administration of 0.1 units of vasopressin does not affect postoperative urine outflow and renal function, and is therefore a safe and simple method to facilitate prostatic surgery.

S-295.

WITHDRAWN.

S-296.

WITHDRAWN.

S-297.**INCIDENT OF HYPOTHERMIA WITH PASSIVE WARMING:
RETROSPECTIVE OBSERVATIONAL STUDY**

AUTHORS: E. Yamamoto, R. Kanamori, T. Uno, M. Nagai,
T. Terada, M. Ozaki, Y. Sakuyama;

AFFILIATION: Anesthesiology, Tokyo Women's Medical
University, Tokyo, Japan

INTRODUCTION: Active warming is generally acknowledged as a method of intraoperative temperature management. However, according to a survey conducted on intraoperative temperature management in Europe, there are still many facilities where active warming is not in practice.¹ In Japan, the concept of active warming has finally gained widespread acceptance in university hospitals and other large-scale facilities, but medium-sized hospitals have yet to adopt active warming. This is said to be due to cost-related concerns and a lack of awareness among medical professionals, including anesthesiologists.

Methods: We conducted a retrospective observational study on the incidence of hypothermia in 2152 cases in whom surgeries were performed under general anesthesia over the three years from 2009 to 2011 at a hospital with 300 beds. This facility performs about 800 surgeries with general anesthesia per year. From the operation charts of the 2000 surgeries performed under general anesthesia, we obtained data on body temperatures at the time of anesthetic administration and at 60 minutes thereafter; the lowest intraoperative temperature; the highest intraoperative temperature, and the body temperature at the time of departure from the operating room. The acquired data were then plotted manually. For general anesthesia, mainly inhalant anesthetics were used (combined with epidural anesthesia in some cases). The surgeries were performed by the departments of orthopedics, cerebral surgery, urology, gastroenterological surgery, general surgery and obstetrics/gynecology. The only method of temperature management employed was to cover the patient with a blanket, while warming of blood before transfusion was not actively performed. The patients' body temperatures were measured after anesthetic administration using a pharyngeal temperature probe. As to patients' characteristics, we obtained data on the type of surgery, disease, age, gender, height, body weight, operating time, duration of anesthesia, amount of blood loss and the amount of transfusion.

RESULTS & DISCUSSION: Those with a lowest intraoperative temperature of no more than 36°C accounted for 27.2% of all cases. Patients with a temperature of 36°C or lower at the time of departure from the operating room accounted for more than 21.2% of all cases. Even with passive warming alone, the probability of hypothermia development can be lowered just by keeping the body temperature relatively high at the time of entering the operating room. Elderly patients, those with low BMI and patients undergoing a prolonged operation were at higher risk for a decrease in body temperature to less than 36°C. Therefore, simply by performing active warming exclusively in these high-risk patients, cost efficiency may be achieved.

CONCLUSION: In temperature management using passive warming alone, the incidence of hypothermia was 27.2% during surgery and 21.4% at the time of departure from the operating room.

REFERENCE:

1. Eur J Anaesthesiol. 2007 Aug;24(8):668-75. Epub 2007 Apr 11.

S-298.

USE OF AN ELECTRONIC TRACKING AND DATA CAPTURE SYSTEM PAIRED WITH A SHARED RESPONSIBILITY MODEL TO MANAGE POST-ANESTHESIA EVALUATIONS AND MEASURE ANESTHETIC QUALITY

AUTHORS: K. McCarty, V. Kurzweil, A. Agarwala

AFFILIATION: Department of Anesthesia Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA

INTRODUCTION: Post-operative assessments are a required component of complete anesthetic care from both a legal and optimal care standpoint. They present a valuable learning opportunity to gain feedback from patients and gather information to improve future anesthetic care. While completion of post-anesthesia assessments is a standard expectation, the process is highly variable. Inconsistency at our institution contributed to 1) inability to collect reliable data on short-term post-operative outcomes, 2) inability to track which post-ops had not been completed, and 3) primary anesthesia teams not always available to complete their own post-ops due to misaligned timing with staff and OR schedules. In response, we designed an electronic and shared responsibility model to improve data capture, quality and consistency of post-op evaluations.

METHODS: An electronic feed of the OR schedule was relayed to a homegrown tracking board (Fig. 1) that displayed all patients who received an anesthetic but did not yet have a post-op evaluation. The board linked to an electronic post-op evaluation form (Fig. 2) that, when completed, cleared the patient from the board. These new systems were piloted on patients that bypassed the PACU and went directly from the OR to a floor or ICU. Evaluation criteria required

by regulations were forced entries. Other fields were optional, but encouraged. All evaluations were completed in-person on the morning of post-op day (POD) 1, usually by a clinician independent from the patient’s intraoperative care team.

RESULTS: Between Apr. 2013 and Sep. 2014 anesthesia was provided for 58,599 patients, 5973 (10.2%) of which were part of the pilot population. Among that group, 70 (1.2%) had problems with inadequate hydration, 263 (4.4%) required post-op transfusion, 456 (7.6%) had nausea/vomiting, and 83 (1.4%) complained of inadequate pain control. A subset of these patients were evaluated for additional criteria: 0.5% of 2838 patients reported dissatisfaction with their anesthetic care and 2 out of 2738 patients had suspected awareness. Post-op concerns were noted for 4.0% of 2520 patients and it was suggested that 97 of 4030 (2.4%) patients receive additional follow-up from an anesthesia provider (Fig. 3).

CONCLUSION: An electronic tracking tool and evaluation form enabled our organization to easily collect data from post-op evaluations, identify patients in need of post-op assessments and use a shared responsibility model when the primary team was unavailable. Preliminary results establish baseline performance for anesthetic quality and identify areas in need of further improvement and study. For example, factors contributing to the 4.4% post-op transfusion rate and 2.4% additional care rate need determination. This data will also enable to us compare the impact of workflow choices, such as using non-primary care team members and POD 0 vs. POD 1 evaluations. While using electronic tracking, data collection, and a shared responsibility model helped to overcome initial challenges, new factors were identified for further consideration as we move to wider implementation of the electronic system.

MRN	Last Known Anesthesia Location	Date Of Service	Patient Name	PostOp Window	Anesthesiologist	Anesthetist	Procedure	Periop Discharge Location	PostOp Complete	PostOp Team	Action
Slot 16 (CPC Wang 3)		10/22/2014		48			RIGID BRONCH, LARYNGOTRACHEAL RESECTION AND RECONSTRUCTION (R & R)	Departed for SICU - Ellison 4	No	SICU	
OR 37 (MAIN OR)		10/22/2014		42			EXPLORATORY LAPAROTOMY, bilateral embolization	Departed for SICU - Ellison 4	No	SICU	
OR 27 (MAIN OR)		10/22/2014		41			TRACHEAL RESECTION AND RECONSTRUCTION	Departed for SICU - Ellison 4	No	SICU	
OR 37 (MAIN OR)		10/23/2014		28			EXPLORATORY LAPAROTOMY	Departed for SICU - Ellison 4	No	SICU	
OR 89 (LUNDER 4)		10/23/2014		20			THORACIC LUMBAR ANTERIOR FUSION	Departed for SICU - Ellison 4	No	SICU	
OR 84 (LUNDER 4)		10/23/2014		19			RIGHT POPLITEAL ANEURYSM RESECTION	Departed for SICU - Ellison 4	No	SICU	
OR 26 (MAIN OR)		10/23/2014		12			LEFT THORACOTOMY	Departed for SICU - Ellison 4	No	SICU	
OR 37 (MAIN OR)		10/24/2014		2			EXPLORATORY LAPAROTOMY	Departed for SICU - Ellison 4	No	SICU	
OR 28 (MAIN OR)		10/24/2014		0			RIGHT FLANK EXPLORATION	Departed for SICU - Ellison 4	No	SICU	

Red Text means Time since D Time is more than 40 hours.
Blue Text means Time since D Time is more than 24 hours but less than 40 hours.

Figure 1. Post-Op Tracking Board

S-298 • continued

* Level of Consciousness -- Pick one --

Loc Comments

Vital Signs Stable Yes No *(See nursing flow sheet for physical details)*

* BPS	<input type="text"/>	mmHg	* Pulse	<input type="text"/>	bpm	* RR	<input type="text"/>	insp/min	
* BPD	<input type="text"/>	mmHg	* SpO2	<input type="text"/>	%	* Temp(F)	<input type="text"/>		* Temp(C)

*** Hydration** -- Pick one -- Preop Pain Score

Has Patient required Post-Op Transfusions? Yes No Current Pain Score

*** Post Op Airway Status** -- Pick one -- *** Pain Control Adequate** Yes No

Supplemental Oxygen -- Pick one -- Pain Comments

*** Nausea/Vomiting** -- Pick one -- Patient Satisfied with Anesthetic Yes No

Breathing Spontaneously Yes No

Spinal/Epidural/Peripheral Block level resolving (if primary anesthetic) Yes No Patient's questions answered Yes No

Spinal/Epidural/Peripheral Block Resolving Comments Evidence of Unexpected Intra-op Awareness Yes No

Post-Operative concerns Yes No Post-op Recall Comments

Other Comments:

Additional follow-up by anesthesia required Yes No

Save * **Bolded in green are CMS Requirements**

Figure 2. Electronic post-op form

Post-Op Issue:	Total evaluated	# with issue	% with issue
Inadequate Hydration	5973	70	1.2%
Post-Op Transfusions	5973	263	4.4%
Resolved / improving PONV	5973	424	7.1%
Ongoing PONV	5973	32	0.5%
Overall PONV rate	5973	456	7.6%
Pain Control Inadequate	5973	83	1.4%
Patient not Satisfied with Anesthetic	2838	14	0.5%
Patient's questions not answered	2732	44	1.6%
Evidence of Awareness	2738	2	0.1%
General post-Op Concerns	2520	101	4.0%
Additional follow-up Required	4030	97	2.4%

Figure 3. Frequency of post-operative issues discovered during a pilot of post-anesthesia evaluations using a new electronic tracking and assessment system for patients sent directly from the OR to an inpatient floor or ICU.

S-299.

THE PREDICTION OF POSTOPERATIVE OPIOID REQUIREMENTS IN CHRONIC OPIOID CONSUMING PATIENTS - A RETROSPECTIVE OBSERVATIONAL STUDY

AUTHORS: K. Wakaizumi¹, N. Ihara¹, D. Nishimura¹, Y. Fukuda², S. Hashiguchi¹, H. Morisaki¹

AFFILIATION: ¹Anesthesiology, Keio University School of Medicine, Tokyo, Japan, ²Anesthesiology, Tokyo Adventist Hospital, Tokyo, Japan

INTRODUCTION: Acute postoperative pain management of patients with a history of current opioid consumption is challenging since standard treatment dosages and strategies for non-opioid-user are often ineffective in providing pain relief to these patients. Hence, we hypothesized patients who had received opioid therapy prior to their surgery would require more intense opioid therapy for postoperative pain relief, and performed a retrospective observational study that examined post-operative opioid requirements in chronic opioid-consuming patients (COCPs) who underwent surgery. We also provided an adequate opioid prescription for the initial postsurgical state.

METHODS: After obtaining IRB approval, we reviewed medical records of COCPs who had undergone surgery between April 2001 and July 2012, and selected the patients who used patient-controlled analgesia (PCA) after surgeries. We compared total amounts of opioids including basal and rescue doses for 24 hours between pre- and postoperative periods, and also examined surgical procedures, operated body part, and postoperative analgesic treatments. As the kind of opioids or route for administration differs among patients, we converted the amount of opioids into potency of morphine; 15 mg of intravenous morphine was considered equivalent to 30 mg of oral morphine, 20 mg of oral oxycodone, and 0.15 mg of fentanyl (intravenous, transdermal, epidural)^{1,2}. Then we analyzed the correlation between preoperative morphine consumption (pre-M) and postoperative morphine requirement (post-M). Morphine sparing effect of postoperative continuous epidural analgesia (PCEA) was examined by using the post-M to pre-M ratio. Linear regression and unpaired t-test were performed for statistical analyses.

RESULTS: We selected 99 COCPs in this study and 46 patients were excluded due to lack of data and difficulty in pain evaluation (Figure 1). Thus 53 COCPs were analyzed for the study. None of the patients quit PCA due to adverse effects of opioids such as nausea and vomiting, drowsiness, and respiratory depression. The median dose of pre-M was 15.0 mg and the maximum was 200 mg (Table 1). Post-M correlated significantly with pre-M ($R^2 = 0.80$, Figure 2). We expected PCEA would reduce postoperative opioid requirement, however the post-M to pre-M ratio did not differ between PCEA (+) and (-) patients (Figure 3). The bottom line of the 95% prediction band crossed the 30 mg of pre-M on the X-axis (Figure 2).

CONCLUSIONS: Opioid requirement for postoperative 24 hours depends on preoperative opioid consumption. PCEA does not reduce the postoperative opioid requirement in COCPs. Appropriate basal opioid dose for postoperative pain treatment in COCPs is predicted as follows:

$$X = 1.15 (C - 30)$$

Where “X” is the postoperative basal morphine consumption per day, and “C” is the preoperative morphine consumption per day. This formula is applicable only for COCPs consuming 30 mg or more of pre-M.

REFERENCES:

1. Palliative care guidebook for cancer pain. 50–2, 2008, Aomisyua (Japan).
2. J. Clin. Anesth. 1994; 6: 308–314.

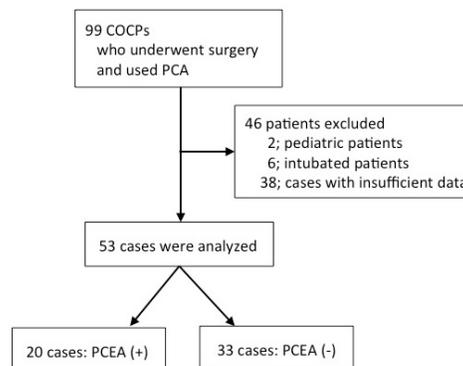


Figure 1. Flowchart of the study selection process. COCP: chronic opioid-consuming patient, PCA: patient control analgesia, PCEA: postoperative continuous epidural analgesia.

Table 1. Patient characteristics

	Value
Age (y/o), mean (range)	52.3 (20–88)
Sex	M = 23, F = 30
Weight (kg), mean (range)	54.87 (38–96.6)
Pre-M (mg), median (range)	15.0 (7.5–200)
Surgery site (n)	18; Abdomen 17; Spine 11; Limbs (Bone & Joint) 5; Thorax 2; Others

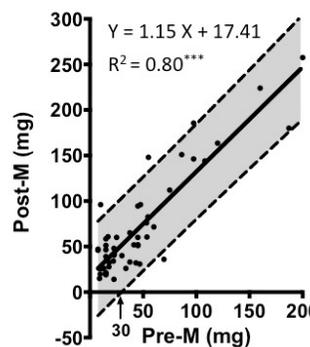


Figure 2. Correlation between post-M and pre-M ($R^2 = 0.80$, $n = 53$). The dark area represents 95% prediction band. Linear regression was performed for statistical analysis. *** $P < 0.001$.

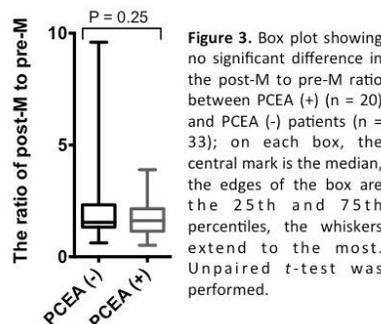


Figure 3. Box plot showing no significant difference in the post-M to pre-M ratio between PCEA (+) ($n = 20$) and PCEA (-) patients ($n = 33$); on each box, the central mark is the median, the edges of the box are the 25th and 75th percentiles, the whiskers extend to the most. Unpaired t-test was performed.

S-300.

LONG-TERM SEQUELAE IN PATIENTS WHO EXPERIENCED A MALIGNANT HYPERTHERMIA EVENT

AUTHORS: K. Werneid¹, S. Riazi², B. Brandom¹

AFFILIATION: ¹Department of Anesthesiology, Children Hospital of Pittsburgh, Pittsburgh, PA, ²Department of Anesthesiology, Toronto General Hospital, Toronto, ON, Canada

INTRODUCTION: Malignant Hyperthermia (MH) is a potentially fatal, autosomal dominant disorder associated with administration of volatile anesthetics and/or the depolarizing paralytic succinylcholine. Symptoms include muscle rigidity, tachycardia, elevated body temperature, metabolic acidosis, which are secondary to accelerated skeletal muscle metabolism (Ref 1 and 2). Emphasis on the episodic MH event obscures the fact that MH susceptibility is a chronic condition, and some MH susceptible patients may develop symptoms subsequent to anesthetic exposure (Ref 3). This is the first study examining the sequelae of an MH event after hospital discharge.

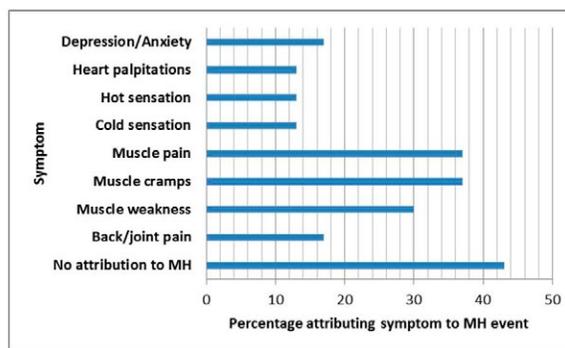
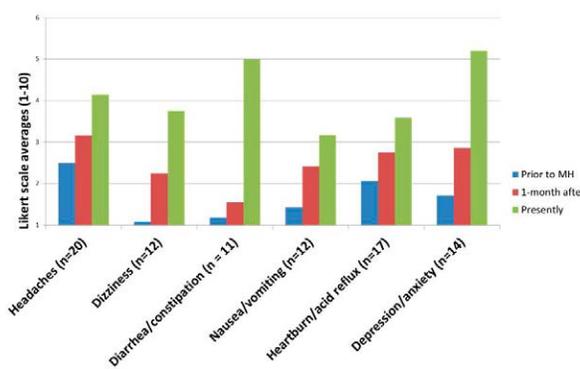
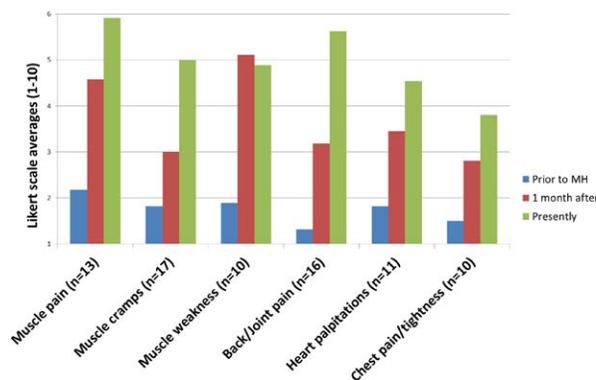
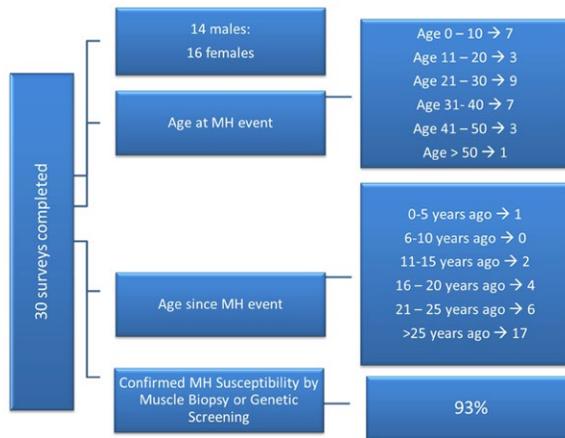
METHODS: A survey was sent to patients who voluntarily registered with the North American Malignant Hyperthermia Registry (USA-based) or the Malignant Hyperthermia Investigation Unit (Canada-based), which included questions on symptoms predominating prior to the MH event, one month after the MH event, and presently on a Likert scale of 1-10 with a free text option to expound further. Participants were also asked their thoughts on causality between MH and these symptoms. A total of 30 responses were gathered and analyzed (19.5% response rate).

RESULTS: Participants were categorized by their age at the time of the MH event: 23% between 0-10 years old, 10% between 11-20, 30% between 21-30, 23% between 31-40, 10% between 41-50, and 3% over 50. Most (75%) stayed in the ICU between 1-4 days, and 57% experienced the event over 25 years ago. In 93% of respondents, diagnosis of MH was confirmed via caffeine-halothane contracture and/or genetic testing (Figure 1). For those that indicated they experienced a symptom, averages on a Likert scale revealed a clear increase in severity over time with the exception of muscle weakness, which only indicated increased severity after the MH event occurred, and a slight decrease presently when compared to one month from the event (Figures 2 and 3). While 43% did not attribute any long-term symptoms to their MH event, others believed certain symptoms were linked, including muscle pain (39%), muscle cramps (36%), muscle weakness (32%), back/joint pain (18%) and depression/anxiety (18%) (Figure 4).

CONCLUSION: Our study concluded that long-lasting morbidities may be attributed to an MH event. Chronic musculoskeletal symptoms are exhibited by the majority of patients who experience acute MH. The purpose of this survey was to obtain subjective details from patients who experienced an MH event. While causality cannot be determined, the prevalence of muscle pains, cramps, and weakness after an MH crisis warrants further investigation into the long-term post-operative consequences of MH.

REFERENCES:

1. Anesthesia and Analgesia 2010; 110: 498-507.
2. Anesthesiology 2008; 108: 603-11.
3. Anesthesiology 2007; 106: 901-6.



S-301.

EFFECTS OF HEPARIN BRIDGING ANTICOAGULATION ON PERIOPERATIVE BLEEDING AND THROMBOEMBOLIC RISKS

AUTHORS: K. Ono, H. Hidaka, Y. Koyama, K. Ishii

AFFILIATION: Anesthesiology and Oncological Pain Medicine, Fukuyama City Hospital, Fukuyama, Japan

INTRODUCTION: Patients undergoing major malignancy surgery are at high risk for perioperative bleeding as well as for thromboembolic events (TEEs) especially when they are taking warfarin (VKA) or antiplatelet (APT) agents preoperatively. To minimize such risks, heparin bridging anticoagulation (HBA) is recommended during the interruption of VKA or APTs^{1,2}. Recent publications³, however, provided different results indicating that HBA increased the bleeding risk without decreasing the TEE risk. The purpose of this study was to compare the bleeding and TEE risks associated with perioperative HBA in patients undergoing major abdominal malignancy surgery.

METHODS: A retrospective review of the medical records was performed for patients who underwent gastric, colorectal, hepatic/pancreaticobiliary or urological malignancy surgery at our institution between April 2005 and March 2014. Three groups of patients were identified according to preoperative administration of VKA or APTs, e.g. patients who initiated a low-dose HBA after the suspension of preoperative VKA or APTs (HBA group), those who suspended VKA or APTs without initiation of HBA (non-HBA group) and those who were on neither VKA or APTs preoperatively (Control group). In the HBA group, a low-dose intravenous unfractionated heparin (10,000-150,000 units/day) was administered through 6 hours before surgical procedure and resumed 24-36 hours after the procedure. The incidence of exogenous blood transfusion

and TEEs (cerebral infarction, acute coronary syndrome, pulmonary embolism, sudden death, etc.) within 30 days after surgery were chosen as primary outcomes, on which comparisons were made between the 3 groups. Statistical analyses were performed using Chi-square test with Bonferroni correction. P<0.01 was considered statistically significant.

RESULTS: There was no statistically significant difference on either outcome between the HBA group (n=120) and the non-HBA group (n=201). In contrast, both outcomes of the HBA and the non-HBA group were significantly higher (P<0.001) than those of the Control group (n=2698, See Table). Subgroup analysis of the non-HBA group showed no significant difference on either outcome between patients who suspended VKA and those who suspended APTs.

CONCLUSIONS: Neither the incidence of exogenous blood transfusion or TEEs differed whether HBA was initiated or not, whereas both outcomes were increased in patients who were on antithrombotic agents preoperatively as compared with those who were not. The latter may be explained by a decrease in threshold for blood transfusion and an increase in the TEE risk in patients with such cardiovascular comorbidities as antithrombotic agents were indicated for. Different results on the bleeding risk from the previous reports may be attributable to differences in doses and types of HBA. Above findings may suggest that at least a low-dose HBA is unlikely to be effective for the prevention of TEEs in patients undergoing major abdominal malignancy surgery.

REFERENCES:

1. Chest. 2012; 141: e326S-e350S.
2. N Engl J Med. 2013; 368: 2113-2124.
3. Circulation. 2012; 126: 1630-1639.

Table. Effects of HBA on the Incidence of Blood Transfusion and TEEs

	A) HBA Group (n=120)	B) non-HBA Group (n=201)	C) Control Group (n=2698)	P(A vs B) (A vs C) (B vs C)
Exogenous Blood Transfusion (n) (%, 95% Confidence Limit)	28 (23.3,15.8-30.9)	44 (21.9, 14.4-29.1)	334 (12.4,11.1-13.6)	0.764 <0.001 <0.001
TEEs (n) (%, 95% Confidence Limit)	5 (4.2,0.6-7.7)	11 (5.5,1.3-9.6)	15 (0.6,0.3-0.8)	0.603 <0.001 <0.001

HBA: Heparin Bridging Anticoagulation, TEEs: Thromboembolic Events

S-302.

EPIDURAL ADMINISTRATION OF DROPERIDOL WITH PATIENT-CONTROLLED EPIDURAL ANALGESIA REDUCES POSTOPERATIVE NAUSEA AND VOMITING WITHOUT PROLONGATION OF QT INTERVAL FOR PATIENTS UNDERGO GYNECOLOGIC SURGERY, PARALLEL RANDOMIZED CONTROLLED STUDY

AUTHORS: E. Nakajima¹, T. Iijima¹, H. Yokomichi², T. Hanawa³, K. Hanawa⁴, T. Matsukawa¹

AFFILIATION: ¹Anesthesiology, University of Yamanashi Hospital, Chuo City, Japan, ²Department of Health Sciences, University of Yamanashi, Chuo City, Japan, ³Department of Pharmacy, Tokyo University of Science, Noda, Chiba, Japan, ⁴Pharmacy, Yamanashi Prefectural Central Hospital, Kofu, Yamanashi, Japan

INTRODUCTION: Postoperative nausea and vomiting (PONV) remains a critical issue in the perioperative management. A recent meta-analysis suggests that with prophylactic low-dose droperidol in adults, there is still significant antiemetic efficacy with a low risk of adverse effects¹). We tested a hypothesis that epidural administration of droperidol with patient-controlled epidural analgesia (PCEA) reduces PONV for gynecologic surgery until the third postoperative day. **Methods:** Women scheduled to undergo gynecologic surgery were randomly assigned to receive the PCEA solution of 0.06% ropivacaine in combination with fentanyl 4 µg/mL with 25 µg/mL droperidol (group D) or to receive without droperidol (group C) using the minimization method to balance proportion of smoker and those who prone to motion sickness. All study personnel and participants were blinded to assignment for the duration of the study. Patients were performed electrocardiography prior to surgery and at the first postoperative afternoon at the almost same time. Administration of PCEA solution was started before end

of surgery and was continued at least until the third postoperative morning. PONV were assessed both with 4-point scale and with a visual analogue scale. Data were collected at the end of anesthesia (EOA), at 1-5 h after the completion of surgery (POD0), in the first postoperative morning (POD1M), in the afternoon (POD1A), in the second postoperative morning (POD2M) and in the third postoperative morning (POD3M). Our primary outcomes were the incidences of PONV at each assessment point and the incidence of complete responder that was defined as the patient both with no severe nausea and vomiting, and with no use of antiemetics until POD3M. Secondary outcomes were patient characteristics, anesthetic and surgical data, postoperative pain score, need for supplemental drugs, severity for PONV, use of antiemetics, presence of motor blockade, the sensory block level, the incidence of QT elongation, and other adverse events. **Results:** Data from 80 patients in group C, 80 patients in group D were analyzed. No differences were noted with respect to baseline without weight and BMI. The incidences of PONV in group C, and D at the EOA, POD0, POD1M, POD1A, POD2M and POD3M were 6.4% vs 7.7%(p=1.000), 18.0% vs 16.7%(p=1.000), 37.2% vs 16.7%(p=0.0064), 25.6% vs 15.6%(p=0.1645), 26.9% vs 11.7%(p=0.01243) and 6.6% vs 6.6%(p=1.000), respectively. In grope C vs D, the incidence of complete responder was 35.5% vs 52.6% (p=0.0496) in Per Protocol Set, 35.9% vs 51.2% (p=0.0562) in intention to treat analysis. There were no cases of severe drowsiness, respiratory depression, hypotension, the lethal arrhythmia and severe extrapyramidal symptom that have need of treatment. There was no significant difference in the incidences of QT elongation between the two groups . **Conclusions:** We conclude that droperidol added to the solution for PCEA provides postoperative nausea and vomiting relief until the third postoperative morning without the prolongation of QT interval for patients undergo gynecologic surgery.

REFERENCES:

1. Eur J Anaesthesiol 2012;29:286-94

Patient Characteristics, Anesthetic and Surgical Data		group C (n=78)	group D (n=78)
Age (yrs)		41.7±11.4	44.7±9.2
Height (cm)		157.5±5.0	157.8±6.0
Weight (kg)		52.8±8.4	56.6±10.2
Body mass index (kg/m ²)		21.3±3.2	22.7±3.8
Type of disease			
	benign	62(79.49)	63(80.77)
	malignant	16(20.51)	15(19.23)
Type of surgery			
	open surgery	64(82.05)	61(78.21)
	Laparoscopic surgery	13(16.67)	16(20.51)
	Vaginal Total Hysterectomy	1(1.28)	1(1.28)
motion sickness			
	yes	29(37.18)	28(35.90)
	no	49(62.82)	50(64.10)
smoking			
	yes	15(19.23)	15(19.23)
	no	63(80.77)	63(80.77)
Myerson's sign (+)		0	0
surgery duration (min)		167.7±107.3	168.1±90.0
anesthesia duration (min)		220.4±111.6	223.0±96.0
intraoperative use of fentanyl (µg)		153.2±123.1	160.9±106.2
intraoperative use of remifentanyl (µg)		2124.4±1541.2	2401.3±1265.5
bolus mepivacaine concentration (1%/1.5%/2%)		8/64/6	6/65/7
continuous mepivacaine concentration (1%/1.5%/2%)		10/65/3	5/72/1
mepivacaine bolus volume (mL)		5.97±1.19	6.04±1.33
Epidural insertion site			
	L1/2	5(6.41)	2(2.56)
	Th12/L1	43(55.13)	48(61.54)
	Th11/12	27(34.61)	26(33.33)
	Th10/11	2(2.56)	2(2.56)
	Th9/10	1(1.28)	0
total numbers of segments blocked tested by cold test after administration of 2% lidocaine or mepivacaine			
	rt	4.60±2.47	4.76±2.61
	lt	4.10±2.85	3.68±2.85
flurbiprofen (mg)		48.74±3.68	49.33±2.38

Values are number of patients(%) or means±standard deviation

S-302 • continued

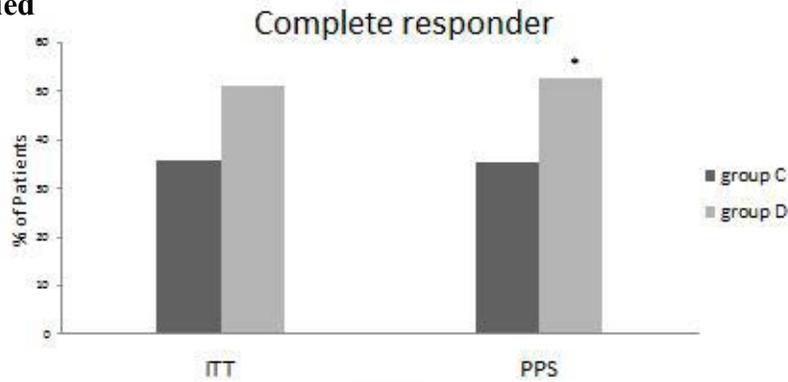


Fig. 1

Complete responder (CR) = the patient both with no severe nausea and vomiting, and with no use of antiemetic rescue medications until POD3M.
ITT = Intention-to-treat PPS = per protocol set

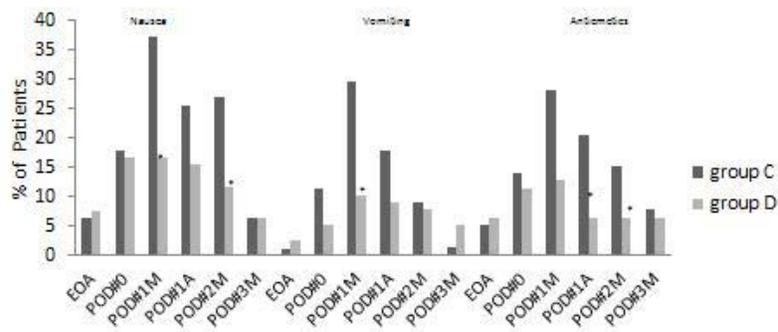
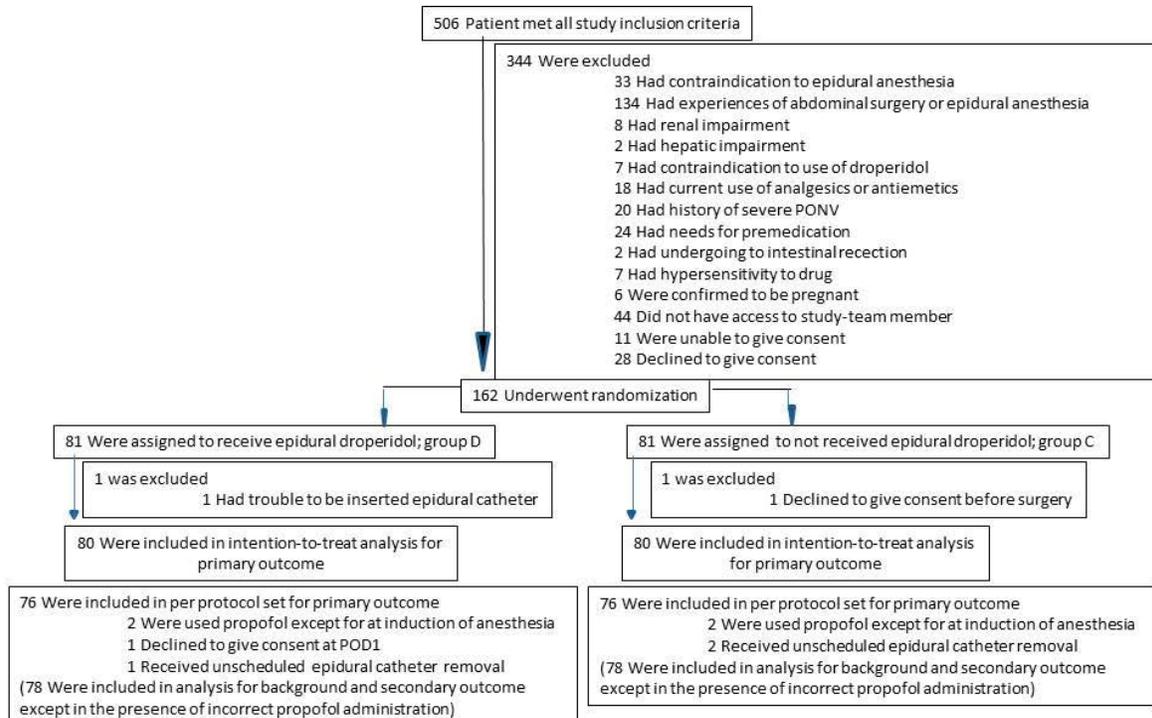


Fig.2

EOA = the end of anesthesia, POD0 = at 1-5 h after the completion of surgery
POD1M = in the first postoperative morning, POD1A = in the afternoon
POD2M = in the second postoperative morning, POD3M = in the third postoperative morning
* = p value <0.05



S-303.**COMPARING TARGETS FOR SURGICAL MORTALITY IMPROVEMENT**

AUTHORS: J. A. Hyder¹, E. Wakeam², J. Adler³, A. DeBord Smith⁴, S. Lipsitz⁵, L. L. Nguyen⁶

AFFILIATION: ¹Anesthesiology, Mayo Clinic, Rochester, MN, ²Surgery, University of Toronto, Toronto, ON, Canada, ³Surgery, Massachusetts General Hospital, Harvard School of Public Health, MA, ⁴Surgery, Brigham and Women's Hospital, Brigham and Women's Hospital, MN, ⁵Internal Medicine, Harvard Medical School, Harvard Medical School, MA, ⁶Surgery, Brigham and Women's Hospital, Brigham and Women's Hospital, MA

BACKGROUND: Quality improvement efforts have focused on patients in the failure-to-rescue (FTR) subpopulation because their high risk of death varies across high- and low-mortality hospitals. These efforts are hampered by inefficiencies of identifying patients requiring rescue and escalating care. Efficient strategies may focus on preoperatively-identifiable subpopulations that are singled out for special postoperative care. We compared preoperatively-identifiable subpopulations and the FTR subpopulation across low- and high-mortality hospitals for potential mortality reduction.

METHODS: Patients undergoing small bowel resection, pancreatectomy, colorectal resection, open abdominal aortic aneurysm repair, lower extremity arterial bypass, and nephrectomy were identified in the Nationwide Inpatient Sample. Low- and high-mortality hospitals were defined using risk- and reliability-adjusted mortality quintiles. Five target subpopulations were established a priori: the FTR population, predicted high-mortality-risk (highest-20th percentile), emergency surgery, elderly (>75 years), and diabetic patients. In each target subpopulation, we compared population prevalence, mortality variation, and potential mortality reduction.

RESULTS: Across low- and high-mortality quintiles (n=282 hospitals per quintile), respectively, the size of target subpopulations varied as follows: FTR population (20.2% vs 22.4%, p=0.002), high-mortality-risk populations (19.9% vs 19.3%, p=0.5152), the elderly (26.3% vs 25.1%, p=0.2711) and emergency surgery populations (36.5% vs 37.8%, p=0.4846). For each subpopulation, variation in mortality rates across low- and high-mortality hospitals was greatest for the high-mortality-risk (7.5% vs 20.2%, p<0.0001) and FTR subpopulation (7.8% vs 18.9%, p<0.0001). In Monte Carlo simulations, potential total mortality reductions for high-mortality hospitals (baseline=5.22% mortality) approached 50% for the FTR population (2.73%;95%CI=2.61%-2.87%), the high-risk population (2.76%;95%CI=2.59%-2.92%) and the emergency surgery population (2.56%;95%CI=2.42%-2.67%).

CONCLUSION: Preoperatively-identifiable patients with high-mortality-risk may be a preferred target for mortality improvement target given a high potential mortality reduction and opportunity for tailored perioperative management.

S-304.**RISK FACTORS FOR UNPLANNED TRACHEAL INTUBATIONS IN GENERAL AND VASCULAR SURGERY PATIENTS**

AUTHORS: S. Devine¹, G. Magee², D. E. Stein³, G. S. Murphy⁴

AFFILIATION: ¹Outcomes Research, Merck, Olivette, MO, ²Outcomes Research, Premier, Charlotte, NC, ³Surgery, Drexel University College of Medicine, Philadelphia, PA, ⁴Anesthesia, NorthShore University HealthSystem, Evanston, IL

INTRODUCTION: Unplanned tracheal intubations (re-intubation) after planned extubation in the operating room are a major contributor to postoperative morbidity and mortality. Re-intubation requiring unplanned admission to the intensive care unit has been associated with a 90-fold higher risk of dying in the hospital.¹ Several perioperative variables have been associated with the need for postoperative reintubation.² The aim of this database investigation was to determine demographic, surgical, pre-, inter-, and postoperative factors associated with need for re-intubation during the post-surgical hospital stay.

METHODS: Patients undergoing general or vascular surgery discharged between Jan 1 2012 and Dec 31 2013 were identified from the Premier hospital database. Surgery type was categorized using the NSQIP surgical category definitions. Re-intubations occurring at any time during the hospital stay were identified. An algorithm of ICD-9 procedure codes and hospital charge descriptions was developed to identify re-intubations. Pre-, intra- and post-operative comorbidities, medications, complications and previously identified risk factors for re-intubation were examined. Multivariate models were developed to assess adjusted risks of re-intubation based upon the above-mentioned characteristics. This study reviewed and exempted by the New England Institutional Review Board.

RESULTS: Data were analyzed on 557,592 patients. Re-intubations occurred in 7,152 patients (1.3%) of which 2,343 (0.42%) occurred within 48 hours of the procedure. Based upon the multivariate model, the strongest associations with a re-intubation at any time post-surgery was trauma versus elective surgery (RR 6.04, 95% CI 4.22-8.66), a diagnosis of sepsis (RR of 7.70, 95% CI 7.23-8.20), pneumonia (RR 3.78, 95% CI of 3.54-4.05), and hemiplegia (RR 3.25, 95% CI of 2.80-3.78) and the use of a neuromuscular blocking agent (NMB) without a reversal agent (RR 3.96, 95% CI of 3.68-4.25). The relative importance of these risk factors for re-intubation varied based the time elapsed since surgery. The RR of re-intubation was higher within the first 48 hours for patients undergoing trauma surgery (RR 10.51, 95% CI of 6.61-16.73) and those who received an NMB without reversal (RR 6.02, 95% CI of 5.35-6.78). The RR for re-intubation after post-surgery day 3 was highest amongst those with sepsis (RR 12.32, 95% CI of 11.26-13.48) and pneumonia (4.26, 95% CI of 3.88-4.68).

CONCLUSIONS: In this analysis of the Premier database, general or vascular surgery patients undergoing trauma surgery or who develop sepsis appeared to be at highest risk for postoperative re-intubation. While these events are unintended, they are not necessarily modifiable. Of the modifiable risk factors evaluated in the model, the failure to use a NMB reversal agent appeared to have the strongest impact on early risk for re-intubation. Further studies are needed to clarify the role of reversal of neuromuscular blockade on important postoperative complications including reintubation.

REFERENCES:

1. BMJ, 345, e6329.
2. Surgery, 154(2), 376-383.

S-305.

BIOREACTANCE SHOWS IMPAIRED CARDIAC FUNCTION IN ROBOTIC PROSTATECTOMY

AUTHORS: J. M. Watkins-Pitchford

AFFILIATION: Anesthesiology, Virginia Commonwealth University, Richmond VAMC, Richmond, VA

INTRODUCTION: Robotic Prostatectomy is performed in steep trendelenburg, causing Starling increases in cardiac index and power index. Bioreactance monitoring shows that cardiac performance is significantly compromised, even though blood pressure and heart rate remain unremarkable through the trendelenburg period of increased venous return to the heart.

METHODS: Routine use of bioreactance monitoring (NICOM 4, Cheetah Medical) followed 12 patients for robotic prostatectomy, in steep trendelenburg. Age, height, weight, heart rate, cardiac index, cardiac power index, mean arterial pressure, and total peripheral resistance index were tabulated at the start and end of the trendelenburg period. A 2-tailed paired t-test was used to show statistical significance of the changes of each parameter. The study continues.

RESULTS: (see table)

CONCLUSIONS: Trendelenburg position was seen to be most highly significantly associated with declines in cardiac power index, but not peripheral resistance. It appears therefore that decreases in contractility cause the fall in arterial pressure, not vasodilation with volatile anesthetic agents. We are concerned that decreased contractility and cardiac frailty of this age group may pose a risk of adverse event. Decreased cardiac power index is a strong independent predictor of morbidity in cardiac failure and shock; we see a similar CPI in several of the patients here.

REFERENCES:

1. Rosenblum, H., Helmke, S., Williams, P., Teruya, S., Jones, M., Burkhoff, D., Mancini, D. and Maurer, M. S. (2010), Peak Cardiac Power Measured Noninvasively With a Bioreactance Technique Is a Predictor of Adverse Outcomes in Patients With Advanced Heart Failure. *Congestive Heart Failure*, 16: 254-258. doi: 10.1111/j.1751-7133.2010.00187.x
2. Fincke R, Hochman JS, Lowe AM, Menon V, Slater JN, Webb JG, LeJemtel TH, Cotter G; SHOCK Investigators. Cardiac power is the strongest hemodynamic correlate of mortality in cardiogenic shock: a report from the SHOCK trial registry. *J Am Coll Cardiol*. 2004 Jul 21;44(2):340-8.

Cardiovascular Effects of Trendelenburg

	Mean	StandardDeviation	n = 12 P(2-tailedpairedt)
Duration (minutes)	141(99-193)	28	
Heartrate Start	80.4(66-92)	10.7	
Heartrate End	73.8(64-93)	8.0	0.0048**
Cardiac Index start	3.70(2.02-4.91)	0.81	
Cardiac Index End	2.33(0.89-4.37)	0.90	0.0020**
Mean Arterial Press start	100.58(79-121)	14.15	
Mean Arterial Press end	82.08(64-103)	11.42	0.0096**
Cardiac Power Index start	0.83(0.5-1.4)	0.25	
Cardiac Power Index end	0.52(0.2-0.8)	0.22	0.00049***
Total Peripheral Resistance Index start	2567(1652-4567)	850	
Total Peripheral Resistance Index end	3419(1520-8265)	1875	0.095ns
Age	63.8(54-75)	6.2	

S-306.**ANNEXIN-A1 BIOMIMETIC PEPTIDE ACTIVATES SIRTUIN-3 AND PROTECTS THE HEART FROM ISCHEMIA-REPERFUSION INJURY IN RATS FOLLOWING CARDIAC SURGERY****AUTHORS:** Z. Zhang, Q. Ma, M. V. Podgoreanu**AFFILIATION:** Department of Anesthesiology, Duke University Medical Center, Durham, NC**INTRODUCTION AND GENERAL PURPOSE OF THE STUDY:** Perioperative myocardial injury (PMI) due to ischemia-reperfusion (IR) remains a major cause of cardiovascular morbidity and mortality following cardiac surgical procedures. Molecular mechanisms associated with PMI have not yet been fully identified, which hinders the development of new therapeutic strategies. Annexin-A1 (ANXA1) has been implicated in cardioprotection through resolution of inflammation in part via regulation of histone deacetylation. Sirtuin-3 (SIRT3) is a class III histone deacetylase implicated in regulating mitochondrial oxidative phosphorylation and myocardial metabolism. Having recently reported that a novel ANXA1 biomimetic peptide (Ac-QAW) attenuates PMI, we tested the hypothesis that Ac-QAW provides cardioprotection via modulating SIRT3-dependent pathways that are critical to the death/survival decision in cardiomyocytes following IR.**METHODS:** In-vivo IR- All animal experiments were performed with Institutional Animal Care and Use Committee approval. Male Sprague Dawley rats (400g, n=5) were subjected to 2 hours of cardiopulmonary bypass (CPB) with 1 hour of deep hypothermic circulatory arrest (DHCA) at 18°C, and randomized to receive vehicle, Ac-QAW (2 mg/kg, iv) or a scrambled peptide (scrP, 2mg/kg, iv) 1 hour before CPB and 1 hour after reperfusion. In-vitro simulated IR- Adult rat ventricular cardiomyocytes (ARVCs, n=3) or SIRT3-deficient ARVCs (by siRNA mediated knock-down) were exposed to 10 µM Ac-QAW or scrP for 1 hour, and then subjected to oxygen-glucose deprivation (OGD) for 2 hours. Efficacy endpoints assessed at 24 hours post-reperfusion (rat) and post-reoxygenation (ARVC), included apoptosis (TUNEL) and necrosis (Troponin I). SIRT3-mediated activation of MnSOD (manganese superoxide dismutase) and AMPK (AMP-activated protein kinase) was measured by immunoprecipitation, lysine deacetylation, and Western blot. Cellular levels of reactive oxygen species (ROS) and ATP were determined by ELISA. Mitochondrial cytochrome c (cyt c) was determined by Western blot.**RESULTS AND MAJOR FINDINGS:** Ac-QAW but not a scrambled peptide significantly attenuated myocardial necrosis and apoptosis ($p < 0.05$, n=5) induced by surgical IR. siRNA-mediated SIRT3 knock-down led to increased cardiomyocyte death ($P < 0.05$, n=3) after OGD. The observed cardio and cytoprotective effects were associated with activated mitochondrial SIRT3, which in turn 1) enhanced MnSOD activity by SIRT3-mediated lysine deacetylation, and decreased ROS-induced cell death; 2) increased AMPK-mediated cellular ATP production and promoted cell survival; 3) preserved mitochondrial integrity, as evidenced by maintained mitochondrial levels of cyt c.**CONCLUSIONS:** Ac-QAW-dependent cardioprotective effects are in part driven by pro-survival mechanisms involving increased mitochondrial SIRT3, MnSOD-mediated antioxidant defenses, AMPK-mediated ATP production, and preservation of mitochondrial integrity and dynamic function.

S-307.

CAN THE USE OF DESFLURANE AFTER TOTAL INTRAVENOUS ANESTHESIA SHORTEN RECOVERY TIME IN SPINE SURGERY?

AUTHORS: D. Lee, T. Kim, H. Kim, E. Kim

AFFILIATION: Anesthesia and Pain Medicine, Pusan National University Hospital, Busan, Korea, Republic of

INTRODUCTION: Total intravenous anesthesia (TIVA) using propofol and remifentanyl is frequently utilized when electrophysiological monitoring is used during spine surgery. Because inhalation agents have been associated with amplitude reduction of cortical somatosensory evoked potentials and muscle recordings from transcranially evoked motor evoked potentials.

In spine surgery using electrophysiological monitoring, we experienced the different recovery time between using desflurane after TIVA and TIVA only.

So, We compared the recovery time of use of desflurane after TIVA and TIVA alone in spine surgery.

METHODS: 27 patients scheduled for elective spine surgery using electrophysiological monitoring were included in this study. All were classified as ASA classes I and II and were 18 to 70 years old.

The patients were allocated randomly to TIVA alone group(Group T) and converting group (Group C). Anesthesia induction was performed in all patients using target controlled infusion (TCI), effect-site concentration of propofol at 5 ug/ml and remifentanyl at 4 ng/ml, cisatracurium 0.2mg/kg for muscle relaxation. After anesthesia induction, IV infusion of propofol TCI 2 to 5 ug/ml and remifentanyl TCI 2 to 4 ng/ml was continued. All patients were maintained equally between 40 and 60 points on the bispectral index system(BIS). In Group T, TIVA was used until the end of surgery. And in Group C, TIVA was used until the end of electrophysiological monitoring and then desflurane was used instead of propofol. At the end of the surgical procedure, immediately before the patient was turned from prone to supine, all anesthetic agents-propofol, desflurane, remifentanyl-were stopped and time from ending of anesthesia to recovery (tidal volume recovery, eye opening, extubation) was noted.

RESULTS: Both group showed no significant differences with respect to demographic data, operation times and anesthesia times. And there was no statistical differences in total amount of propofol, remifentanyl, cisatracurium throughout the anesthetic period. Tidal recovery time was significantly faster in Group C(Group C: 9.67±2.64min., Group T: 14.95±4.85min., p=0.02) as well as eye opening time(Group C: 9.42±2.69min., Group T: 15.5±6.24min, p=0.04). Times to extubation also show significant faster time in Group C(Group C: 10.35±2.9min, Group T: 17.27±6.54min, p=0.02).

CONCLUSIONS: In spine surgery, at the end point of electrophysiological monitoring, use of desflurane instead of propofol showed a faster recovery time compared with TIVA only group.

REFERENCES:

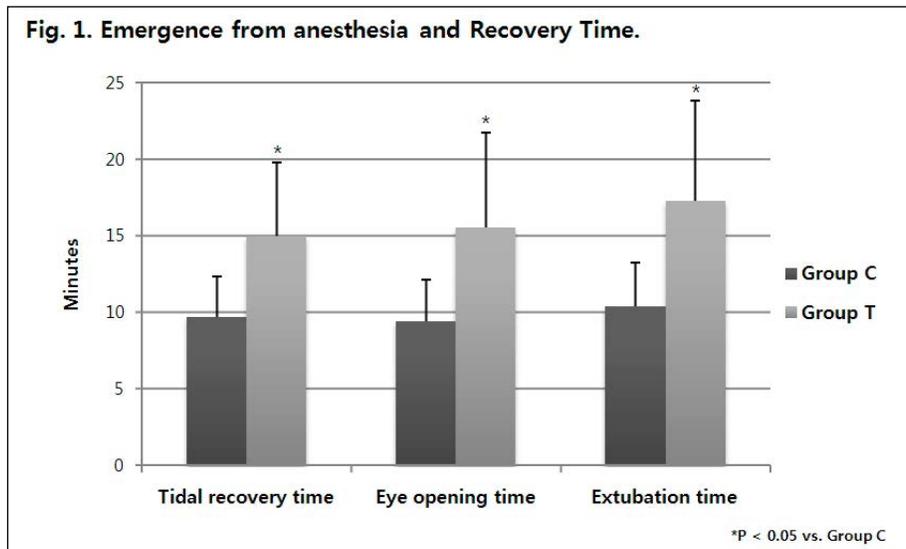
1. Early recovery, cognitive function and costs of a desflurane inhalational vs. a total intravenous anaesthesia regimen in long-term surgery. Acta anaesthesiol Scand 2006; 50: 14-18.
2. Intraoperative neurophysiological monitoring during spine surgery with total intravenous anesthesia or balanced anesthesia with 3 % desflurane. J Clin Monit Comput J Clin Monit Comput. 2014 Mar 19. [Epub ahead of print]

Table 1. Demographic Data and Anesthesia and Operation Times.

	Group C (n=13)	Group T (n=14)
Sex (male/female)	6 / 7	6 / 8
Age, years	55.6 ± 12.4	59.3 ± 11.2
Height, cm	168.5 ± 9.5	163.0 ± 7.5
Weight, kg	66.3 ± 9.3	66.4 ± 13.8
Operation time, minutes	275.8 ± 55.3	296.8 ± 60.9
Anesthesia time, minutes	239.2 ± 57.8	254.6 ± 56.1

Table 2. Total Drug Requirements.

	Group C (n=13)	Group T (n=14)
Propofol, mg	1955.5 ± 650.4	2188.8 ± 638.3
Remifentanyl, µg	1703.7 ± 862.3	1623.4 ± 704.0
Cisatracurium, mg	17.3 ± 5.0	19.7 ± 4.5



S-308.

USE OF COMMON MEDICATIONS PREOPERATIVELY DOES NOT AFFECT RISK OF POSTOPERATIVE COMPLICATIONS IN PATIENTS WITH CHRONIC KIDNEY DISEASE

AUTHORS: S. Kendale, J. S. Yeh, L. Bennici, J. Blitz

AFFILIATION: Anesthesiology, NYU School of Medicine, New York, NY.

INTRODUCTION: The mechanisms by which reduced preoperative glomerular filtration rate (eGFR) predispose patients to adverse postoperative outcomes are not well defined¹. Furthermore, the effects of medications commonly prescribed to slow the progression of chronic kidney disease (CKD) are unclear in the perioperative period^{2,3,4}. The goal of this study was to evaluate these medications on the following postoperative outcomes: acute kidney injury (AKI), myocardial infarction (MI), infection, venous thromboembolism (VTE), and readmission within 30 days. We hypothesized that patients with CKD who were on an angiotensin converting enzyme inhibitor (ACE-I), angiotensin receptor blocker (ARB), diuretic, statin, beta blocker, insulin or calcium channel blocker (CCB) preoperatively would have lower rates of surgical complications than CKD patients who were not on these medications.

METHODS: With institutional review board approval, patients with reduced eGFR (<60 ml/min/1.73m²) and a list of their prescribed medications at the time of surgery were isolated from a database of adult patients who underwent elective surgery at a single large academic institution between June 2011 and July 2013. Patients were identified as either taking or not taking ACE-Is, ARBs, diuretics, statins, beta blockers, insulin, or CCBs.

Propensity score matching was done by first performing logistic regression with each medication individually as the dependent treatment variable. Preoperative medical comorbidities, age, and gender were used as covariates that may influence preoperative medication use. One-to-one matching without replacement was performed based on the derived propensity scores. The outcomes of interest were AKI, MI, infection, VTE, and readmission within 30 days, and were analyzed by logistic regression.

RESULTS: After applying exclusion criteria, 2865 patients remained. Matching resulted in between approximately 250 and 1100 pairs depending on the medication. After matching, there was no apparent association between the preoperative medications explored and the outcomes of interest, except for a statistically significant association between beta blocker use and readmission within 30 days (Table 1).

CONCLUSIONS: This study suggests that common medications taken by patients with CKD preoperatively do not have a significant effect on the development of postoperative complications. Furthermore, our results do not support discontinuation of pre-existing medications or the addition of any of these agents prior to surgery. Identifying factors modifiable by medication management or lifestyle interventions is a critical step toward developing protocols to enhance patient safety and postoperative recovery in the CKD population. Further investigation is needed to determine the effect of other factors such as surgical severity, smoking status and volume status on postoperative outcomes to define optimal protocols for CKD patients.

REFERENCES:

1. Eur Heart J 2007; 28: 782-784.
2. BJA. 2014; 113(4):644-51.
3. Anesth Analg May 2014;118(5): 938-944
4. Anesth Analg 2005;100:636 -644

Effect of Medication on Postoperative Outcomes After Matching (Odds Ratio [95% CI, p value])

	ACE-I/ARB	Diuretic	Statin	Beta blocker	Insulin	CCB
AKI	1.2 (0.8-1.9, 0.34)	1.2 (0.8-1.8, 0.43)	1.1 (0.7-1.8, 0.60)	0.91 (0.6-1.5, 0.70)	1.2 (0.5-2.4, 0.71)	1.2 (0.7-2.1, 0.56)
MI	0.95 (0.5-1.8, 0.88)	0.96 (0.5-1.7, 0.9)	0.88 (0.4-1.8, 0.70)	0.60 (0.2-1.3, 0.22)	0.81 (0.2-2.0, 0.65)	0.6 (0.3-1.5, 0.30)
Infection	0.67 (0.3-1.0, 0.08)	0.70 (0.4-1.4, 0.33)	0.67 (0.4-1.2, 0.18)	0.82 (0.40-1.7, 0.59)	1.4 (0.4-4.8, 0.56)	1.0 (0.4-2.3, 1)
VTE	0.70 (0.3 - 1.6, 0.41)	0.80 (0.3-2.0, 0.65)	0.71 (0.3-1.6, 0.41)	0.80 (0.3-2, 0.64)	1.5 (0.2-11.5, 0.66)	1.8 (0.5-6.8, 0.37)
Readmission	1.0 (0.8-1.3, 0.70)	1.2 (0.9-1.6, 0.13)	1.1 (0.9-1.5, 0.30)	1.9 (1.4-2.5, <0.01)	1.1 (0.7-1.8, 0.72)	1.1 (0.8-1.6, 0.46)

S-309.

PROMOTING PERIOPERATIVE ADVANCE CARE PLANNING: A SYSTEMATIC REVIEW OF ADVANCE CARE PLANNING INSTRUMENTS

AUTHORS: R. A. Aslakson¹, A. Schuster², J. Reardon¹, T. Lynch¹, J. Miller³, M. Weiss⁴, J. F. Bridges⁵

AFFILIATION: ¹Anesthesiology and Critical Care Medicine, The Johns Hopkins School of Medicine, Baltimore, MD, ²Health Policy and Management, The Johns Hopkins School of Public Health, Baltimore, MD, ³N/A, Patient/family stakeholder co-investigator – N/A, Baltimore, MD, ⁴Surgery, The Johns Hopkins School of Medicine, Baltimore, MD, ⁵Health Policy and Management, The Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

INTRODUCTION AND GENERAL PURPOSE OF THE STUDY: As nearly all patients are incompetent to make decisions while receiving anesthesia, perioperative advance care planning (ACP) could be useful, particularly should the patient become incapacitated during the perioperative period. Moreover, perioperative ACP could better empower patients to receive care that is consistent with their goals, entrust surgeons to offer the surgeries that are most appropriate in achieving those goals, and empower anesthesiologists to devise perioperative plans that respect and advocate for those goals. The objective of this study is to identify possible instruments to promote perioperative ACP, to describe research findings, and to discuss further steps in developing an ACP instrument specifically targeted for a perioperative population.

METHODS: Using predefined search terms, researchers searched PubMed, EMBASE, Cochrane, SCOPUS, Web of Science, CINAHL, PsycINFO, and Sociological Abstracts for studies that evaluated ACP instruments among perioperative adult and general adult populations. Studies were reviewed against inclusion criteria and data was abstracted and risk of bias was assessed for included studies.

RESULTS AND MAJOR FINDINGS: The literature search identified 5,327 articles, 39 of which met inclusion criteria. These studies evaluated video, paper, audio, computer, or multi-component instruments to promote ACP. No instruments were evaluated in a perioperative patient population; the majority of instruments were evaluated in outpatient ambulatory populations (n=28), primarily of older adults (n=19) (Table 1). Over 50 unique outcomes were reported and, through prioritization of outcomes by a designated patient/family member co-investigator, they were conceptualized into four categories: informed treatment choice, ACP status, opinion regarding ACP instrument, and patient-centered outcomes (PCOs). ACP instruments decreased preferences for aggressive interventions (such as cardiopulmonary resuscitation), increased discussion and completion of written advance directives, were universally well-tolerated, and reduced decisional conflict and uncertainty.

In conclusion, no existing instrument-based ACP aids were developed for or evaluated in a perioperative population, although findings from these studies are likely generalizable to perioperative populations and may be used to inform the style and content of a perioperative ACP aid. As instruments were universally tolerated, increased ACP discussions between patients and family members and/or clinicians, and reduced decisional conflict and uncertainty among patients and family members, an ACP instrument specifically designed for a perioperative population is likely both feasible and useful. Further research is needed to develop such an instrument and to evaluate instrument efficacy in a perioperative population.

Table 1. Characteristics of studies assessing instrument-based aids for advance care planning

Characteristic	No. (%) of 39 Articles
Study design	
Randomized controlled trial	22 (56.4)
Nonrandomized controlled trial	4 (10.3)
Pre-post study	13 (33.3)
Country of origin	
USA	31 (79.5)
Canada	6 (15.4)
European Countries	1 (2.6)
Asian Countries	1 (2.6)
Year of publication	
1990 – 1999	11 (28.2)
2000 – 2009	13 (33.3)
2010 – 2014	15 (38.5)
Population	
Cancer	5 (12.8)
Dementia	7 (17.9)
COPD/lung disease	3 (7.7)
ESRD	1 (2.6)
HIV	1 (2.6)
ALS	1 (2.6)
Lifethreatening illness(notdefined)	2 (5.1)
General population	19 (48.7)
Age	
19 – 50	1 (2.6)
50 – 65	16 (41.0)
>65	19 (48.7)
Not reported	3 (7.7)
Race/Ethnicity (where makes up greatest % of population)	
White	24 (61.5)
African American	3 (7.7)
Latino	1 (2.6)
Not reported/collected	11 (28.2)
Setting	
Ambulatory	28 (71.8)
Inpatient	3 (7.7)
Nursing home	4 (10.3)
Senior citizen center	2 (5.1)
Rehabilitation center	1 (2.6)
Not specified	1 (2.6)

S-310.

EFFECT OF IMPLEMENTING A PERIOPERATIVE SURGICAL HOME INCLUDING AN ENHANCED RECOVERY AFTER SURGERY PATHWAY FOR COLORECTAL SURGERY PATIENTS

AUTHORS: M. D. McEvoy¹, A. B. King², J. P. Wanderer¹, T. Geiger³, M. Terekhov⁴, J. M. Ehrenfeld¹, W. Sandberg⁵

AFFILIATION: ¹Department of Anesthesiology, Vanderbilt University, Nashville, TN, ²Anesthesia and Critical Care Medicine, Vanderbilt University Medical Center, Nashville, TN, ³Department of Surgery, Vanderbilt University Medical Center, Nashville, TN, ⁴Anesthesiology and Perioperative Informatics Division, Vanderbilt University Medical Center, Nashville, TN, ⁵Department of Anesthesiology, Vanderbilt University School of Medicine, Nashville, TN

INTRODUCTION: Perioperative care in the United States is often costly and fragmented. A number of studies have demonstrated that enhanced recovery after surgery (ERAS) programs work.¹ The concept of the Perioperative Surgical Home (PSH) advances upon ERAS by placing these multi-component care pathways into a system of care that spans the period from operative decision to discharge.² In partnership with colorectal surgeons at our institution we launched a Perioperative Consult Service (PCS) that coordinated surgical and anesthesia care from operative decision to post-discharge that included an ERAS pathway and daily rounding by a Perioperative Consult Service.

METHODS: After IRB approval, perioperative records were obtained for all elective colorectal procedures performed for the 6 months preceding implementation of the start of PCS (1/2014 – 6/2014) and 4.5 months following implementation (7/2014-10/15/2014). Procedures included were those performed by a colorectal surgeon which were scheduled with any one of a defined set of Current Procedural Terminology codes. Patient age and gender were obtained, along with intraoperative fluids given, estimated blood loss and utilization of gabapentin, acetaminophen, ketorolac, ketamine, number of anti-emetics given by class and total opioids measured in morphine equivalents. Case mix index and length of stay were abstracted from hospital billing records.

Table 1. Baseline Characteristics

	Pre Intervention (n=172)	Post Intervention (n=131)	P
Age	51.9 (17.6)	48.6 (17.7)	0.13
% Male	48.5	51.3	0.12
Case Mix Index	2.2 (0.94)	2.6 (1.6)	0.046
Operative Time (min)	148.6 (81.0)	145.5 (82.1)	0.755
Anesthesia Time (min)	213.0 (88.8)	199.4 (91.6)	0.755
Estimated Blood Loss (cc)	83.7 (156.2)	115.4 (108.3)	0.041

Data as Mean (SD) except where indicated.

RESULTS: 285 charts were reviewed; 114 of these were post intervention. There was no difference in age, gender, operative time or anesthesia time between the two groups. Patients with surgery after instituting the PSH with ERAS had a higher Case Mix Index and estimated blood loss (EBL), although the change in EBL was only 30mL (Table 1). The post intervention group also had a shorter median length of stay (p< 0.008), received less total fluid intraoperatively, were more likely to receive all components of multimodal analgesia (p <0.001), and received significantly fewer morphine equivalents than the control group (p <0.001) (Figure 1 and Table 2).

CONCLUSION: The implementation of a PSH combined with an ERAS program significantly shortened median length of stay, and decreased morphine equivalents and fluid administration intraoperatively. The use of multimodal analgesia increased after implementation of this program.

REFERENCES:

1. Geltzeiler CB, Rotramel A, Wilson C, Deng L, et al. Prospective Study of Colorectal Enhanced Recovery After Surgery in a Community Hospital. JAMA Surg. 2014;149(9):955-961
2. Kain ZN, Vakharia S, Garson L, Engwall S, et al. The Perioperative Surgical Home as a Future Perioperative Practice Model. Anesth Analg 2014; 118(5):1126-30.

Percentage of Patients Receiving Each Component Before and After Institution of the Enhanced Recovery After Surgery Protocol and Perioperative Surgical Home

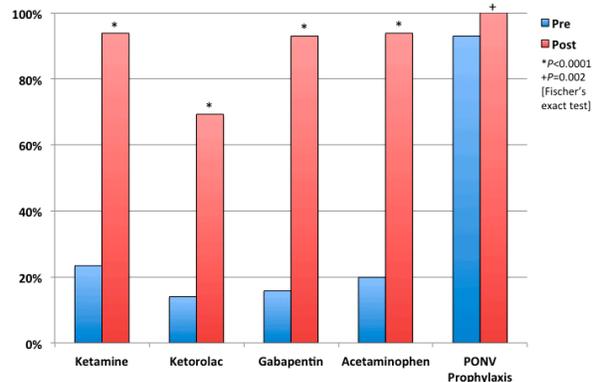


Table 2. Perioperative Outcome and Process Metrics

	Pre Intervention (n=172)	Post Intervention (n=131)	P
Length of Stay (Median)	4.45	3.44	0.008
Plasmalyte (mL)	1764 (929)	1508 (841)	0.014
Normal Saline (mL)	184 (538)	72.4 (351)	0.021
Morphine Equivalents	33.8 (18.1)	5.3 (11.3)	<0.001

Data as Mean (SD) except where indicated.

Figure 2. Run Chart of Length of Stay over Time



S-311.

WITHDRAWN.

S-312.**ISOFLURANE INHIBITS DNA DAMAGE SIGNALING IN THE LUNGS OF MICE****AUTHORS:** K. C. Das¹, J. Wasnick², V. Kundumani-Sridharan¹**AFFILIATION:** ¹Anesthesiology, Texas Tech University Health Sciences Center, Lubbock, TX, ²Anesthesiology, Texas Tech University Health Sciences Center/ univ, Lubbock, TX

INTRODUCTION: Hyperoxia causes significant DNA damage and activates ataxia-telangiectasia mutated (ATM) and ATM-related kinases activation in the lung^{1,2}. This activation induces cell death pathways via or independent of tumor suppressor protein p53 resulting in apoptotic cell death and consequent tissue damage. Isoflurane is a volatile anesthetic that is frequently administered to patients in combination with various concentrations of oxygen during surgical procedures. Oxygen toxicity is a concern when used in high concentration. Studies have shown that isoflurane provides significant protection against reperfusion injury of the heart. However, the effects, if any, of isoflurane to mitigate lung injury secondary oxygen toxicity are unknown. In this current investigation, we hypothesized that short duration of 60% FiO₂ exposure of 2 hours duration would cause DNA damage and induce DNA damage signaling in the lung. Likewise we hypothesized that isoflurane would decrease this signaling resulting in decreased apoptotic lung cell death.

METHODS: C57BL/6 mice aged from 6 to 8 weeks were exposed to room air, 60% oxygen, isoflurane (2%) in room air or isoflurane in oxygen (60%) for 2 hours. Following exposure, lung tissue was harvested free of blood. Western analysis for DNA damage signaling proteins was performed. The Institutional Animal Care and Use Committee (IACUC) of Texas Tech University Health Sciences Center, Lubbock, approved all experimental protocols.

RESULTS: We evaluated the phosphorylation of p53 in response to the 4 different exposure combinations. Our data show that p53(Ser15) was not phosphorylated in mice lungs exposed to room air or room air and isoflurane (2%). However, strong p53(Ser-15) phosphorylation was observed in the 60% FiO₂ exposure group. In contrast, mice exposed to both isoflurane (2%) and 60% oxygen did not show p53 (Ser15) phosphorylation. This data demonstrates that isoflurane inhibits the p53 activation when given in combination with oxygen and thus provides significant protection against DNA damage signaling. This data also demonstrates that the upstream signaling molecules activated by oxygen could be suppressed in presence of isoflurane. Thus, we show for the first time that isoflurane decreases DNA damage signaling pathway when administered in combination with increased oxygen concentrations. Further studies are in progress in this area of investigation in our laboratory.

CONCLUSION: Our studies show that the DNA damage signaling occurs in the lung after less than 2 hours exposure of mice to hyperoxia. Further, our findings show that isoflurane provides significant protection against activation of DNA damage signaling in the lung during anesthesia.

REFERENCES:

1. Differential roles of ATR and ATM in p53, Chk1, and histone H2AX phosphorylation in response to hyperoxia: ATR-dependent ATM activation. *Am J Physiol Lung Cell Mol Physiol* 294, L998-L1006, 2008
2. Hyperoxia activates the ATR-Chk1 pathway and phosphorylates p53 at multiple sites. *Am J Physiol Lung Cell Mol Physiol* 286, L87-97, 2004

S-313.**DO BIOMARKERS IMPROVE THE RCRI? AN INTERIM ANALYSIS OF THE TROPONIN ELEVATION AFTER MAJOR SURGERY (TEAMS) STUDY****AUTHORS:** M. Machina¹, K. Karkouti², S. Beattie³**AFFILIATION:** ¹Department of Anesthesia, Toronto General Hospital, Toronto, ON, Canada, ²Anesthesia, Toronto General Hospital, Toronto, ON, Canada, ³Anesthesia, University of Toronto, Ancaster, ON, Canada

INTRODUCTION: Injury to the myocardium occurs when cardiac troponin (cTn) is elevated in the blood, regardless of whether it meets diagnostic criteria for myocardial infarct (MI) (cTn-I > 0.3 ng/mL) or is sub-threshold but elevated (0.07 < cTn-I < 0.3 ng/mL), sometimes termed 'troponin leak' (hereafter: myocardial injury). Postoperative myocardial infarction (MI) occurs in 2-5% of patients undergoing non-cardiac surgery, increasing length and cost of hospital stay², with mortality the outcome in 29-40%^{3,5}, yet little is known of the long-term outcomes of these patients, and less is known of the long-term outcome of patients with myocardial injury. Furthermore, clinical preoperative risk stratification tools, such as the Revised Cardiac Risk Index (RCRI), perform well, but do not include preoperative clinical biomarkers (eg: cTn, BNP, HbA1c) that are associated with cardiac events.

Study Purpose: The primary goal of the TEAMS study is to explore the relationship between myocardial injury (including MIs) after non-cardiac surgery and long-term health related quality of life (HRQoL). One TEAMS sub-study, planned a priori, is to examine the role of preoperative biomarkers included the RCRI.

METHODS: In accordance with the Declaration of Helsinki, after receiving institutional Research Ethics Board approval, a prospective observational cohort single-centre study was launched. Up to 300 consecutive patients undergoing non-cardiac, non-transplant surgery will be recruited. Inclusion criteria included ability to provide written informed consent, age > 18 years, ASA 2-4 and expected postoperative length of stay > 48hrs. For this sub-study, the outcome is an adverse cardiac event measured by elevated cTn in postop day 1-3, inclusive. As an interim analysis of an ongoing study, the sample size of the current analysis is 129 patients.

RESULTS: Interim results are presented for the study population to date with complete data sets. The mean (SD) age of the study population was 67.8 (8.9) years, with 42 (32.5%) being female and 87 (67.5%) being male. Patients had pre-existing risk factors as follows: n=14 for coronary artery disease; n=2 for congestive heart failure; n=11 for cerebrovascular disease; n=29 for diabetes; n=23 for chronic kidney disease. The mean (SD) length of stay in hospital was = 6.4 (5.4) days. Of the 129 study patients, 17 (13.2%) had elevated postoperative troponin (cTn-I > 0.07ng/mL). Using the interim data to predict myocardial injury, the c-statistic of the RCRI ROC curve was 0.7040 when using just pre-existing risk factors, but increased to 0.7835 when preoperative troponin, BNP, and HbA1c were included in the model.

CONCLUSIONS: Preliminary interim data analysis suggests that preoperative biomarkers may have a role to play in clinical preoperative risk stratification tools such as the RCRI. Further analysis is needed.

REFERENCES:

2. *J. Vasc. Surg.* 43, 533-8 (2006).
- Can. Med. Assoc. J.* 173, 627-634 (2005).
- Ann. Intern. Med.* 154, 523-528 (2011).
- Ann. Surg.* 248, 320-8 (2008).

S-314.**CHRONIC OPIOID ASSOCIATED CENTRAL SLEEP APNEA: A SYSTEMATIC REVIEW**

AUTHORS: D. Correa¹, R. Farney², F. Chung³, J. Wong³, M. Nagappa⁴

AFFILIATION: ¹Anesthesiology, Mount Sinai Hospital, Toronto, ON, Canada, ²Anesthesiology, University of Utah Health Sciences Center Intermountain Sleep Disorders Center, Intermountain Healthcare, LDS Hospital,, Salt Lake City, Utah, USA, UT, ³Anesthesiology, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, ON, Canada, ⁴Anesthesiology, Toronto Western Hospital, University of Toronto, Toronto, ON, Canada

ABSTRACT

BACKGROUND: Over the past decade opioid use for the treatment of chronic pain has increased dramatically, parallel to it the unintentional over dose deaths.¹ Chronic opioid use is linked to a variety of sleep disordered breathing (SDB) particularly central sleep apnea (CSA)² that may contribute to opioids overdose death. Currently, information regarding the perioperative management of patients with chronic opioid associated CSA is limited. The objectives of this review are to review the prevalence, mechanisms, risk factors, perioperative management. and positive airway pressure treatment.

METHODS: We searched Medline (1983 to July 2014), Medline in process and other non-indexed citations (July 2014), EMBASE (1983 to July 2014), Cochrane Central Registry of Controlled Trial, Cochrane Database of Systematic Reviews (2005 to July 2014) and, PubMed basic search (1983 to July 2014) for relevant English language articles using key terms: “central sleep apnea” and “opioids” (literature search terms available as supplementary material).

RESULTS: The search strategy yielded 8 studies. The total numbers of patients were 560. The overall prevalence of SDB in patients on chronic opioids is very high (42% to 85%) with mean of 70% and CSA is (14.1% - 60%) with mean of 24%. The morphine equivalent daily dose (MEDD) was strongly associated with the severity of the SDB, predominantly CSA, with a MEDD of > 200mg being a threshold of particular concern. Concurrent use of benzodiazepines or hypnotics in relation to the severity of CSA was reported in one study. Body mass index (BMI) was inversely related to the severity of SDB.

Continuous positive airway pressure (CPAP) may be ineffective in eliminating or may even increase CSA.

There were varying recommendations regarding the best type of positive airway pressure therapy for the treatment of opioid-associated CSA. Adaptive servo ventilation and bilevel positive airway pressure ventilation was effective in some reports.

CONCLUSION: The overall prevalence of CSA in all populations receiving chronic opioids was 24%. The risk of CSA appears to be greater with MEDD more than 200 mg and in non-obese persons but is not clearly increased by concurrent benzodiazepines or hypnotics. The respiratory patterns associated with opioids are distinctive and non-apneic hypoxemia can be observed. CPAP is often ineffective and there were altering recommendations of best positive airway pressure therapy. Limited data are available on the peri-operative management. No screening instruments or known risk factors have been validated for identifying patients with opioid associated CSA. There is a need for further prospective studies on the perioperative risks and management of these patients.

REFERENCES:

1. Caravati EM, Nangle B, Rolfs RT and P-P. Increase in poisoning deaths caused by non-illicit drugs--Utah, 1991-2003. *Morb Mortal Wkly Rep* 2005;54:33-6.
2. Teichtahl H, Prodromidis A, Miller B, Cherry G, Kronborg I. Sleep-disordered breathing in stable methadone programme patients: a pilot study. *Addiction* 2001;96:395-403.

S-315.

REDUCED PREOPERATIVE ESTIMATED GLOMERULAR FILTRATION RATE IS ASSOCIATED WITH POSTOPERATIVE MAJOR NON-CARDIAC ADVERSE EVENTS INCLUDING INCREASED RISK OF READMISSION WITHIN 30 DAYS OF SURGERY

AUTHORS: J. Blitz, M. Shoham, V. Narine, N. Mehta, B. S. Sharma, P. Shekane, S. Kendale;

AFFILIATION: Anesthesiology, NYU School of Medicine, New York, NY

INTRODUCTION: Chronic Kidney Disease (CKD) has long been recognized as an independent predictor of major adverse cardiac events^{1,2}, and recent studies have demonstrated that the impact of CKD extends to other significant postoperative events including cerebrovascular accidents, all-cause mortality, and increased hospital length of stay^{3,4}. However, whether CKD predisposes patients to other postoperative complications has not been elucidated. We examined the incidence of CKD in our surgical population and compared the rates of significant postoperative complications including: acute kidney injury (AKI), venous thromboembolism (VTE), myocardial infarction (MI), infection, and 30-day readmission to our hospital across declining preoperative glomerular filtration rate (eGFR) values. We hypothesized that there is a direct association between rates of major surgical complications and stage of CKD.

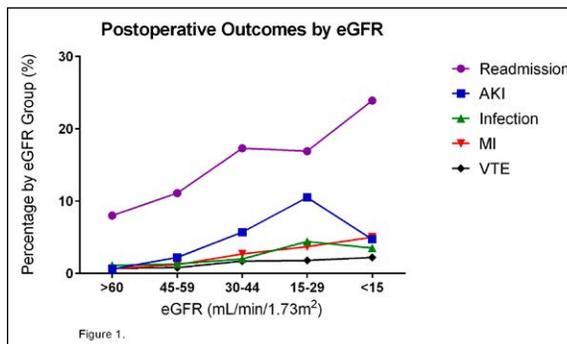
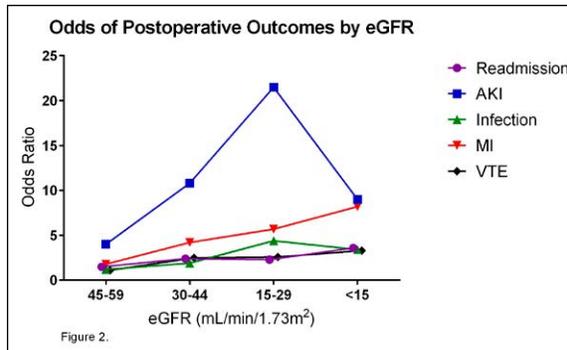
Methods: With IRB approval, a retrospective analysis of a database of adult patients who underwent elective surgery between June 2011 and July 2013 at a single large academic institution was performed. Patients with reduced GFR (<60 ml/min/1.73m²) were identified and categorized by stage of CKD. Odds of readmission to hospital within 30 days, as well as new diagnosis of AKI, VTE, MI, and infection in these patients were determined using logistic regression.

RESULTS: Of the 48714 patients in the database with an available GFR on record, 43072(88%) met inclusion criteria. Of the 4097 patients with eGFR <60 ml/min/1.73m², 3448 (84%) did not have a preoperative ICD-9 diagnosis of CKD on record. When categorized by increasing stage of CKD and compared to GFR >60 ml/min/1.73m², increasing numbers of these patients were readmitted to the hospital within 30 days of their procedure (OR 1.5, 95% CI 1.3-1.7, p<0.001 to OR 3.5, 95% CI 2.6-4.5, p<0.001 for Stage 3A to Stage 5 CKD respectively) [Figures 1,2]. Patients with higher stage CKD also tended to demonstrate increasing odds of acute kidney injury (OR 21.5, 95% CI 15.3-29.6, p<0.001 for stage 4 CKD), myocardial infarction (OR 8.2, 95% CI 4.7-13.3, p<0.001 for stage 5 CKD), infection (OR 4.4, 95% CI 2.7-6.8, p<0.001 for stage 4 CKD) and venous thromboembolism (OR 3.3, 95% CI 1.4-6.6, p<0.001 for stage 5 CKD).

DISCUSSION: This study highlights that CKD is a common, underreported comorbidity in the surgical population with significant impact on major postoperative complications. Interestingly, the rates of postoperative VTE, AKI, MI, infection and hospital readmission increased with increased stage of CKD. Furthermore, our study extends the association between preoperative CKD and postoperative adverse events to a broader range of surgical populations than previously described. Recognizing the association between preoperative low eGFR and increased rates of postoperative complications and hospital readmissions will facilitate the development of perioperative protocols to enhance patient safety and reduce hospital costs.

REFERENCES:

1. Circulation 1999; 100: 1043-9.
2. J Am Coll Cardiol 2007; 50: e159-241.
3. BJA. 2014; 113(4):644-51.
4. Anesthesiology. 2013; 118:809-24.



S-316.**OCULAR RADIATION EXPOSURE AND SHIELDING IN AN INTERVENTIONAL RADIOLOGY SUITE****AUTHORS:** D. Salek, B. Leone, P. Mongan**AFFILIATION:** Anesthesiology, Mayo Clinic, Jacksonville, FL

INTRODUCTION: Radiation from fluoroscopic images is often cited as the largest single source of occupational radiation exposure in medicine¹. One study reported interventional procedures under fluoroscopic guidance exposed the anesthesiologist to >3x the radiation exposure of the radiologist². We undertook a pilot study under controlled conditions to quantify the amount of ocular radiation exposure from background scatter in a typical neurointerventional procedure.

METHODS: Radiation exposure at different personnel locations in a neuro-interventional suite were evaluated at approximate eye level (60 in. above the floor) during runs of a Philips Allura Xper FD20/20 setup. Dosimeters were located in areas approximating the location of the scrub technologist and the anesthesia provider. Readings were taken on a “phantom” patient (anthropomorphic head model) and the Dose Area Product (DAP) was compared with actual acquisitions during intracerebral aneurysm coiling procedures. The study protocol was then repeated using a 0.75 in. thick Lucite shield positioned between the radiation source and the dosimeter representing the anesthesiologist’s position. We measured personal dose equivalents (instadose; mrem) and exposure rates (mR/hr) for both shielded and unshielded runs.

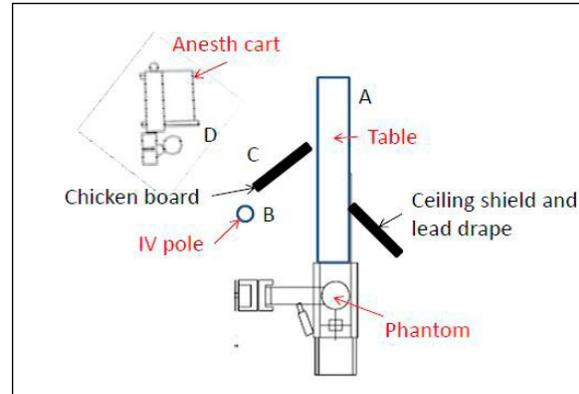
RESULTS / DISCUSSION: During unshielded runs, the anesthesia provider’s personal dose equivalent was 42 mrem and exposure rates were found to be higher for acquisition runs (263.3 mR/hr) than fluoroscopic runs (11 mR/hr). Similarly, during unshielded runs the radiation technologist’s position dose equivalent was 22 mrem and exposure rates were 115 mR/hr for acquisition runs and 4.3 mR/hr for fluoroscopic runs.

During shielded runs, we found a significant drop in exposure rates as well as personal dose equivalents at both positions. The anesthesiologist’s personal dose equivalent dropped to 9 mrem (78.6% reduction) and exposure rate fell for acquisition runs (to 5 mR/hr; 98.1% reduction) and fluoroscopic runs (to 0 mR/hr; 100% reduction). At the scrub tech position the personal dose equivalent fell to <3 mrem (86.4% reduction) and exposure rates during acquisition runs fell (to 5 mR/hr; 95.7% reduction) as did they for fluoroscopic runs (to 0 mR/hr; 100% reduction).

DISCUSSION/CONCLUSION: In our mock interventional neuroradiology setup, the anesthesia provider is exposed to at least twice the background radiation scatter as the technologist during both shielded and unshielded runs. This study demonstrates that a significant and potentially detrimental ocular dose of background radiation scatter may occur in typical neurointerventional radiology cases involving anesthesia personnel. Anesthesia personnel should take appropriate precautions to reduce or eliminate the potential of ocular radiation exposure.

REFERENCES:

1. The United Nation Scientific Committee on the Effects of Atomic Radiation. Sources and Effects of Ionizing Radiation. UNSCEAR 2000. Report to the General Assembly, with Scientific Annexes. Annes E. Occupational radiation exposures. New York: United Nations, 2000.
2. Anesthesiology 2011; 114: 512-520.



S-317.

GOAL DIRECTED INTRAOPERATIVE THERAPY FOR HEAD AND NECK MICROVASCULAR FREE TISSUE TRANSFER

AUTHORS: W. R. Hand¹, W. D. Stoll¹, M. D. McEvoy²

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, Medical University of South Carolina, Charleston, SC, ²Anesthesiology, Vanderbilt University, Nashville, TN.

INTRODUCTION: Patients receiving free flap of the head and neck, historically, large volumes of fluid have been administered to maintain hemodynamic stability. This practice is due to an anecdotal belief that vasoactive medications should be avoided due to microvascular anastomoses. However, recent evidence suggests vasopressors are commonly used and have minimal affect on human flap outcomes. In intermediate to high-risk surgeries, utilizing Goal Directed Therapy (GDT) has been associated with improved patient outcomes. Our study aims to show an intraoperative GDT protocol decreases intensive care unit (ICU) length of stay (LOS) for patients receiving a free tissue transfer reconstruction of the head and neck.

METHOD: 94 patients scheduled for a primary resection of the head and neck with resultant free flap reconstruction were enrolled following inclusion/exclusion criteria and randomized into treatment or control protocols. Treatment group therapy followed a specific algorithm (Figure 1) utilizing real-time values from arterial waveform analysis. These values included blood pressure, stroke volume variation, cardiac index, and systemic vascular resistance. Control group patients' therapy was limited to judicious administration of fluids to maintain blood pressure within 20% of baseline. Our primary endpoint was ICU length of stay (LOS) with secondary endpoints included: flap failure, medical complications, and total fluid administration.

RESULTS: 94 patients were enrolled between April 2013 and August 2014. The groups were similar in terms of age, race, gender, type of flap, ASA classification, BMI, and smoking status. The ICU length of stay was significantly shorter in the treatment group (32.2h vs 57.3h, p=0.025). The total hospital length of stay was shorter, but did not reach statistical significance (180.0h vs 258.4h, p=0.101). The incidence of major surgical morbidity was higher in the control group for all categories, though none reached statistical significance: flap failure (4.25% vs 6.38%), flap death (4.25% vs 8.51%) or need for reoperation (8.51% vs 17.02%). Patients in both groups received similar total volumes of fluid (5887 vs 6318mL, p=0.462).

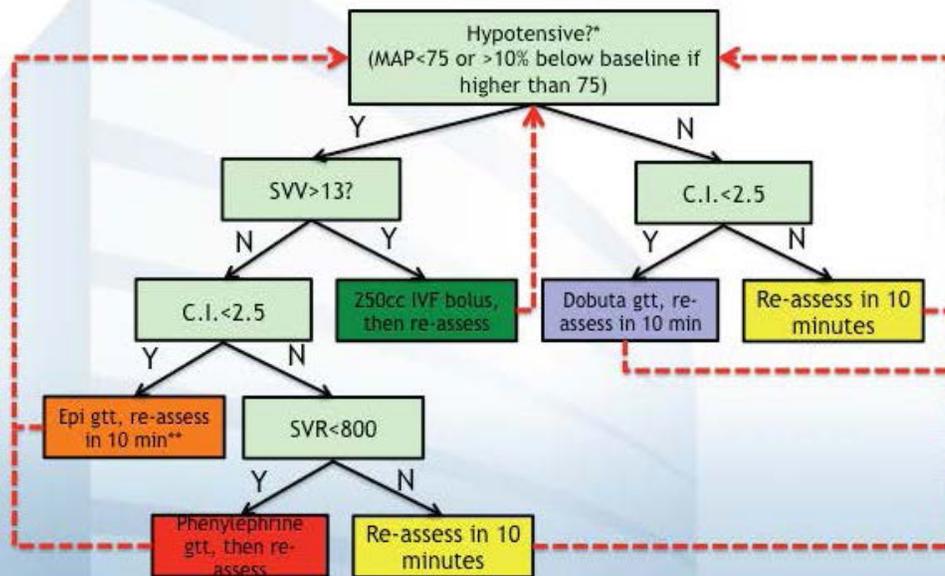
CONCLUSION: Our results indicate patients treated with arterial waveform-derived GDT had a decreased ICU LOS. This is a reasonable proxy for several clinical events including adequate spontaneous ventilation, hemodynamic stability, flap viability, and return of cognitive function. Many GDT patients required vasoactive medication administration without a measurable increase in flap failure or death.

Figure 1: Goal Directed Therapy Algorithm

REFERENCES:

1. Benes J et al. Intraoperative fluid optimization using stroke volume variation in high risk surgical patients: results of a prospective randomized study. *Critical Care* 2010; 14:R118.
2. Monroe MM et al. Vasopressor use in free tissue transfer surgery. *Otolaryngology-Head and Neck Surgery* 2010; 142: 169-73.
3. Gan T et al. Goal-directed intraoperative fluid administration reduces length of hospital stay after major surgery. *Anesthesiology* 2002; 97:820-6.

Flo-Trac Intra-op Treatment Algorithm



*Note: Patient to be ventilated at 8cc/kg throughout case as long as peak airway pressure is <35 cm H₂O.
**Note: If HR < 60, may give glycopyrrolate 0.4-1.0mg IV prior to initiating epi infusion.

S-318.**APPLYING LATENT CLASS ANALYSIS TO PERIOPERATIVE RISK STRATIFICATION IN PATIENTS UNDERGOING INTRAABDOMINAL GENERAL SURGERY****AUTHORS:** M. Kim¹, M. Wall², G. Li³**AFFILIATION:** ¹Anesthesiology, Columbia University Medical Center, New York, NY, ²Biostatistics (in Psychiatry), Columbia University, New York, NY, ³Anesthesiology and Epidemiology, Columbia University, New York, NY.**INTRODUCTION:** Perioperative risk stratification is often performed using indexes to identify “independent” risk factors. However, few, if any, risk factors are truly independent and various combinations of comorbidities may have differential effects on the risk of mortality.¹ In addition, many risk factors not achieving statistical independence are excluded from multivariable analysis.² We used latent class analysis (LCA), a model-based clustering technique, to identify distinct classes of comorbidities and risk factors in patients presenting for intraabdominal general surgery. We then determined if these classes could be used to predict the risk of perioperative mortality.**METHODS:** After IRB exemption, the 2005-2010 ACS-NSQIP was used to obtain a cohort of patients undergoing intraabdominal general surgery. Demographic and comorbidity data were entered into LCA models to identify the latent classes. Statistical and clinical criteria were used to determine the optimal number of classes. Individuals were assigned to a class based on the highest posterior probability of class membership. Relative risk regression was used to determine the associations between the latent classes and 30-day mortality, with adjustments for procedure and age.**RESULTS:** The final sample included 466,177 observations. A 9-class model was determined to be the optimal model for analysis. (Classes numbered by order of increasing mortality.) Based on the prevailing demographic and comorbidity characteristics of each class (Table 1), a general description of each class was obtained (Table 2). The lowest risk classes (1-4) had mainly younger patients while the highest risk classes (7-9) had mainly older patients. Morbid obesity was characteristic of both a low risk class (2) and an intermediate risk class (6). Emergencies were characteristic of both low risk classes (1) and high risk classes (7, 9). Other comorbidities had various distributions among the different classes. Overall 30-day mortality was 2.6%, while the risk by latent class ranged from 0.06% to 21.9%. Compared to a class with an average risk of mortality (7), the highest risk class had an 8-fold higher mortality, while the lowest risk class had 41-fold lower mortality (Table 3). After adjusting for procedure and age, the latent classes remained significantly associated with 30-day mortality, though the rank order of some classes changed and others converged towards a similar adjusted risk. The highest risk class had a 5-fold increase in mortality (compared to average risk class) while the lowest risk class had a 13-fold decrease in the mortality.**CONCLUSIONS:** LCA was able to identify distinct classes of patients undergoing intraabdominal general surgery based on comorbidity and demographic data. Further, the latent classes were significantly associated with the risk of 30-day mortality, even after adjusting for procedure and age. This work demonstrates the utility of a latent class model incorporating all available preoperative data to risk-stratify patients with regards to perioperative mortality.**REFERENCES**

1. J Gen Intern Med. 2007; 22:403.
2. Circulation. 1999; 100:1043.

S-318 • continued

Table 1. Baseline characteristics of the total sample and each latent class in the 9-class model in patients undergoing intraabdominal general surgery procedures, American College of Surgeons National Surgical Quality Improvement Program, 2005-2010.

	Total Sample	Nine Class Latent Class Analysis Model								
		1	2	3	4	5	6	7	8	9
N	466,177	56,302	64,100	20,011	49,635	95,440	48,642	30,831	68,338	32,878
% of Total		12.1	13.8	4.3	10.6	20.5	10.4	6.6	14.7	7.1
	%	Class Percentages (%)								
Female	57.8	31.2	80.7	59.1	81.9	48.7	58.6	54.2	56.0	48.9
Age										
<40	23.7	68.3	41.5	31.2	64.2	3.9	1.2	1.5	0.0	6.0
40-50	17.4	21.4	35.3	21.8	22.0	19.9	11.7	13.8	0.0	9.2
50-60	21.0	9.2	20.6	22.2	10.4	37.2	38.6	29.2	0.3	18.6
60-70	17.9	1.1	2.6	14.1	3.3	29.7	40.0	27.9	16.4	24.0
70-80	12.9	0.0	0.0	7.8	0.1	9.1	8.5	17.4	48.0	23.4
>80	7.3	0.0	0.0	2.9	0.0	0.2	0.0	10.2	35.2	18.8
Body Mass Index										
<18.5	2.8	1.7	0.0	1.6	6.0	3.0	0.3	3.0	3.2	7.0
18.5-25	25.5	32.0	0.0	21.7	40.1	33.0	3.2	26.9	36.7	31.3
25-30	27.2	36.5	0.0	25.8	24.1	39.2	14.0	34.5	37.8	27.4
30-35	16.6	18.9	5.4	17.1	14.2	19.7	21.7	20.5	16.5	16.2
>35	28.0	10.9	94.6	33.7	15.6	5.2	60.8	15.2	5.7	18.1
Emergency	24.0	63.3	2.2	11.7	31.7	1.6	4.5	83.7	9.3	58.6
Functionally Dependent	7.8	1.4	0.5	1.5	4.0	1.3	2.7	7.5	10.2	62.5
Current Smoker	19.4	28.4	16.3	19.3	23.6	24.0	14.7	19.4	6.2	24.1
Congestive Heart Failure	1.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	1.3	10.3
Myocardial Infarction	0.6	0.0	0.0	0.1	0.0	0.1	0.4	0.2	0.9	5.6
Coronary Revascularization	8.1	0.2	0.3	3.2	0.2	2.7	17.2	7.2	22.2	23.6
Angina	0.6	0.0	0.1	0.2	0.1	0.1	1.1	0.4	1.1	3.6
Hypertension	44.8	3.9	43.1	31.8	4.4	31.2	93.1	56.5	78.1	71.9
Peripheral Vascular Disease	1.4	0.0	0.1	0.4	0.1	0.4	1.9	0.7	2.7	8.1
Diabetes	15.8	1.3	18.9	9.3	2.3	5.7	49.7	12.0	19.7	30.2
Dyspnea	12.0	0.5	21.2	8.4	2.4	4.7	23.6	5.1	14.9	35.1
Ventilator Dependent	1.6	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	21.9
Chronic Obstructive Pulmonary Disease	4.7	0.0	0.9	2.0	0.3	2.8	7.6	5.0	8.5	20.0
Pneumonia	0.9	0.0	0.0	0.0	0.2	0.1	0.0	0.2	0.2	10.6
Ascites	2.2	0.7	0.0	0.3	2.0	1.3	0.4	4.3	1.5	14.2
Varices	0.2	0.0	0.0	0.0	0.1	0.3	0.2	0.2	0.1	1.2
Acute Renal Failure	0.8	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.1	10.3
Dialysis	1.2	0.0	0.0	0.3	0.0	0.0	1.2	0.0	0.0	15.0
Impaired Sensorium	1.1	0.0	0.0	0.1	0.1	0.0	0.0	0.5	0.3	14.1
Stroke	4.9	0.1	0.6	1.8	0.6	1.8	7.1	4.2	13.6	17.7
Wound Infection	3.4	0.6	0.8	1.6	3.9	1.5	3.1	1.2	2.0	23.1
Steroid Use	4.1	1.3	0.7	2.1	7.1	2.9	4.5	3.9	4.2	13.9
Bleeding Disorders	5.4	0.4	1.0	1.7	2.8	2.1	6.4	6.7	8.5	27.4
Transfusion	0.9	0.0	0.0	0.1	0.6	0.2	0.1	0.2	0.7	8.6
Sepsis	16.1	30.1	1.4	3.7	19.8	1.7	3.8	52.1	5.4	66.5
Cancer	21.8	0.4	1.4	13.0	8.9	48.7	19.7	3.2	47.8	14.6
Estimated Glomerular Filtration Rate										
Missing	7.9	5.1	5.8	99.3	4.3	4.5	3.4	0.5	2.2	1.3
<15	1.3	0.1	0.1	0.0	0.2	0.1	1.4	0.2	0.2	14.5
15-30	2.1	0.0	0.0	0.0	0.1	0.1	1.6	3.0	3.4	16.6
30-60	12.6	0.4	1.0	0.0	0.9	4.6	20.3	22.8	39.8	25.7
60-90	33.2	19.6	28.0	0.6	9.5	46.4	43.9	52.2	50.7	19.1
>90	42.8	74.8	65.2	0.1	85.0	44.3	29.3	21.4	3.7	22.8
Hematocrit										
Missing	5.4	0.7	2.5	88.5	0.6	1.4	3.4	0.3	1.7	1.0
<34	19.3	0.0	3.8	0.0	32.9	14.9	14.4	12.6	32.7	64.6
34-38	22.0	0.8	22.4	0.7	45.5	20.2	24.4	19.6	29.2	16.9
>38	53.4	98.4	71.3	10.8	21.0	63.5	57.7	67.5	36.4	17.4

Note: Percentages in bold indicate that the proportion of patients with the given characteristic in the latent class is higher than the proportion in the overall sample.

S-318 • continued

Table 2. Descriptions of the main characteristics of each latent class in the 9-class model.

Class	Class Descriptions
1	Young (age <50), low rate of comorbidities, emergent procedures.
2	Young (age <50), morbidly obese females.
3	Young (age <60), low rate of comorbidities, obesity, no preoperative labs.
4	Young (age <50), normal to underweight females, emergent procedures.
5	Middle aged (age 40-70), low rate of comorbidities, with cancer.
6	Middle aged (age 50-70), morbidly obese with cardiovascular and associated comorbidities (diabetes, chronic kidney disease, etc.).
7	Older (age >50), mild to moderate comorbidities, emergent procedures.
8	Older (age >60), moderate to severe comorbidities, with cancer.
9	Older (age >60), severe comorbidity burden, functionally dependent.

Table 3. Thirty-day mortality and adjusted relative risk of 30-day mortality based on assigned latent class in patients undergoing intraabdominal general surgery procedures, American College of Surgeons National Surgical Quality Improvement Program, 2005-2010.

Class	Mortality		Latent Class Only		Adjusted for Procedure		Adjusted for Procedure and Age	
	N	(%)	RR	95% CI	RR	95% CI	RR	95% CI
9	32,878	22	8.33 *	[7.76, 8.94]	5.32 *	[4.94, 5.73]	5.02 *	[4.66, 5.40]
8	68,338	3.5	1.34 *	[1.24, 1.45]	0.977	[0.900, 1.06]	0.720 *	[0.662, 0.784]
7	30,831	2.6	1.00		1.00		1.00	
6	48,642	0.94	0.356 *	[0.318, 0.399]	0.376 *	[0.334, 0.423]	0.431 *	[0.383, 0.485]
5	95,440	0.76	0.290 *	[0.262, 0.320]	0.212 *	[0.191, 0.234]	0.258 *	[0.233, 0.286]
4	49,635	0.47	0.178 *	[0.154, 0.205]	0.181 *	[0.156, 0.209]	0.337 *	[0.286, 0.397]
3	20,011	0.46	0.177 *	[0.143, 0.219]	0.199 *	[0.160, 0.247]	0.258 *	[0.207, 0.320]
2	64,100	0.12	0.046 *	[0.036, 0.058]	0.080 *	[0.062, 0.103]	0.129 *	[0.100, 0.167]
1	56,302	0.06	0.024 *	[0.017, 0.034]	0.040 *	[0.029, 0.056]	0.076 *	[0.054, 0.107]
Total	466,177	2.6						

RR, relative risk; CI, confidence interval.

Adjustment for procedure based on the Clinical Classifications Software of the Agency for Healthcare Research and Quality.

Subspecialty Abstracts

Regional Anesthesia

S-319.**TWO MODELS TO DEFINE THE RELATIONSHIP BETWEEN THE REGIONAL ANESTHESIA CONSULTANT AND THE PRIMARY ANESTHESIOLOGIST****AUTHORS:** D. Waisel, K. Matthes, K. Boretsky**AFFILIATION:** Department of Anesthesiology, Perioperative and Pa, Boston Children's Hospital, Boston, MA

The rise of regional anesthesia services brings forth the need to define the relationship between the regional anesthesia consultant and the primary anesthesiologist. In a traditional consulting relationship, consultation is sought. The consultant advises and the primary physician decides. Advice may be considered over time. The primary physician is often an expert in the patient's morbidities while the consultant is often only an expert in a specific organ system. Significant disagreements about care between primary physician and consultant are often resolved by consulting colleagues and senior clinicians.

This is a focused analysis of the relationship between the two anesthesiologists. In practice, the preferences of the patient and surgeon weigh into the decision, but those relationships are not subject to this analysis.

Consultation regarding regional anesthesia is different. The consultant is as expert as the primary anesthesiologist about anesthesiology. Regional anesthesia consultants may bring themselves into patient care sans a formal request by the primary anesthesiologists. The time frame is often short. There may not be written or understood protocols to define practice. A model is needed to consider how to mediate differences between the primary anesthesiologist and the regional anesthesia consultant. Any model should focus on the extent of data supporting the risk/benefit of the specific intervention in the identified patient.

The first model to mediate differences between the primary anesthesiologists and the regional consultant is a binary model. The primary anesthesiologist "owns" the patient and the regional consultant can attempt to overrule only if 1) the standard of care is being breached or 2) there is Level 1 evidence (Oxford Center of Evidence-Based Medicine 2011 Levels of Evidence) supporting the intervention. Given the limited data and the lack of a defined standard of care about when to use regional anesthesia, the primary attending's decision is often unimpeachable.

The second model is a gradual increase in the importance of the regional consultant's advice based on increasing levels of evidence. This can be imagined as a line with a slope of 1 and a starting point of $x=0, y=0$. As the evidence of a positive risk to benefit ratio increases, the need to act on the consultant's recommendation increases. The level of evidence should be weighted in the standard format. This model also may be considered as a series of gradated steps that are defined explicitly by levels of evidence.

The binary approach mostly preserves the traditional priority of the primary anesthesiologist. This may lead to less than ideal care if the regional consult has superior knowledge about risks and benefits of regional anesthesia. The gradual increase approach may give better patient care, but at the potential harm of disenfranchising the primary anesthesiologist. This may have short-term consequences such as the primary anesthesiologist not being as invested in making the regional anesthesia work and long-term consequences such as harming the primary anesthesiologist's relationship with colleagues and the department.

S-320.

OUTCOME OF THORACIC EPIDURAL ANESTHESIA ON GRAFT LEAKAGE AFTER MINIMALLY INVASIVE ESOPHAGECTOMY

AUTHORS: P. Rahman

AFFILIATION: Anesthesiology, UC San Diego, San Diego, CA

INTRODUCTION: The most frequent postoperative complications after esophagectomy are respiratory failure and graft leakage, both associated with a high postoperative mortality¹. Currently, minimally invasive esophagectomy (MIE) is being favored for surgical management of esophageal cancer^{2,3}. This case series present effect of thoracic epidural anesthesia (TEA) on graft leakage after MIE.

METHODS: 35 patients who had MIE were included during 2007-2011. TEA was started successfully in 31 (89%). Before induction of general anesthesia, epidural catheter was inserted at the mid-thoracic inters pace (T6-T8), tested with 3 ml bupivacaine 0.5%. Before starting surgery, the epidural block was topped up with 10 ml bupivacaine 0.25%, directly followed by a continuous administration of a mixture of (Ropivacaine 0.2% and Dilaudid 20 µg/ml). TEA was maintained throughout perioperative period and continued during ICU stay.

RESULT: Of the 35 patients, none suffered in hospital mortality. Leucocytosis and fever was noted in 7 (20%) patient, 2 (6%) patient found to have pneumonia,³ (9%) patient had respiratory failure requiring prolonged mechanical ventilation. Cardiac arrhythmia was common 8 (23%) after 24 hours, most common arrhythmia being atrial fibrillation.⁴ (11%) patient had demonstrated graft leakage

ANALYSIS & DISCUSSION: Graft leakage was detected by endoscopy and or video esophagogram on 7-10th post operative day. Thoracic epidural analgesia (TEA) was associated with decreased odd of developing graft leakage (OR 0.02, p > 0.05). There were lower odd of developing graft leakage among male sex; Older patients, prior smoking history, preexisting pulmonary disease has higher odd of developing graft leakage.

Risk factors for graft leakage has been previously described⁴. TEA has been established as a cornerstone in the perioperative care after thoracic and major abdominal surgery providing most effective analgesia and decrease adverse perioperative cardiac events.⁵

TEA in our case series was associated with reduction of odd of graft leakage after MIE, which is consistent with similar findings after open esophagectomy⁴.

CONCLUSIONS: Thoracic epidural anesthesia resulted in decrease odd of graft leakage after minimally invasive esophagectomy.

REFERENCES:

1. Ng J. Update on anesthetic management for esophagectomy. Current Opinion in Anesthesiology 2011; 24:37-43
2. Nagpal K, Ahmed K, Vats A, et al. Is minimally invasive surgery beneficial in the management of esophageal cancer? A meta-analysis Surg Endosc 2010;24:1621-1629
3. Biere SS, Cuesta MA, van der Peet DL. Minimally invasive versus open esophagectomy for cancer: a systematic review and meta-analysis. Minerva Chir 2009; 64:121-133.
4. Michelet P, D'Journo XB, Roch A, et al. Perioperative risk factors for anastomotic leakage after esophagectomy: influence of thoracic epidural analgesia. Chest 2005; 128:3461-3466
5. Popping DM, Elia N, Marret E, et al. Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: a meta analysis. Arch Surg 2008; 143:990-999.

Number of patients (n)	35
Age	65.5 (±10.16)
Male (mean ±SD)	66.9 (±9.14)
Female(mean ±SD)	63.3(±11.3)
Sex (M: F)	2.5 :1
History	
Smoking	(21/35)60%
Pulmonary diseases	(9/35) 26%
Cardiovascular disease	(9/35) 26%
Diagnosis	
Adenocarcinoma	(28/35) 80%
Squamous cell carcinoma	(4/35) 11%
End stage Achalasia	(2/35) 6%
Other	(1/35) 3%
ASA Class	
ASA II	(9/35) 26%
ASA III	(25/35)71%
ASA IV	(1/35)3%
Prior treatment	
Chemoradiation	(12/35) 34%
Endoscopic procedure	(8/35) 23%

	OR (95% CI)
Age	1.11 (0.91 - 1.34)
Male sex	0.09 (0.002 - 5.09)
Weight	1.01 (0.99 - 1.03)
Smoking History	5.73 (0.26 - 125.5)
TEA	0.026 (0.0003-2.45)

S-321.**THE USE OF DEXMEDETOMIDINE AFTER REGIONAL BLOCKADE IN SHOULDER SURGERY PATIENTS IN BEACH CHAIR POSITION**

AUTHORS: P. M. Gupta¹, M. Kronenfeld², K. D. Eichenbaum³, D. W. Saberito⁴, D. E. Feierman⁵

AFFILIATION: ¹Anesthesiology, Maimonides Medical Center, Brooklyn, NY, ²Anesthesiology, Maimonides Medical Center, NY, NY, ³Anesthesiology, Stanford University, Palo Alto, CA, ⁴Anesthesiology, Maimonides Medical Center, Brooklyn, NY, ⁵Anesthesiology, Maimonides Medical Center, Brooklyn, NY

INTRODUCTION: Propofol is often the drug of choice for ambulatory orthopedic cases. Dexmedetomidine has the unique pharmacologic profile of providing sedation without respiratory depression¹. This is particularly relevant in patients with morbid obesity and/or challenging airways.

METHODS: We evaluated how dexmedetomidine (Dex) fares against propofol TIVA in a prospective randomized controlled study of 50 patients following interscalene brachial plexus block. We measured intra- and post-operative hemodynamics, adequacy of anesthesia, requirement for airway intervention, and PACU length of stay. Midazolam was administered as a supplemental medication in both groups, and no narcotics were given.

After IRB approval, 50 patients were randomized to receive either propofol or Dex for TIVA after interscalene brachial plexus block was performed preoperatively under ultrasound guidance and nerve stimulation (40-50 mL mixture: 0.5% ropivacaine and lidocaine 1.5% with epinephrine 5 mcg/ml).

RESULTS: Demographics and ASA class distribution did not differ significantly between the two groups. There were no significant differences in volume of local anesthetic, respiratory instability and hemodynamic change either intra- or post-op. Although there was no significant difference between groups in patients that experienced hypotension (Dex: n=5, propofol: n=4), all episodes were easily corrected with ephedrine. No bradycardia was noted in either group. All patients tolerated nasal cannula and there were no oral or nasal airways placed. There was no significant difference and no airway rescue maneuvers were required. However, 3 patients in the propofol group required either repositioning or chin lift. Neither group reported intraoperative awareness. Post-operative nausea and vomiting, and post-operative pain did not differ significantly. However, the Dex group had significantly longer PACU stays (Dex: X=159±12 min, propofol: X=126±12 min p<0.021).

CONCLUSION: Our results demonstrate safe and effective anesthesia for sitting patients using Dex after regional blockade. Although not statistically significant, none to the patients receiving Dex needed airway repositioning or chin lift. We would recommend that Dex should be preferentially considered for patients predisposed to airway obstruction; however, the standard use of Dex over propofol, needs to be reconsider since the use of Dex as the agent for TIVA was associated with longer PACU stays.

REFERENCES:

1. Venn RM, Hell J, Grounds RM. Respiratory effects of dexmedetomidine in the surgical patient requiring intensive care. *Crit Care* 2000;4:302-8.

S-322.**CHLORHEXIDINE VERSUS POVIDONE-IODINE IN PREVENTING COLONIZATION OF FEMORAL NERVE CATHETERS FOR TOTAL KNEE ARTHROPLASTY**

AUTHORS: J. Marino¹, D. Blitz¹, O. Dowling², D. Bosshart³, F. Overdyk¹

AFFILIATION: ¹Anesthesiology, Hofstra North Shore-LIJ School of Medicine, New Hyde Park, NY, ²Anesthesiology, North Shore-LIJ Health System, New Hyde Park, NY, ³Anesthesiology, North Shore – LIJ Hospital @ Syosset, Syosset, NY

INTRODUCTION: Continuous femoral nerve block (CFNB) techniques continue to be increasingly used in the management of postoperative pain after total knee arthroplasty. Although the risk of infection with CFNB has been poorly defined, the rate of catheter colonization after antisepsis with povidone-iodine has been demonstrated to be as high as 57%¹. Alcohol based antiseptic solutions have been demonstrated to have greater antibacterial activity as compared to standard iodine based solutions during central venous access and epidural catheter placement^{2,4}. However, there have not been any formal comparisons made for continuous femoral nerve block catheters. The goal of this study is to determine the effectiveness of 0.5% alcoholic chlorhexidine and 10% aqueous povidone-iodine in preventing catheter colonization and skin flora associated with postoperative continuous femoral nerve catheter placement.

METHODS: After IRB approval and written informed consent, patients undergoing knee replacement requiring continuous femoral nerve catheter blocks for post-operative analgesia were randomized to receive skin preparation and cleaning with alcohol-based chlorhexidine or povidone-iodine. Femoral catheters were inserted using recommended aseptic techniques. After 48 hours, catheters were removed, and distal tip, and culture swabs of the skin overlying the catheter insertion site were collected and semi quantitatively cultured. Any growth was characterized as colonization.

RESULTS: Demographics and risk of infection in 29 patients were similar between the two groups. Femoral catheters placed after skin preparation with chlorhexidine were found to be colonized nearly half as often as those placed after antisepsis with povidone-iodine {4/16 [25%] vs 6/13 [46%], p=0.23}. Skin around the site of catheter insertion after preparation with chlorhexidine was found to be colonized less than half as often after antiseptic preparation with povidone-iodine {3/16 [19%] vs. 6/13 [46%], p=0.11}. Organisms were largely *Escherichia coli* or coagulase negative *Staphylococcus* for both the catheter tips and skin swabs. There was no colonization and no skin flora in 56 % of subjects in the chlorhexidine group, while only 31% of subjects in the povidone-iodine group demonstrated no colonization (9/16 vs. 4/13, p=0.17). While the data is not statistically significant, we observed a trend of decreased colonization.

CONCLUSION: Alcohol-based chlorhexidine antiseptic skin preparation before the placement of femoral nerve catheters in patients undergoing knee replacement is associated with a lower bacterial colonization rate as compared to povidone-iodine. This study was funded with a grant from Medline.

REFERENCES:

1. Cuivillion P, et al. *Anesth Analg* 2001; 93:1045-1049
2. Hebl J, et al. *Reg Anesth Pain Med*. 2006;31:311-323.
3. Mimoz O, et al. *Crit Care Med* 1996;24:1818-1823.
4. Kinirons B, et al. *Anesth* 2001;94(2).

S-323.**FREQUENCY OF CARDIOPULMONARY COMPLICATIONS AND MORTALITY IN PATIENTS RECEIVING POST-OPERATIVE REGIONAL ANALGESIA FOLLOWING TOTAL HIP OR KNEE ARTHROPLASTY**

AUTHORS: M. Tien, G. A. Wilson, V. Hernandez Torres, A. Jacob, D. R. Schroeder, C. B. Mantilla

AFFILIATION: Department of Anesthesiology, Mayo Clinic, Rochester, MN

INTRODUCTION: Multimodal analgesic regimens featuring regional anesthesia and peripheral nerve blockade are now commonly employed following major orthopedic surgery.¹ The purpose of this study was to determine the frequency of adverse cardiopulmonary events and mortality following total hip or knee arthroplasty in contemporary practice.

METHODS: The medical records of patients undergoing hip or knee arthroplasty were reviewed for an 18-year period (January 1996-December 2013) spanning the introduction of multimodal analgesic regimens including peripheral nerve blockade. Prospectively collected institutional databases were used to identify patients with the diagnosis of myocardial infarction (MI), pulmonary embolism (PE), deep venous thrombosis (DVT), or death within 30 days of surgery. The frequencies of adverse cardiopulmonary events and death were calculated overall and separately for patients undergoing unilateral or bilateral hip or knee arthroplasty.

RESULTS: A total of 34,517 patients underwent total hip or knee arthroplasty in the period of study. The proportion of patients receiving regional blockade for postoperative analgesia increased from 0.67% before 1999 to 99.41% after 2004. Overall, 992 patients experienced one or more adverse events. The overall frequency of adverse events or death was 2.87% (MI: 1.49%, DVT: 0.72%, PE: 0.44%, and death: 0.51%). The frequency of any complication or death was not different across time. Overall, the frequency of any adverse event or death was greater in patients undergoing unilateral hip (3.29%) vs. knee (2.42%) arthroplasty ($p < 0.001$). All complications increased in frequency with older age in both sexes, particularly in patients over the age of 70 years old. The frequency of MI or death was greater in male patients and in patients undergoing hip arthroplasty. The frequency of DVT and PE was greater in patients undergoing knee arthroplasty. Ultimately, the frequency of any cardiopulmonary complication or death was not significantly different between the patients who received regional blockade for postoperative analgesia and the patients who did not ($p = 0.115$).

CONCLUSIONS: The overall frequency of adverse cardiopulmonary events or death within 30 days after total hip or knee arthroplasty with contemporary practice is 2.87%. These frequencies did not change substantially following the introduction of multimodal analgesic regimens featuring regional anesthesia and peripheral nerve blockade. The findings of this study support the notion that the known benefits of regional anesthesia for patients undergoing total knee or hip arthroplasty can be obtained without increasing the risk of perioperative cardiopulmonary complications or death.

REFERENCES:

1. A comprehensive anesthesia protocol that emphasizes peripheral nerve blockade for total knee and total hip arthroplasty. *J Bone Joint Surg Am*, 2005. 87 Suppl2: p. 63-70.

S-324.

A COMPARISON OF CONVENTIONAL LANDMARK GUIDED MIDLINE VERSUS PRE-PROCEDURE ULTRASOUND – GUIDED PARAMEDIAN TECHNIQUES IN SPINAL ANESTHESIA

AUTHORS: K. Kallidaikurichi Srinivasa¹, G. Iohm², F. Loughnane², P. Lee²

AFFILIATION: ¹Anesthesia, Cork university Hospital, Cork, Ireland, ²Anaesthesia, Cork university Hospital, Cork, Ireland

INTRODUCTION: Spinal anesthesia is widely performed using a surface landmark based ‘blind’ technique. Multiple passes and attempts while administering spinal anesthesia are associated with a greater incidence of post dural-puncture headache, paraesthesia and spinal hematoma.¹⁻⁵

We hypothesised that the routine use of pre-procedural ultrasound-guided paramedian spinal technique results in less number of passes required to enter the subarachnoid space when compared to the conventional landmark based midline approach.

METHODS: After local ethics approval, 100 consenting patients scheduled for elective total joint replacements (Hip and Knee) were randomised into group C (conventional) and group P (pre-procedural ultrasound guided paramedian technique) with 50 in each group. The patients were blinded to the study group. All spinal anesthetics were administered by consultant anesthesiologist. In group C, spinal anesthetic done via midline approach using clinically palpated landmarks. In group P, pre-procedural ultrasound scan was used to mark the paramedian insertion site and spinal anesthetic was done via paramedian approach (Fig 1, Fig 2)

RESULTS: The distribution of demographic data of the patients (age, sex and height), type of surgery, history of lumbar spine surgery, history of difficult dural tap and grading of palpated landmarks was similar between the two groups. The average number of passes (defined as the number of forward advancements of the spinal needle in a given inter-spinous space i.e. withdrawal and redirection of spinal needle without exiting the skin) noted in group C was 8.2+/-12.3 (mean +/-SD) which was significantly higher than 4+/-4 (mean +/-SD) in group P (p = 0.025). The number of attempts (defined as the number of times the spinal needle was withdrawn from the skin and reinserted) was also significantly greater in group C at 2+/- 1.6 (mean +/- SD) versus 1.3 +/- 0.7 (mean +/- SD) in group P (p= 0.008). Group P on an average took 81.5 seconds longer compared to group C to identify the landmarks (p <0.0001). All other parameters such as grading of palpated landmarks, time taken for spinal anesthetic injection, peri-procedural pain scores, peri-procedural patient discomfort VAS score, dose of intrathecal Bupivacaine used, conversion to general anesthetic, paraesthesia and radicular pain during needle insertion were similar between the two groups.

CONCLUSION: Routine use of paramedian spinal anesthesia in the orthopedic patient population undergoing joint replacement surgery guided by pre-procedure ultrasound examination, significantly decreases the number of passes and attempts needed to enter the sub-arachnoid space.

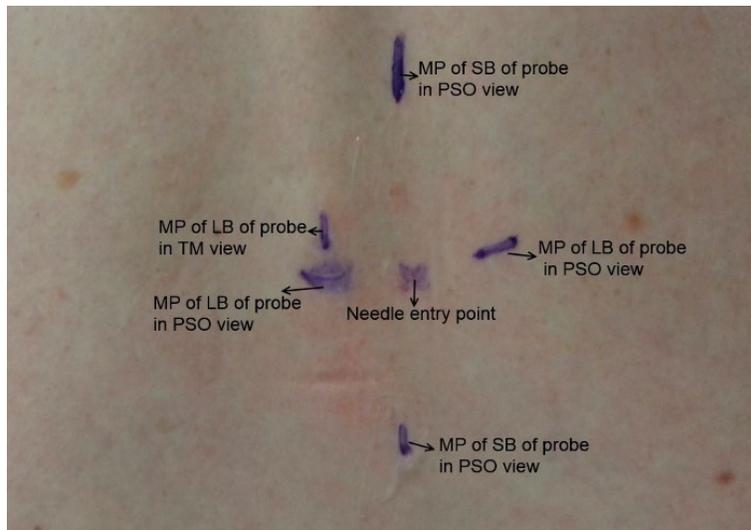
REFERENCES:

1. European journal of anaesthesiology. 2002;19(6):447-51.
2. Anesthesiology. 1997;87(3):479-86.
3. Anaesthesia. 1992;47(10):902-3.
4. Anesthesia and analgesia. 2007;104(4):975-9.
5. Anesthesia and analgesia. 1994;79(6):1165-77.

Figure 1
LFD -Ligamentum flavum dura complex, PLL - Posterior longitudinal ligament.



Figure 2
MP-Midpoint, LB - Long border of probe, SB - Short border of probe.



S-325.**COMPARISON OF REGIONAL TECHNIQUES FOR ANALGESIA FOLLOWING TOTAL HIP ARTHROPLASTY: A RETROSPECTIVE COHORT ANALYSIS**

AUTHORS: C. W. Hackney¹, B. J. Wolf², J. R. McSwain¹, H. A. Demos³, S. H. Wilson¹

AFFILIATION: ¹Anesthesia, Medical University of South Carolina, Charleston, SC, ²Biostatistics, Medical University of South Carolina, Charleston, SC, ³Orthopedics, Medical University of South Carolina, Charleston, SC

INTRODUCTION: Total hip arthroplasty is a successful surgery with increasing demand but associated with significant postoperative pain that impede patient rehabilitation.¹⁻³ Both lumbar epidurals and lumbar plexus nerve blocks have been described for postoperative analgesia.^{4,8} However, it is unclear if one technique is more beneficial.

METHODS: A randomly selected, retrospective cohort of 116 patients (58 with lumbar epidurals and 58 with lumbar plexus nerve blocks) were evaluated using electronic medical records following primary total hip arthroplasty. Postoperative opiate consumption at 48 hours was the primary end point. Secondary end points included use of multimodal analgesics, presence of side effects, time of first ambulation, distance ambulated each day, level of assistance needed to ambulate, and time to discharge. Descriptive statistics were calculated to characterize subjects in the different block type groups. Comparisons in opiate consumption were conducted using linear mixed models. Multivariable models were utilized to examine primary and secondary endpoints.

RESULTS: Patients with a lumbar plexus block consumed less opiates at 24, 36 and 48 hours relative to patients that received epidural analgesia ($P=0.047$, 0.002 and 0.002 , respectively). Patients with lumbar plexus blocks were more likely to have received non-opiate, multimodal pain medications. Patients with lumbar plexus blocks ambulated earlier (24.6 ± 2.01 hours versus 31.7 ± 3.01 hours) and farther relative to patients with epidurals ($P<0.001$ for both) and had discharge orders written earlier (58.2 ± 6.68 hours vs. 73.6 ± 6.35 hours).

CONCLUSIONS: Lumbar plexus nerve blocks in combination with multimodal, oral pain medications are an effective and potentially superior method for postoperative analgesia and physical rehabilitation after primary total hip arthroplasty in comparison with epidural catheters.

S-326.

WHOLE EXOME SEQUENCING OF A FAMILY WITH LOCAL ANESTHETIC RESISTANCE

AUTHORS: S. R. Clendenen¹, N. Clendenen²

AFFILIATION: ¹Anesthesiology, Mayo Clinic Florida, Jacksonville, FL, ²Yale University, New Haven, CT

INTRODUCTION: Local anesthetics (LA) work by blocking sodium conductance through voltage gated sodium channels. Failure of a LA to produce blockade of nociception is uncommon. Complete resistance to LA is limited to a small number of case reports^{1,2} and a larger screening study³. The cause of such resistance is unknown, although genetic variation has been proposed as a potential mechanism. A patient presented for surgery involving her upper extremity with a history of inadequate loss of sensation follow LA administration. A peripheral nerve block of the brachial plexus was performed with ultrasound guidance with injection of 30 ml of 1.5% mepivacaine with a complete failure of the block. (Figure 1) We hypothesized that LA resistance is due to a variant form of voltage gated sodium channel and we test this hypothesis by performing whole exome sequencing for a family with 3 of 4 family members with LA resistance. (Figure 2)

METHODS: Whole Exome Sequencing

The patient and their immediate family provided informed consent for DNA sequencing and they were screened with a questionnaire to identify family members with a history of LA resistance.

A whole blood sample was collected and sent for exome sequencing using the Illumina HiSeq 2000 platform and the results were analyzed using the Genome Analysis Toolkit.

Genetic data analysis: Exome sequencing results for four individuals were referenced to the 1000 Genomes Project and the NHLBI ESP to identify variants associated with local anesthetic resistance, present in less than 1% of the general population, and located in functional regions of the genome.

Identifying Nav 1.5 in Peripheral Nerves

To determine whether Nav 1.5 is present in peripheral nerves we performed immunohistochemistry with highly specific antibodies on healthy human peripheral nerve tissue. The staining revealed Nav 1.5 staining throughout the cell body and along the peripheral nerve fiber (Fig 4A) similar to Nav 1.7 (Fig 4B).

RESULTS: Whole exome sequencing of the four family members was performed to identify genetic variants shared by the three individuals with LA resistance but not present in the unaffected family member. 396 genetic variants were identified, only one of which was identified in a voltage gated sodium channel susceptible to LA inhibition (Nav 1.5). Table 1

CONCLUSION: Resistance to local anesthetics in humans has been documented in the literature and one mechanism is postulated thought to be related to genetic variance. We identified a genetic variant in the gene encoding for Nav 1.5 that is associated with LA resistance. We also demonstrate that Nav 1.5 is present in human peripheral nerves to support the plausibility that an abnormal form of the Nav 1.5 protein could be responsible for the observed local anesthetic resistance.

REFERENCES:

1. Kavlock R, Ting PH. Local anesthetic resistance in a pregnant patient with lumbosacral plexopathy. *BMC anesthesiology* 2004;4:1.
2. Hoppe J, Popham P. Complete failure of spinal anaesthesia in obstetrics. *International journal of obstetric anesthesia* 2007;16:250-5.
3. Trescot AM. Local anesthetic “resistance”. *Pain physician* 2003;6:291-3.

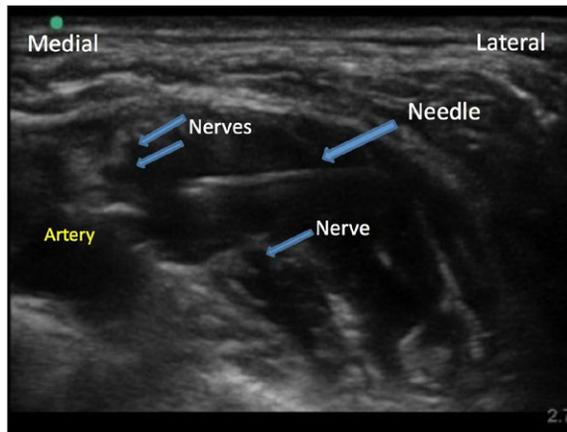


Figure 1. Ultrasounographic image of the patient’s brachial plexus in contact with local anesthetic, which is visible as the hypoechoic fluid-tissue interface surrounding the needle.

Figure 2. Pedigree

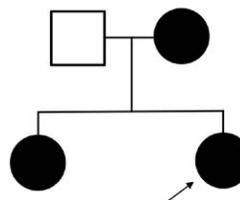


Figure 2. Pedigree demonstrating the relationship between the subjects who had their exome sequenced. The affected individuals reported a history of reduced efficacy of local anesthetics during medical and dental procedures. Arrow indicates the proband.

S-326 • continued

Figure 4A. Human peripheral nerve stained with Nav 1.5 antibody.

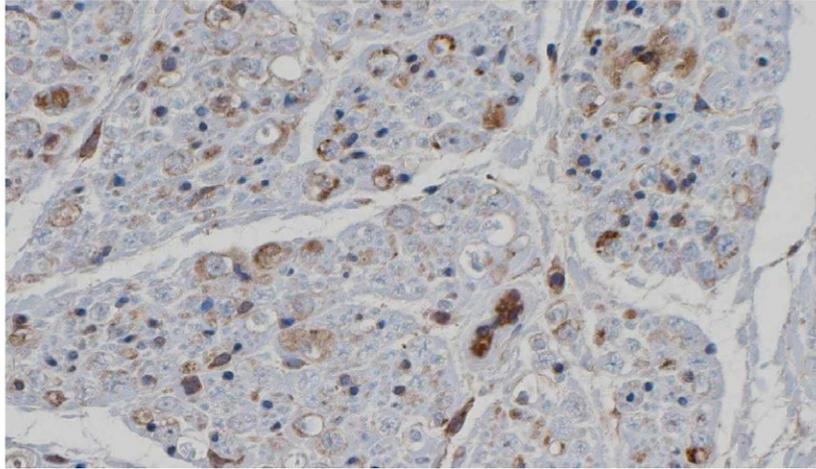


Figure 4B. Human peripheral nerve staining with Nav 1.7 antibody.

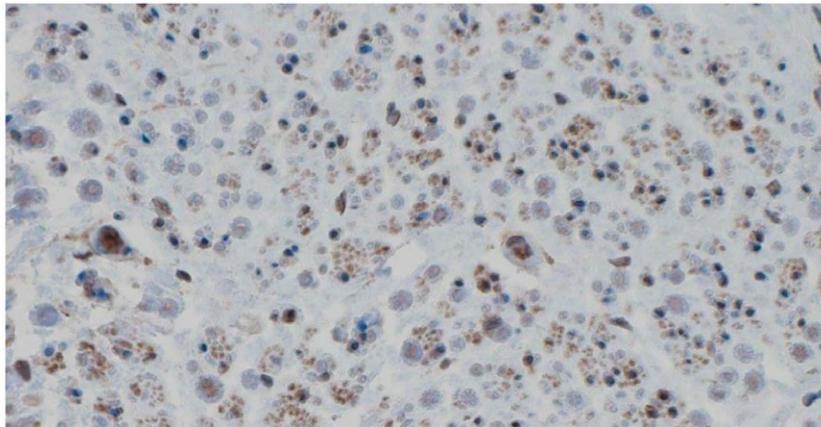


Table 1. Exome sequencing summary of affected family members

Total variants	396	
Variant type	Number of variants	Percentage of variants
Exon	355	90%
Intron	88	22%
Promoter	38	10%
5' UTR	9	2%
3' UTR	4	1%
MicroRNA	2	0.5%
Non-coding RNA	13	3%
Mitochondrial	0	0
Missense	315	80%
Frameshift	13	3%
In-frame	15	4%
Stop gain	12	3%
Stop loss	2	0.5%
Start loss	0	0
Synonymous	3	1%

S-327.**CONTINUOUS INTERCOSTAL NERVE BLOCK FOR POSTOPERATIVE ANALGESIA AGAINST MINIMALLY INVASIVE CARDIAC SURGERY**

AUTHORS: A. Sakai¹, H. Murata¹, K. Ogami¹, T. Ichinomiya¹, T. Hara²

AFFILIATION: ¹Anesthesiology, Nagasaki University Hospital, Nagasaki, Japan, ²Anesthesiology, Nagasaki University, Nagasaki, Japan

INTRODUCTION: Cardiac surgery through right mini-thoracotomy is defined as a type of minimally invasive cardiac surgery (MICS). Despite less-invasive procedure^{1,2}, patients who underwent MICS sometimes complain severe postoperative pain. Therefore we introduced continuous intercostal nerve block (CINB) as one of the postoperative analgesia options against MICS. The aim of this retrospective analysis was to investigate the efficacy of CINB for postoperative analgesia against MICS based on perioperative opioid requirements.

METHODS: We identified consecutive patients aged 18 years and older undergoing elective mitral valve surgery, atrial septal defect closure or left atrial myxoma using MICS procedure through right mini-thoracotomy under propofol/remifentanyl general anesthesia between January 1, 2012, and September 30, 2014, at Nagasaki University Hospital. Patients were excluded if they had a history of previous cardiac surgery, if they underwent reoperation or reintubation within 24 h from the first MICS. After establishing extracorporeal circulation, surgical procedure was completed through the right 4th intercostal mini-thoracotomy with about 7 cm skin incision at mid-axillary line. In the patients who received CINB, a catheter was placed at the 4th intercostal space dorsal to the skin incision site at the surgical field before the closure of the thoracotomy. After injecting 10 mL of 0.75% ropivacaine, 0.2% ropivacaine at a rate of 4 mL/h was continuously infused through the catheter for about 72 h postoperatively. A main measurement was the total dose of intravenous fentanyl within 24 h after extubation. Data were analyzed using the Mann-Whitney U-test or Fisher's exact test when appropriate. $P < 0.05$ was considered statistically significant.

RESULTS: We identified 47 patients fulfilling the inclusion criteria, 30 patients received a postoperative CINB, while 17 patients did not. The two groups (CINB group vs no block group) were comparable in age, height, weight, body mass index, anesthesia time and operation time, the total dose of intraoperative intravenous fentanyl. The total doses of intravenous fentanyl within 24 h after extubation were 6.6 mcg/kg (median, range 0-39.3) in the CINB group and 11.3 mcg/kg (median, range 0-35.9) in the no block group ($p=0.22$). No complication related to CINB was observed.

CONCLUSION: We investigated the analgesic efficacy of CINB against MICS based on perioperative opioid requirements. CINB might be an effective and safe method to reduce postoperative opioid consumption after MICS through right mini-thoracotomy.

REFERENCES:

1. The Journal of Japan Society for Clinical Anesthesia Vol.32 No.3, 2012
2. European Journal of Cardio-thoracic Surgery Vol.33 537-541, 2008

S-328.**INTRAOPERATIVE ANALGESIC DRUG INJECTIONS AT THE SURGICAL WOUND SITE REDUCES POSTOPERATIVE PAIN AFTER KNEE SURGERY IN RATS**AUTHORS: A. Buvanendran¹, J. S. Kroin², K. Tuman³AFFILIATION: ¹Anesthesiology, Rush University Medical Center, Chicago, IL, ²Anesthesiology, Rush university Medical Center, Chicago, IL, ³Anesthesiology, Rush University Medical Center, Chicago, IL

INTRODUCTION: Many surgeons now use injections of drugs into the wound during total knee arthroplasty (TKA) surgery to reduce postoperative pain.^{1,2} However, despite widespread use of local infiltration analgesia, there is relatively limited evidence as to which drug and dose is adequate from clinical trials.² To test the efficacy of this local route of administration under a controlled situation we tested rats with a knee surgery model that simulated some aspects of TKA.³

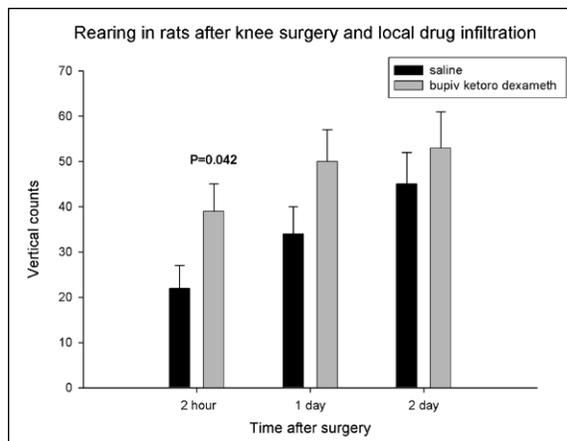
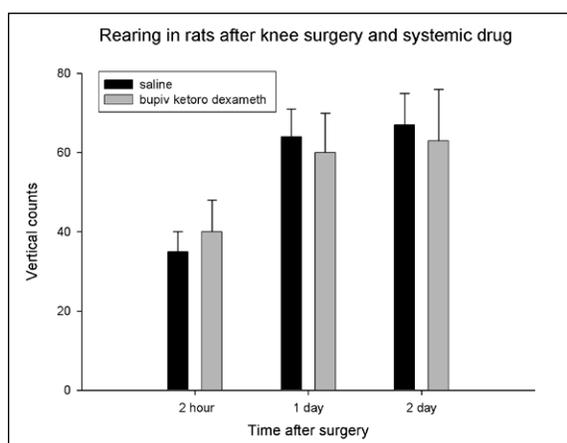
METHODS: With IACUC approval, rats were anesthetized with 1.5% isoflurane in oxygen and a 1-cm long skin incision made over the patella tendon. The tendon was freed from underlying fascia and moved laterally to expose the joint. Using a diamond bur, a 1.4-mm diameter, 0.5-mm deep hole was drilled in both the femur and the tibia, 2 mm above and below the knee joint respectively.³ Then, 10 μ L of drug was injected into each hole (IH), and there was a 2-min delay for drug to be absorbed. The holes were then filled with cold-curing dental cement. The skin margins were elevated and 30 μ L of drug was injected (PA) into the wound. The skin was closed with 4-0 nylon sutures. For systemic control injections, 50 μ L of drug was injected subcutaneously beneath the abdominal skin. Drug combinations consisted of local anesthetic, NSAID, and steroid (0.75% bupivacaine, 6 mg/mL ketorolac, 2 mg/mL dexamethasone). After surgery, spontaneous rearing behavior was measured as a method to assess postoperative pain, with increased rearing indicating less pain.³

RESULTS: When the 3-drug combination was injected in the bone holes (IH, 10 μ L per hole), and after cementing, injected periarticular (PA, 30 μ L), rearing was increased at 2 h postsurgery compared to saline (fig. 1). The same 3-drug combination injected systemically (50 μ L) did not have a significant effect on rearing (fig. 2). When bupivacaine alone was injected (IH +PA), there was not a significant effect on rearing. However, when ketorolac plus dexamethasone was injected (IH +PA), rearing was increased at 2 h postsurgery.

DISCUSSION: Local drug infiltration using a local anesthetic plus anti-inflammatory drugs reduces pain-related activity after knee surgery, while systemic injection of the same drugs was without effect. Preliminary results suggest that local infiltration of anti-inflammatory drugs are more important than the local anesthetic drug in reducing knee postoperative pain.

REFERENCES:

1. JBJS 2006;88-A:959-63;
2. Br J Anaesth 2014;113:360-74; 3. Anesth Analg 2008;107:300-8.

**Figure 1****Figure 2**

S-329.**EFFECT OF THE HEIGHT OF THE OPERATING TABLE
DURING SPINAL ANESTHESIA****AUTHORS:** H. Sohn, J. Kim**AFFILIATION:** Department of Anesthesiology and Pain Medicine,
Seoul National University Bundang Hospital, Seongnam-si,
Korea, Republic of.**INTRODUCTION:** The height of the operating table is related to the performance of the procedure and the discomfort of the operator. The aim of this study was to investigate the influence of different operating table heights on the accuracy of needle insertion and the discomfort of the anesthetist during spinal anesthesia.**METHODS:** Sixty patients were randomly allocated into 4 groups by the landmarks on the anesthetist's body: umbilicus (U), lowest rib margin (L), xiphoid process (X), and nipple (N). Before induction of anesthesia, the height of the operating table was adjusted to each group. All patients were in the lateral recumbent position with their shoulders and hips perpendicular to the table. Spinal anesthesia was performed by median approach. The primary outcome was the 'initial angle' between the patient's skin and the spinal needle in view of coronal plane. Until the success of the spinal anesthesia, each coronal angle was measured in company with the sagittal angle. The anesthetist's posture was recorded by taking pictures and the degree of flexion of the neck, back, and knee was measured. At the end of the procedure, the overall subjective discomfort of the anesthetist was investigated.**RESULTS:** Fifteen patients per each group, exclusive of 1 case which converted to general anesthesia, were analyzed. The initial coronal angle between the patients' skin and the spinal needle was the most perpendicular in group X (90.1°) and the most remote from 90° in the group U (98.1°). The final coronal angles, sagittal angles and the success rate were not different between the groups. The subjective necessity for bending the joints was the highest in group U. The objective degree of neck, back, and knee flexion was the highest in group U and the lowest in group X and group N. Anesthetist s complained of discomfort in group U and L compared to group X and N (5.8 and 5.1 vs 2.3 and 2.1).**CONCLUSIONS:** At the xiphoid and nipple level, the angle between the patients' skin and the spinal needle was optimal, and both objective and subjective discomforts of the anesthetists were minimal.**REFERENCES:**Lee, H.C., et al., Higher operating tables provide better laryngeal views for tracheal intubation. *Br J Anaesth*, 2014. 112(4): p. 749-55.

S-330.

THE EFFECTS OF PERIOPERATIVE REGIONAL ANESTHESIA AND ANALGESIA ON CANCER RECURRENCE AND SURVIVAL FOLLOWING ONCOLOGIC SURGERY A SYSTEMATIC REVIEW AND META-ANALYSIS

AUTHORS: Y. Sun¹, T. J. Gan², T. Li¹

AFFILIATION: ¹Anesthesiology, Beijing Tongren Hospital, Capital Medical University, Beijing, China, ²Anesthesiology, Stony Brook University, Stony Brook, NY

PURPOSE: Metastatic recurrence remains the leading cause of death after oncologic surgery.¹ Perioperative regional anesthesia and analgesia (RA) could potentially influence the outcomes of patients with cancer.²⁻³ The aim of this systematic review and meta-analysis was to evaluate the effects of perioperative RA on survival and cancer recurrence after oncologic surgery.

METHODS: The authors searched computerized databases (from inception to August 2014), reference lists and considered all studies comparing effect of RA (combined with or without general anesthesia [GA]) on cancer recurrence or overall survival with that of GA. RA was defined as a part of the body anesthetized with local anesthetics, such as a limb or the lower half of the body. It was divided into central and peripheral blockade. Two independent assessors reviewed retrieved citations. Independent data abstraction was performed on study design, RA strategy, type of cancer, and statistical outcomes. Hazard ratio (HR) estimates were pooled to determine the beneficial effects of RA on risks of cancer recurrence and mortality.

RESULTS: A total of 20 eligible studies including 54,541 patients were included. The meta-analysis showed that perioperative RA use was associated with improved overall survival (HR =0.84, 95% CI 0.75 to 0.94; I² =41%), (Figure 1) but not with reduced cancer recurrence (HR=0.91, 95%CI 0.70 to 1.18; I²=83%). (Figure 2) Similar results were also found following open procedures. When pooled analysis for trials follow-up analyzed data from previous RCTs, no beneficial effect of RA was observed on both overall and cancer recurrence-free survival. In addition, the pooled HR differential varied slightly depending on type of cancer and the subgroup difference was not statistically significant.

CONCLUSION: RA use is associated with improved overall survival but is not associated with cancer recurrence after oncologic surgery. Further studies are needed to clarify this important issue.

REFERENCES:

1. Gupta GP, Massague J. Cancer metastasis: building a framework. *Cell* 2006;127(4):679-95.
2. Bar-Yosef S, Melamed R, Page GG et al. Attenuation of the tumor-promoting effect of surgery by spinal blockade in rats. *Anesthesiology* 2001;94(6):1066-73.
3. O’Riain SC, Buggy DJ, Kerin MJ, Watson RW, Moriarty DC. Inhibition of the stress response to breast cancer surgery by regional anesthesia and analgesia does not affect vascular endothelial growth factor and prostaglandin E2. *Anesth Analg* 2005;100(1):244-9.

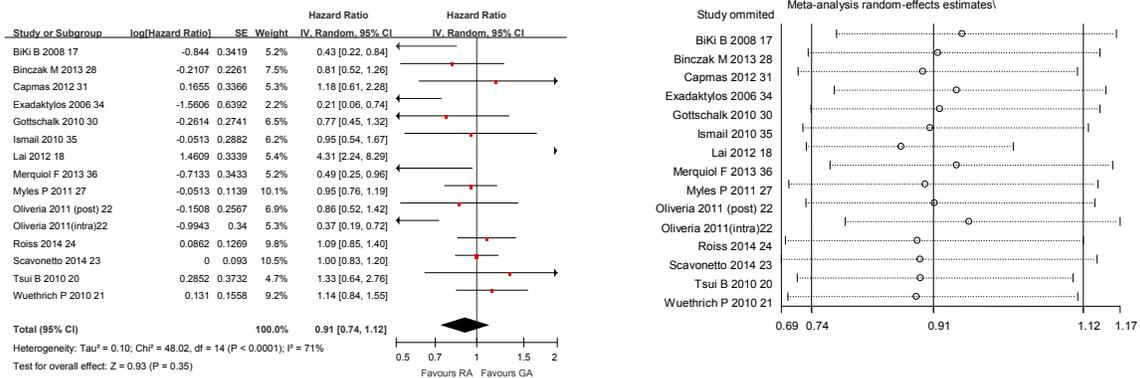


Figure 2 Meta-analysis and pooled hazard ratio (HR) of the effect of perioperative regional anesthesia and analgesia on cancer recurrence-free survival after cancer surgery and the influence analysis of individual studies on the pooled HR. Left hand of figure show Forest plots for cancer recurrence-free survival and right hand of figure show the influence of individual studies on the pooled HR. RA: regional anesthesia and analgesia; GA: general anesthesia; post: epidural analgesia initiated after surgery. intra: epidural analgesia initiated during surgery.

S-330 • continued

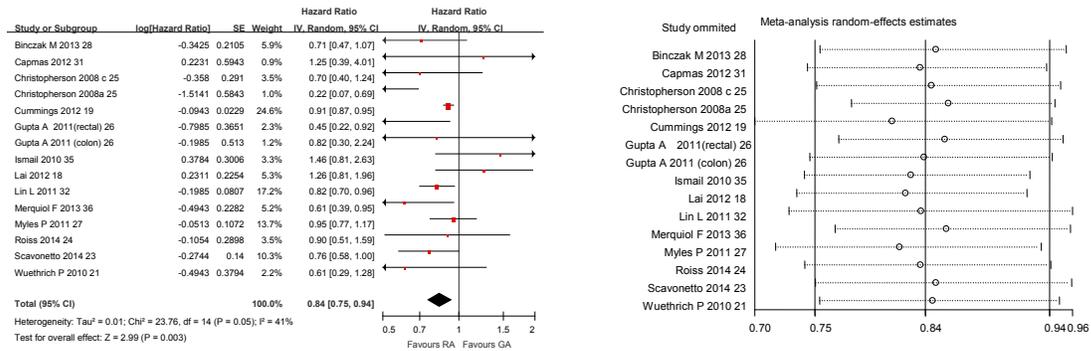


Figure 3 Meta-analysis and pooled hazard ratio (HR) of the effect of perioperative regional anesthesia and analgesia on overall survival after cancer surgery and the influence analysis of individual studies on the pooled HR and the influence analysis of individual studies on the pooled HR. Left hand of figure show Forest plots for overall survival and right hand of figure show the influence of individual studies on the pooled HR. a: patients without distant metastasis before surgery. c: patients with distant metastases before surgery. RA: regional anesthesia and analgesia; GA: general anesthesia

S-331.**THE IMPACT OF CAUDAL BLOCK ON THE SURGICAL OUTCOME IN CHILDREN UNDERGOING HYPOSPADIAS REPAIR****AUTHORS:** M. Kim, Y. Choi, J. Lee**AFFILIATION:** Anesthesia and Pain Medicine, Yonsei University, College of Medicine, Seoul, Korea, Republic of

Introduction: Caudal block (CB) is a safe and reliable technique which is widely used in children undergoing hypospadias repair surgery¹⁻³. A previous study showed that CB may result in penile engorgement during hypospadias repair surgery and insisted that this engorgement might be associated with surgical complications⁴. However, the effect of CB on the surgical outcome after hypospadias repair has not been clearly investigated. Therefore, the objective of this study was to elucidate the impact of CB on surgical outcome after hypospadias repair surgery.

METHODS: The medical records of 372 pediatric patients who underwent hypospadias repair from January 2011 to December 2013 at our institution were analyzed in this retrospective study. These patients were divided into either the CB group or the NCB (no CB) group according to whether the patients received CB or not.

Surgical complications for 3 months after surgery were compared between the CB and the NCB group. Logistic regression analysis was done to identify the risk factors of surgical complications.

RESULTS: Patients' characteristics and surgical data are shown in table 1. Incidence of the surgical complications was significantly higher in the CB group than in the NCB group. The comparison of surgical complications between groups is summarized in table 2. According to multivariate analysis in the logistic regression, CB and surgical techniques were independent risk factors of surgical complications (table 3). Patients that received CB had 2.7 of odds for occurrence of the surgical complications compared with those that did not receive CB (95% CI: 1.553-4.85, $P < 0.001$).

CONCLUSIONS: This analysis demonstrated that CB was an independent risk factor for deterioration of surgical outcome in children after hypospadias repair. Further study is needed to clarify the underlying cause or mechanism of this phenomenon.

REFERENCES:

1. Anesthesiology, 65(1): p. 84-6, 1986
2. Pediatric Anesthesia, 15(6): p. 491-4, 2005
3. Clinical Anesthesia, 20(6): p. 442-6, 2008
4. Pediatric Anesthesia, 22(7): p. 707-12, 2012

Table 1.**Patients' characteristics and surgical data. Values are median (range), mean (SD), or number of patients (proportion, %).**

	CB group (n=218)	NCB group (n=154)	P value
Demographic data			
Age (month)	10 (2-117)	10 (6-91)	0.815
Height (cm)	77.5 (12.5)	76.9 (12.6)	0.652
Weight (kg)	10.3 (3.5)	10.2 (4.1)	0.752
Surgical data			
Hypospadias types			0.010
Glanular	10 (4.6%)	6 (3.9%)	
Subcoronal	17 (7.8%)	5 (3.3%)	
Penile	135 (61.9%)	83 (53.9%)	
Penoscrotal	33 (15.1%)	23 (14.9%)	
Scrotal	18 (8.3%)	32 (20.8%)	
Perineal	5 (2.3%)	5 (3.3%)	
Surgical techniques			
MAGPI	5 (2.3%)	7 (4.5%)	0.285
GAP	5 (2.3%)	3 (1.9%)	
Thiersch-Duplay	1 (0.5%)	0 (0%)	
TIP	156 (71.6%)	99 (64.3%)	
TPIF	24 (11.0%)	15 (9.7%)	
modified TPIF	27 (12.4%)	30 (19.5%)	
Combined with chordectomy	199 (91.3%)	140 (90.9%)	0.900
Other additional procedures	165 (75.7%)	92 (59.7%)	0.001

CB, caudal block; NCB, no-caudal block; MAGPI, meatal advancement and granuloplasty; GAP, glans approximation procedure; TIP, tubularized incised plate; TPIF, transverse preputial island flap.

S-331 • continued**Table 2. Comparison of surgical complications between the CB and NCB group. Values are number of patients (proportion, %).**

	CB group (n=218)	NCB group (n=154)	P value
No of patients with surgical complications	77 (35.3%)	36 (23.4%)	0.020
Types of surgical complications			
Urethro-cutaneous fistula	35 (45.4%)	23 (63.9%)	
Urethral stricture	21 (27.3%)	3 (8.3%)	
Urethral diverticulum	11 (14.3%)	7 (19.4%)	
Wound dehiscence	4 (5.2%)	1 (2.8%)	
Others	3 (3.9%)	0 (0.0%)	
Combined	3 (3.9%)	2 (5.6%)	

CB, caudal block; NCB, no caudal block.

Table 3. Analysis of risk factors for surgical complications after hypospadias repair.

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Age (month)	0.998 (0.983-1.013)	0.83	-	-
Surgery time	1.006 (1.003-1.008)	<.0001	1.002(0.994-1.011)	0.596
Anesthesia time	1.006 (1.003-1.008)	<.0001	1.002 (0.993-1.011)	0.685
Height (cm)	0.998 (0.981-1.016)	0.849	-	-
Weight (kg)	0.976 (0.914-1.041)	0.459	-	-
Intraoperative intake	1.003 (1.001-1.005)	0.002	0.992 (0.976-1.009)	0.344
Intraoperative output	1.011 (1.003-1.019)	0.006	1.003 (0.962-1.046)	0.898
Caudal Block				
no	1 (Ref)	-	1 (Ref)	-
yes	1.856 (1.162-2.965)	0.0096	2.744 (1.553-4.85)	0.0005
Surgical techniques				
simple	0.426 (0.096-1.892)	0.262	0.486 (0.107-2.201)	0.349
TIP	1 (Ref)	-	1 (Ref)	-
complex	5.598 (3.371-9.297)	<.0001	4.212 (2.167-8.187)	<0.0001
Chordectomy				
no	1 (Ref)	-	-	-
yes	0.990 (0.455-2.155)	0.98	-	-
Other additional procedures				
no	1 (Ref)	-	1 (Ref)	-
yes	1.823 (1.143-2.907)	0.012	0.916 (0.469-1.79)	0.798

CI, confidence interval; OR, odds ratio; TIP, tubularized incised plate.

S-332.

PERIARTICULAR INFILTRATION ANALGESIA CAN PROVIDE SUFFICIENT ANALGESIA AFTER TOTAL KNEE ARTHROPLASTY WITHOUT PERONEAL NERVE PARALYSIS: COMPARISON WITH SCIATIC NERVE BLOCK

AUTHORS: K. Aikawa¹, T. Hashimoto²

AFFILIATION: ¹Anesthesiology, Sunagawa City Medical Center, Sunagawa city, Japan, ²Anesthesiology, Graduate School of Medicine, Hokkaido University, Sapporo, Japan

BACKGROUND: It is well established that continuous or single-shot femoral nerve block (FNB) provides effective analgesia after total knee arthroplasty (TKA). Although FNB is effective, some patients still experience postoperative posterior knee pain. Sciatic nerve block (SNB) is widely used as a supplemental analgesia after TKA combined with FNB. Despite its effectiveness, SNB often causes peroneal nerve paralysis, which makes it difficult to detect peroneal nerve injury by surgical process. Therefore, performing SNB for TKA is controversial¹. Recently, it is reported that periarticular infiltration analgesia (PIA) is also useful as an adjunctive to FNB after TKA². Furthermore, it is supposed that PIA hardly causes peroneal nerve paralysis.

We conducted a retrospective analysis to compare the frequency of peroneal nerve paralysis and analgesic effectiveness of SNB and PIA.

METHODS: This study was approved by the local institutional ethics committee. Thirty-nine patients who were scheduled to undergo TKA under general anesthesia were enrolled in the study. We excluded revision TKA, regular narcotic use, psychiatric disorder, and severe systemic disorder. All patients received continuous FNB with 20 ml of ropivacaine 0.375%. In the SNB group (N=19), 15-20 ml of ropivacaine 0.375% were injected around sciatic nerve at popliteal successively. These peripheral nerve blocks were performed under ultrasound guided (EDGE®, Sonosite Japan, Tokyo). In the PIA group (N=20), the cocktail compounded from 20 ml of ropivacaine 0.75%, physiological saline 20 ml, adrenaline 0.3 mg, morphine hydrochloride (men 10 mg, women 5 mg), and dexamethasone 3.3 mg were injected into the soft tissues around the time of insertion of artificial joint. Primary outcome measure was the frequency of peroneal nerve paralysis when the patients woke up. Secondary outcome measure was postoperative Numerical Rating Scale (NRS) at rest. NRSs were evaluated at 0, 12, 24, and 48 hours after the operation. Student's t-test, fisher's exact test and two-way repeated measures analysis of variance (ANOVA) were used for statistical analyses. P values less than 0.05 were considered significant.

RESULTS: No significant differences were observed in patient characteristics between the two groups except preoperative ROM (table1).

While there were 16 patients who had peroneal nerve paralysis in the SNB group, none of them had it in the PIA group (P<0.0001, table2).

Regarding pain NRS, the interaction between treatment group and time was statistically not significant (P=0.391) and there was no significant difference between the two groups (P = 0.361). NRSs (mean±SD) at each point were not statistically significant (figure).

CONCLUSIONS: It's suggested that PIA can be good alternative to SNB for TKA, without causing peroneal nerve paralysis.

REFERENCES:

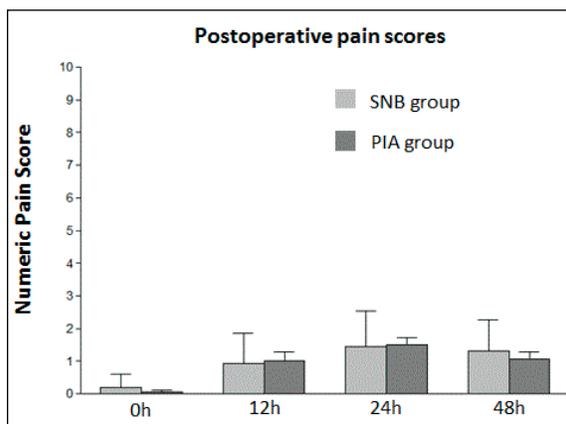
1. Reg Anesth Pain Med 2011;36:421-3.
2. J Arthroplasty 2012;27:1806-11.

Table 1:Patient characteristics

	SNBgroup□N=19□	PIAgroup□N=20□	P
Age (yr)	78 (71-82)	76.5 (69-82)	0.582
Gender (M/F)	3/16	3/17	1.000
ASA status (I/II/III)	0/19/0	0/17/3	
OA/RA	2/17	1/19	0.605
Height (cm)	150 (146-155)	153 (138-159)	0.22
Weight (kg)	57 (52-67)	62.5 (54.5-69)	0.125
BMI(kg□m-2)	25.4 (23.3-26.5)	27.3 (24.3-29.4)	0.103
Preoperative ROM□□	125 (120-140)	115 (95-120)	0.008*
Surgery time (min)	115 (104-120)	113 (105-154)	0.118

Table 2: Postoperative peroneal nerve paralysis

	SNB group	PIA group
Paralysis	16	0
non-paralysis	3	20



S-333.**REVIEW OF CASE REPORTS OF SPINAL HEMATOMAS INVOLVING PEDIATRIC CASES**

AUTHORS: H. T. Benzon¹, A. Nelson¹, A. Patel², H. A. Benzon¹, R. J. McCarthy³

AFFILIATION: ¹Anesthesiology, Northwestern University Feinberg School of Medicine, Chicago, IL, ²Medical School, Robert Wood Johnson Medical School, Piscataway, NJ, ³Anesthesiology, Northwestern University, Chicago, IL

INTRODUCTION: We reviewed the case reports of spinal hematoma to gain insight on the issues related to spinal hematoma.

METHODS: We performed a PubMed search which listed 1812 case reports. After excluding non-English articles, non-case reports, erroneously listed papers, intracranial and spinal subdural hematomas, we identified 545 articles. For this report, we focus on the cases that involved the pediatric population, ages 1 to 18 years.

RESULTS: Eighty four cases involved the pediatric population, 20 were patients with hematologic abnormality (Hemophilia A or B), 20 involved trauma (sport-related, falls, MVA). The rest were of unknown etiology, AV malformation, only 3 were related to the use of anticoagulants. In the patients who had coagulation tests done, 34 had abnormal values (mostly low levels of Factor 8, 9, 4, and fibrinogen) and 24 had normal results. The diagnosis was made by MRI or CT in all the patients except 10 who had either a CT-myelogram or a myelogram. 76 cases had full or partial recovery, 51 had partial recovery. In the 37 patients who had complete paralysis before surgery, 16 had full recovery, 15 had partial recovery, and 6 had no recovery. The timing of surgery in relation to the onset of paralysis are as follows: a) full recovery - 3 emergency, 7 not stated, and 38.14 +/- 32.9 hours in the 7 patients in whom the timing of surgery in relation to the onset of paralysis was stated; b) partial recovery - 6 not stated, and 48 +/-54 hours in the 9 patients in whom the timing of surgery was stated; and, c) no recovery - 4 not stated and 42 and 12 hours in 2 patients in whom the timing of surgery was stated.

DISCUSSION: Spinal hematoma in the pediatric population is usually due to hematologic abnormality usually hemophilia A or B, or due to trauma. Rarely is it from the use of anticoagulants. Recovery was not related to the timing of surgery, as noted by some investigators,¹ at least not in the pediatric population.

REFERENCES:

1. Groen. Neurosurgery 1996;39:494-508

S-334.**POSTOPERATIVE ANALGESIC EFFECT AND SAFETY OF THE INTRAPERITONEAL INSTILLATION OF ROPIVACAINE FOR PAIN RELIEF AFTER LAPAROSCOPIC GYNECOLOGICAL SURGERY**

AUTHORS: C. Yakoshi, H. Niwa, M. Kitayama, K. Hirota

AFFILIATION: Department of Anesthesiology, Hirosaki University Graduate School of Medicine, Hirosaki, Japan

INTRODUCTION: Peripheral nerve block techniques including transtal block and intraperitoneal instillation of local anesthetics (ILA) are increasingly used for the prevention of postoperative analgesia after laparoscopic surgery. Several studies demonstrated efficacy and safety in individual technique use after abdominal surgery. However, information regarding the combined use of transtal block and ILA is rare. In this present study, we have evaluated analgesic efficacy and measured plasma concentrations of ropivacaine following combined use of preoperative rectus sheath block(RSB) and intraoperative ILA using different concentrations of ropivacaine (0.25%, 0.5%) in gynaecological laparoscopic surgery.

METHODS: With ethical committee approval and informed consent, 53 patients who underwent laparoscopic gynaecological surgery were randomly allocated to two groups for receiving ILA with 20 ml of either 0.25% (=0.25% group; n=26) or 0.5% (=0.5% group; n=27) of ropivacaine at the end of pneumoperitoneum, following preoperative bilateral RSB with 20ml of 0.375% ropivacaine. Arterial plasma samples were collected 0, 30, 60, 120, and 180 min after completion of RSB, or 0, 5, 12, 30, 45, 60, and 90 min after of instillation of ropivacaine intraperitoneally. Plasma ropivacaine concentrations were measured by gas chromatography mass spectrometry (GC/MS) (inter and intra assay coefficient of variation and minimum sensitivity were 3.6%, 3.7% and 10ng/ml respectively). The analgesic efficacy was assessed using numerical rating scales for pain and morphine consumption up to 24 hours after surgery.

RESULTS: The mean plasma concentrations (C0) immediately before ILA were 0.52 ± 0.03 and 0.51 ± 0.02 µg/ml and the maximum plasma concentrations (Cmax) were 0.82 ± 0.04 and 1.00 ± 0.05 µg/ml, respectively, for 0.25% group and 0.5% group. Times to Maximum plasma concentrations (Tmax) were attained 17.7 ± 2.3 and 24.4 ± 2.5 min after ILA, respectively, for 0.25% group and 0.5% group. No signs of central nervous system or cardiac toxicity were observed. Pain scales and morphine consumptions in the postanesthetic care unit and the postoperative period was no difference between the two groups.

CONCLUSION: The present study demonstrated that the combined of RSB and ILA of ropivacaine may be safety and more potent enough to relieve pain after laparoscopic surgery than sole technique.

REFERENCES:

1. Br J Surg 2011;98:1068-78.
2. Br J Anaesth 2012;109:185-90.
3. Colorectal Dis 2013;15:146-55.
4. Obstet Gynecol 2011;118:1230-7.
5. Aust N Z J Obstet Gynaecol 2011;51:544-7.
6. Am J Obstet Gynecol 2012;207:419.
7. J Minim Invasive Gynecol 2008;15:554-8.
8. Anaesth Intensive Care 2010;38:623-38.
9. J Minim Invasive Gynecol 2012;19:545-53.
10. J Chromatogr 1990;533:229-34.
11. Br J Anaesth 1997;78:507-14.
12. Anesth Analg 2002;95:450-6.
13. Acta Anaesthesiol Scand 2002;46:616-7.
14. Anesth Analg 2002;94:100-5.
15. Anesth Analg 2012;114:230-2.
16. Reg Anesth Pain Med 1998;23:189-96.

S-335.**COMPARING ADDUCTOR CANAL BLOCK TO FEMORAL NERVE BLOCK FOR TOTAL KNEE ARTHROPLASTY, A RETROSPECTIVE CHART REVIEW****AUTHORS:** N. Shetty¹, S. Nair², A. Vydyanathan³, S. Kim⁴**AFFILIATION:** ¹Anesthesiology, Albert Einstein College of Medicine, Bronx, NY, ²Anesthesiology, Montefiore Medical Center, Bronx, NY, ³Anesthesiology, Montefiore Medical center, New York, NY, ⁴Orthopaedic Surgery, Albert Einstein College of Medicine, Bronx, NY**BACKGROUND:** Regional anesthesia has been routinely used for post-operative total knee arthroplasty (TKA) analgesia. While femoral nerve block (FNB) provides excellent analgesia, it has been associated with quadriceps weakness, and associated falls. The adductor canal block's (ACB) more distal targeting may provide superior analgesia, while limiting weakness. Prospective studies have shown increased strength and equivalent analgesia with ACB, but there is still a paucity of literature. In this retrospective chart review, the authors hypothesized that ACB patients would exhibit less opioid usage and better physical therapy milestones, when compared to FNB.**METHODS:** A proprietary hospital software program known as Clinical Looking Glass (CLG) was used to create a list of patients with ICD-9 code 81.54 (total knee replacement) for the time period 10/01/12-08/01/13, and FNB and ACB patients were identified. Visual analog pain score (VAS), range of motion (ROM), strength, bed mobility, and transfer ability were assessed at various time periods by nurses and occupational therapists. Opioid usage was calculated using a combination of patient-controlled anesthesia, and 24hr post-operative administration by the medical team. 24 hour NSAID and acetaminophen administration were also tracked.**RESULTS:** A total of 227 TKA charts were reviewed, with 175 having sufficient and appropriate data for inclusion in our study (111 ACB, 64 FNB). Opioid/NSAID/acetaminophen use and pain scores were not statistically different between the two groups. Knee extension during ROM-24 hour measurements was markedly lower in the ACB group versus the FNB group (median [25th and 75th percentile], 8.0 [5.0-13.0] (ACB) vs. 12.0 [9.5-15.5] (FNB); $P < .05$), as was ROM-48 hour (median [25th and 75th percentile], 8.0 [4.0-10.0] (ACB) vs. 10.0 [5.0-15.0] (FNB); $P < .05$), indicating an improved ability for patients to extend their knees. ROM extension during patients' 3-6 month follow-up was lower for ACB than FNB as well (95% CI ACB: [.09-1.83], FNB [.88-3.3]; $p < .05$), although inadequate patient follow-up confounded this result. Strength-48 hour was slightly lower for ACB versus FNB (median [25th and 75th percentile], 4.0 [2.4-5.0] (ACB) vs. 5.0 [3.0-5.0] (FNB); $P < .05$). All other target metrics were not statistically significant.**CONCLUSION:** ACB exhibited comparable analgesia and better knee extension than FNB, possibly alluding to increased quadriceps strength. However, 48hr post-operative strength as measured by occupational therapists was higher for FNB. These results are somewhat inconclusive, emphasizing the need for continued research.**REFERENCES:**

1. Ilfeld BM, Duke KB, Donohue MC. The association between lower extremity continuous peripheral nerve blocks and patient falls after knee and hip arthroplasty. *Anesth Analg* 2010; 111: 1552-4.
2. Kim D, Lin Y, Goytizolo E, Kahn, R, Maalouf D, Manohar A, Patt M, Goon A, Lee, Y, Ma Y, and Yadeau J. Adductor Canal Block versus Femoral Nerve Block for Total Knee Arthroplasty: A Prospective, Randomized, Controlled Trial. *Anesthesiology* 2014; 120:540-50

S-336.**FEASIBILITY AND SAFETY OF PARAVERTEBRAL NERVE BLOCKS IN PEDIATRIC PATIENTS.****AUTHORS:** K. Matthes, S. Bitarafan, K. Boretsky**AFFILIATION:** Department of Anesthesia, Perioperative Care and P, Boston Children's Hospital, Harvard Medical School, Boston, MA**INTRODUCTION:** Ultrasound-guided paravertebral nerve blocks are increasingly used in adult patients for thoraco-abdominal procedures but there is limited data about the use in children. Aim of this study is to determine the feasibility and safety of ultrasound-guided paravertebral catheter placement in pediatric patients at a tertiary academic pediatric hospital.**METHODS:** Retrospective chart review of a series of pediatric patients who had a paravertebral catheter placed in the time period 10/2012 to 10/2014. Catheters were placed bilateral (10.7%) or unilateral (89.3%) for a variety of thoracic and abdominal procedures. A linear ultrasound transducer was used in all cases with frequency of oscillation and transducer length chosen based on individual patient characteristics of age, weight, and BMI.**RESULTS:** We placed 237 paravertebral catheters in 214 patients within a 2-year time period. The age of the patients ranged from 1 day to 18 years (median 2 years, IQR 0.8-12 years) with an average weight of 25.3 kg (± 23.5 kg) ranging from 1.8 kg to 113.7 kg. We did not observe any significant complications. The total complication rate was 4.2%. Dislodgement of catheters occurred in 4 cases (1.9%), leakage occurred in 1 case (0.5%), skin irritation in 1 case (0.5%) and minor bleeding at the site in 2 cases (0.9%).**CONCLUSIONS:** This technical description demonstrates the feasibility and safety of paravertebral nerve catheters using a transverse in-line ultrasound-guided technique in a wide range of pediatric patients.

S-337.

CONTINUOUS TRANSVERSUS ABDOMINIS PLANE BLOCK DECREASES FENTANYL REQUIREMENT AFTER RENAL TRANSPLANTATION

AUTHORS: A. Maeda, S. C. Shibata, Y. Matsumoto, T. Imada, K. Okitsu, Y. Fujino

AFFILIATION: Department of Anesthesiology and Intensive Care Medicine, Graduate School of Medicine, Osaka University, Suita, Osaka, Japan

INTRODUCTION: The transversus abdominis plane (TAP) block has been known to provide adequate analgesia over lower abdominal wall.¹ However the efficacy of TAP block for renal transplant recipients is still controversial² and there have been only a few reports describing successful use of continuous local anesthetic infusion with a TAP catheter.^{3,4} In the following retrospective study we evaluated the efficacy of ultrasound guided continuous TAP blocks as a part of multimodal analgesic regimen in comparison with conventional intravenous (IV) fentanyl based analgesia in renal transplant recipients.

METHODS: We reviewed the medical records of renal transplant recipients with pararectal incision between October 9, 2013, and October 8, 2014. All patients were retrospectively classified into either the continuous TAP block group (TAP group) or IV fentanyl based analgesia only group (F group). The patients in the TAP group received ultrasound guided unilateral TAP block with 0.25 % levobupivacaine 20 ml and a multi-holed catheter placed into the TAP. Continuous infusion of 0.2 % levobupivacaine, 6 ml/h was provided postoperatively. The patients in the F group did not receive any neural blockade. In both groups, IV fentanyl with a Patient Controlled Analgesia (PCA) pump was administered as supplemental analgesia. Primary outcome measurement was the cumulative fentanyl consumption for 48 h after surgery. Pain score using Visual Analog Scale (VAS, range 0-100 mm), incident of postoperative nausea, vomiting, time to ambulation, and urine output were analyzed as secondary outcomes.

RESULTS: The records of 22 consecutive patients were analyzed. Between the two groups there were no statistically significant differences in demographic data. No complication related TAP block was observed. Cumulative fentanyl consumption was significantly less in the TAP (n = 11) group than in the F (n = 11) group at 48 h (mean ± standard deviation: 390 ± 255 mcg and 725 ± 415 mcg, respectively; P = 0.04). The TAP group patients had lower VAS scores at 4, 16, 24, 40 h postoperatively, although the differences were narrow at later time points and not statistically significant. Three patients in the F group declined further use of PCA bolus dose before obtaining adequate analgesia due to treatment-resistant nausea and requested non-steroidal anti-inflammatory drugs for rescue analgesia, while TAP group patients did not need any changes in the analgesic regimen. There were no significant differences in other outcomes.

CONCLUSION: In our study, ultrasound guided continuous TAP block provided an opioid-sparing analgesic effect for renal transplant recipients. Its continued use and future investigation are expected.

REFERENCES:

1. Cochrane Database of Syst Rev 2010; CD007705.
2. Anesth Analg 2012; 115: 953-7.
3. Anesth Analg 2009; 109: 1710-1.
4. J Anesth 2014 doi 10.1007/s00540-014-1855-1

S-338.

ANALGESIA AFTER ANTERIOR APPROACH TOTAL HIP ARTHROPLASTY: AN INITIAL COMPARATIVE ANALYSIS OF CONTINUOUS VERSUS MULTILEVEL SINGLE INJECTION PARAVERTEBRAL BLOCKADE

AUTHORS: R. L. McClain, G. Soliman, J. L. Moss, A. Ardon, R. A. Greengrass

AFFILIATION: Anesthesiology, Mayo Clinic, Jacksonville, FL

INTRODUCTION: Anterior approaches for total hip arthroplasty (ATHA) are becoming increasingly popular. Lumbar paravertebral blocks (LPVB) have been used for Post-Operative analgesia for this procedure with some success.^{1,2} We have unpublished data that LPVB of T12-L2 provides good analgesia after ATHA with motor sparing. We postulated that the use of a Continuous Lumbar Paravertebral Block (CPVB) at the L1 root level would provide extended analgesia for ATHA as compared to multilevel single-shot LPVB at T12-L2. Based on this hypothesis, we conducted a pilot retrospective analysis to assess the potential analgesic impact of L1 PVB catheters as compared to T12-L2 single-shot PVBs.

METHODS: The medical records of 10 patients undergoing primary ATHA were reviewed. L1 paravertebral blockade was accomplished with 9mL of 1% ropivacaine with epinephrine 1:200,000 and 0.5mg/ml of preservative-free dexamethasone per level. Anesthesia in the T12-L2 dermatomes was confirmed in all patients prior to initiation of the primary anesthetic. These 10 patients were then compared retrospectively to 7 patients who received multilevel single shot lumbar paravertebral blocks as controls. Primary outcomes were mean opioid consumption in intravenous morphine equivalents and worst recorded visual analog scale (VAS) pain scores during postoperative days 0 to 2 (POD 0 to 2).

RESULTS: Mean opioid consumption was 14.9mg and 11.5mg on POD0 (p=0.52), 18.3mg and 12.5mg on POD1 (p=0.16), and 10.5mg and 6.72mg on POD2 (p=0.29) for patients in the CPVB vs single shot PVB groups respectively (Table 1). Worst VAS scores were not significantly different for all time intervals (Table 2)

CONCLUSION: L1 CPVB, when utilized as part of a multimodal analgesic regimen, results in similar opioid consumption and VAS scores compared to multilevel single shot LPVB for anterior approach total hip arthroplasty.

REFERENCES:

1. Clin Orthop Relat Res. 2014 May;472(5):1475-81.
2. J Arthroplasty. 2002 Jun;17(4):398-401.

Table 1: Mean opioid Consumption (mg IV morphine)

	CPVB	PVB	P value
POD 0	14.9	11.5	0.52
POD 1	18.3	12.5	0.16
POD 2	10.5	6.72	0.29
OA/RA	2/17	1/19	0.605

Table 2: Worst VAS numeric pain scores

	CPVB	PVB	P value
POD0 (PACU to 19:00)	4.1	2.1	0.17
POD0-1(19:00to07:00)	4.1	2	0.02
POD1 (07:00 to 12:00)	2.8	1.4	0.24
POD1 (12:00 to 19:00)	2.9	1	0.08
POD1-2(19:00to07:00)	2.9	1.9	0.32
POD 2 (07:00 to 12:00)	2.6	2.1	0.55
POD 2 (12:00 to 19:00)	1.5	2.2	0.56

S-339.

WITHDRAWN.

S-340.

WITHDRAWN.

S-341.**EFFECTS OF DIFFERENT KINDS AND DIFFERENT DOSES OF 5-HT₃ RECEPTOR ANTAGONISTS ON PREVENTION OF HYPOTENSION AFTER SPINAL ANESTHESIA****AUTHORS:** E. Choi, S. Do**AFFILIATION:** Anesthesiology and Pain Medicine, Seoul National Univ. Bundang Hospital, Gyeonggi-do, Korea, Republic of**INTRODUCTION:** Hypotension after spinal anesthesia is a very common but serious complication. One cause of hypotension is Bezold Jarish reflex.¹ In addition Bezold Jarish reflex occurs through the 5-HT₃ receptor in intracardiac vagal nerve.² We aimed to evaluate the effects of different kinds and different doses of 5-HT₃ receptor antagonist on hypotension after spinal anesthesia.**METHOD:** A prospective, randomized double-blinded study was performed in 53 healthy patients (ASA I or II) undergoing spinal anesthesia. Patients were randomly allocated into one of three groups. Each group received a dose of ramosetron 0.3 mg (group 1, n=17), ondansetron 8 mg (group 2, n=18), ondansetron 4 mg (group 3, n=18) respectively. 5 minutes before spinal anesthesia, 5-HT₃ receptor antagonist was injected intravenously. After spinal anesthesia, administration of crystalloid was restricted to less than 500 ml. Hemodynamic data, occurrence of nausea, occurrence of vomiting, occurrence of shivering, and amounts of vasopressor or atropine were recorded during 30 minutes. Kruskal Wallis test was performed to analyze hemodynamic data and amounts of vasopressor or atropine and chi-square test was performed to analyze other data. A P-value of < 0.05 was considered statistically significantly.**RESULTS:** The lowest measured systolic blood pressure of group 1 was significantly higher than that of other groups (104.5 ± 13.0 vs. 94.7 ± 13.8 vs. 92.1 ± 10.0 , $p = 0.011$). The difference between basal systolic blood pressure and the lowest measured systolic blood pressure of group 1 was lower than that of other groups (17.9 ± 8.9 vs. 27.8 ± 11.9 vs. 31.4 ± 12.5 , $p = 0.007$). Also The difference between basal diastolic blood pressure and the lowest measured diastolic blood pressure, and The difference between basal mean blood pressure and the lowest measured mean blood pressure of group 1 were lower than those of other groups (12.4 ± 7.5 vs. 21.2 ± 9.38 vs. 19.0 ± 8.8 , $p = 0.015$; 12.8 ± 8.0 vs. 20.8 ± 8.8 vs. 21.1 ± 9.5 , $p = 0.014$). The amounts of used ephedrine were not significantly different between three groups, but the mean value of group 1 was lower than that of other groups (0.88 ± 2.0 vs. 4.7 ± 8.1 vs. 1.9 ± 2.5 , $p = 0.232$).**CONCLUSION:** This study showed that administration of 5-HT₃ receptor antagonist before spinal anesthesia is useful for the prevention of hypotension after spinal anesthesia. Also this study found that ramosetron is more effective than ondansetron to prevent of hypotension after spinal anesthesia.**REFERENCE:**

1. Anesthesiology 2003; 98: 1250-60.
2. Exp Physiol. 2005; 90: 175-81.

S-342.

FEMORAL NERVE CATHETER VS. LIPOSOMAL BUPIVACAINE AFTER UNILATERAL TOTAL KNEE ARTHROPLASTY

AUTHORS: R. Desai, M. Goldberg

AFFILIATION: Anesthesiology, Cooper University Medical School at Rowan University, Camden, NJ

INTRODUCTION: Control of postoperative pain after total knee arthroplasty (TKA) is of paramount importance.¹ Regional anesthesia for TKA has been shown to reduce postop pain, morphine use and opioid related side effects, and may improve length of stay (LOS) and postop rehabilitation.² Femoral nerve catheters (FNC) offer patients effective postop pain relief, reduced postop complications and an enhanced postop rehabilitation experience.³ The newer anesthetic, liposomal bupivacaine (LB), has gained considerable interest due its long half-life and comparable costs to continuous catheter techniques. This pilot study examines whether postop FNC analgesia is superior to infiltrative LB.

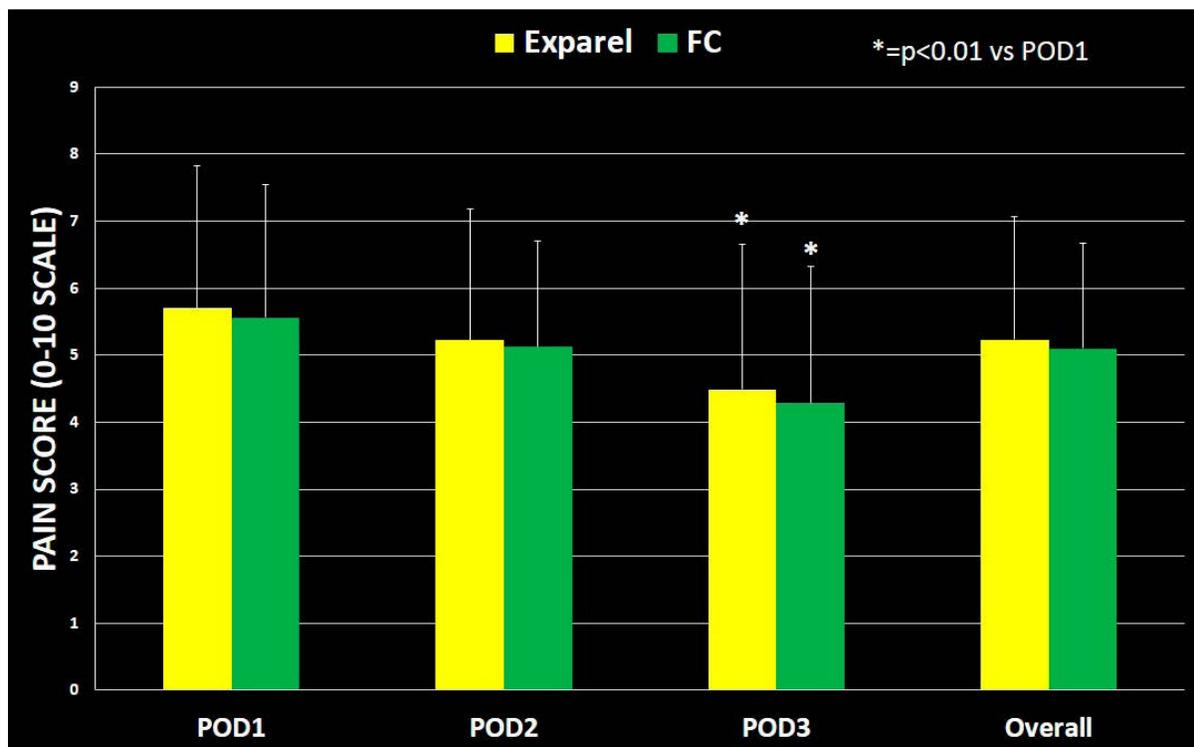
METHODS: After IRB approval, 35 consecutive patients who underwent unilateral TKA by the same surgeon utilizing either FNC or LB from October 2013 to February 2014 were examined in this retrospective study. All patients received spinal anesthesia. A multimodal approach consisting of oral celecoxib and IV dexamethasone, ketorolac, and acetaminophen was used. Standard institutional practice consisted of the following: 1) Preop placement of FNC under U/S, induction of the catheter with 15 mls of 0.25% bupivacaine, and an elastomeric pump delivering 8 ml/hr of 0.125% bupivacaine for 2 postop days, or 2) Intraop infiltration of 90 cc of dilute LB into the posterior capsule, medial and lateral gutters, and the wound itself. Postop pain scores, LOS, need for opioid rescue, need for antiemetic therapy, time to ambulation, postop muscle weakness, and/or falls were recorded. Data were analyzed using the student t-test, and Mann-Whitney test with a p<0.05 considered statistically significant.

RESULTS: 19 patients received LB, 16 patients received FNC, and there were no significant differences between the groups with respect to gender (p=0.49) or operative site (p=0.28). There were statistically significant differences in age (p=0.004): FNC patients were about 6 years younger. Pain scores were significantly decreased from POD1 to POD3 (p=0.001) however there were no significant differences between the groups (p=0.81, see Figure). There were no significant differences between groups in LOS (p=0.73), emesis requiring treatment (p=0.53), number of PACU analgesic doses (p=0.26), and number of postop opiate doses (p=0.11). There was one recorded fall in each group.

CONCLUSION: FNC have been shown to reduce pain after TKA. Pitfalls include difficulties in placing the catheter, catheter dislodgement, infection, and postop muscle weakness (although a large-scale trial recently refuted this).⁴ This pilot study demonstrated similar analgesic effects, patient pain scores, and postop complications between the 2 groups. Although a larger study is warranted, this report suggests that both techniques appear to be safe and effective in controlling pain after TKA.

REFERENCES:

1. Chincholkar M. BJA 2014,112(4):764
2. Macfarlane A, et al. Clin Orthop Relat Res 2009; 467(9):2379-2402
3. Abdallah FW, et al. RAPM 2011, 36(5):493-8
4. Memtsoudis SG, et al. Anesthesiology 2014, 120(3):551-63



S-343.

WITHDRAWN.

S-344.**ANESTHETIC MANAGEMENT FOR CONTINUOUS AMBULATORY PERITONEAL DIALYSIS CATHETER INSERTION AND/OR EXTRACTION USING TRANSVERSUS ABDOMINIS PLANE BLOCK: RETROSPECTIVE COMPARISON WITH GENERAL ANESTHESIA AND NEURAXIAL ANESTHESIA**

AUTHORS: A. Shido, E. Nobuhara, T. Mine, S. Sakura, Y. Saito

AFFILIATION: Anesthesiology, Faculty of Medicine Shimane University, Izumo, Shimane, Japan

INTRODUCTION: Making a plan for perioperative anesthetic management in patients undergoing continuous ambulatory peritoneal dialysis catheter insertion and/or extraction (CAPD surgery) is often difficult because many of these patients have not only renal insufficiency but also poor systemic condition due to co-existing disorders such as heart disease. Moreover, as number of patients undergoing elective surgery without discontinuing anticoagulation therapy has been increasing, choosing appropriate anesthetic methods has become more challenging.

Ultrasound guided transversus abdominis plane block (TAPB)^{1,2} can provide suitable anesthesia for CAPD surgery which requires analgesia mainly on the abdominal wall. Indication of TAPB is less limited by coagulopathy compared to neuraxial anesthesia (NA). We have experienced several cases of CAPD surgery in patients with heart disease, in which TAPB was the main anesthetic technique without general anesthesia (GA).

To evaluate the efficacy and safety of TAPB for CAPD surgery, we reviewed anesthetic management of patients undergoing CAPD surgery using GA, NA, and TAPB.

METHODS: With IRB approval, patients (18 years of age and older) undergoing CAPD surgery in our hospital from December 2003 to November 2014 whose anesthetic management was conducted by anesthesiologists were studied retrospectively. Information related to the anesthetic managements was retrieved from anesthesia records. Data were statistically analyzed according to the method of anesthesia and compared among the groups (GA, NA, and TAPB groups). Primary outcome was to evaluate the analgesic effect of TAPB assessed by intraoperative hemodynamic changes compared with those of other anesthetic methods. Secondary outcome was to evaluate safety of TAPB.

Statistical analysis included one-way analysis of variance followed by Scheffe's test and chi-square test ($P < 0.05$ was considered to be significant).

RESULTS: Of 36 patients included in this study, 10, 16, and 10 patients were in GA, NA, and TAPB group, respectively. All patients who had both heart disease and coagulopathy belonged to TAPB group, except for one who belonged to GA group.

Intraoperative highest systolic blood pressure and heart rate expressed as percentage of their preanesthetic values did not differ among the groups. Significant decrease in systolic blood pressure was found in GA group (60.9 ± 10.1 %, expressed as percentage of preanesthetic value, mean \pm SD) than in TAPB group (77.1 ± 13.1 %, $P = 0.01$). Intraoperative fluid infusion volume (ml/h) was significantly lower in TAPB group (96 ± 36) than in NA group (163 ± 64 , $P = 0.01$). Anesthetic induction time did not differ significantly among the groups.

CONCLUSIONS: Patients who received TAPB showed more stable in hemodynamics than those who received the other anesthetic methods. Our results suggested that TAPB is an effective and safe anesthetic method for CAPD surgery even in the patient with poor systemic condition.

REFERENCES:

1. Anaesth Intensive Care 2007; 35: 616-617
2. Anesth Analg 2008; 106:674-675

S-345.

ULTRASOUND GUIDED SUBCOSTAL TRANSVERSUS ABDOMINIS PLANE (TAP) INFILTRATION WITH LIPOSOMAL BUPIVACAINE VS. BUPIVACAINE IN PATIENTS UNDERGOING ROBOTIC ASSISTED HYSTERECTOMY: A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

AUTHORS: J. Hutchins¹, D. Delaney¹, R. Vogel², R. Ghebre³, L. Downs³, L. Carson³, M. A. Geller³

AFFILIATION: ¹Anesthesiology, University of Minnesota, Minneapolis, MN, ²Masonic Cancer Center Biostatistics and Bioinforma, University of Minnesota, Minneapolis, MN, ³Department of Obstetrics, Gynecology and Women’s Health, University of Minnesota, Minneapolis, MN

INTRODUCTION: Robotic assisted hysterectomy has been associated with decreased length of stay and pain when compared to open procedures however those with robotic assistance still suffer from postoperative pain.^{1,2} The use of transversus abdominis plane (TAP) blocks has been evaluated in both open and laparoscopic hysterectomy but not in robotic assisted hysterectomy. The primary objective was to determine the effect of a TAP block with liposomal bupivacaine vs. bupivacaine on total opioid use in the first 72 hours after robotic assisted hysterectomy.

METHODS: This was a University of Minnesota IRB approved study. 60 patients who underwent robotic assisted hysterectomy were randomly assigned to either receive a subcostal TAP with liposomal bupivacaine or bupivacaine prior to surgery. The patients were enrolled between 10/2013 to 10/2014. Patients were followed up for 72 hours after injection both in the hospital as well as at home. Pain intensity was assessed via an 11-point numerical rating scale (NRS). While in the hospital their pain was assessed by a blinded pain nurse practitioner and while at home assessed by a blinded medical student or nurse practitioner. A blinded medical student recorded opioid, acetaminophen, and ibuprofen use.

RESULTS AND MAJOR FINDINGS: There was no difference in baseline characteristics between the two groups. Those with liposomal bupivacaine TAP had significantly decreased total opioids in the first 72 hours after robotic assisted hysterectomy compared to those with bupivacaine. Those who had a liposomal bupivacaine TAP had decreased maximal and minimal pain in the PACU, maximal pain and minimal pain 0-24 hours after block, and decreased maximal pain 24-48 and 48-72 hours after the block when compared to bupivacaine. In addition those with liposomal bupivacaine TAP had decreased incidence of nausea/vomiting in the first 72 hours after injection.

CONCLUSION: A TAP with liposomal bupivacaine provided superior pain control, decreased opioid use, and decreased nausea/vomiting when compared to a TAP with bupivacaine for patients undergoing robotic assisted hysterectomy.

REFERENCES:

1. Boggess JF, Gehrig PA, Cantrell L, Shafer A, Ridgway M, Skinner EN, Fowler W. A case-control study of robot-assisted type III radical hysterectomy with pelvic lymph node dissection compared with open radical hysterectomy. *Am J Obstet Gynecol* 2008;199:357e1-7.
2. Boggess JF, Gehrig PA, Cantrell L, Shafer A, Ridgway M, Skinner EN, Fowler WC. A comparative study of 3 surgical methods for hysterectomy with staging for endometrial cancer: robotic assistance, laparoscopy, laparotomy. *Am J Obstet Gynecol* 2008;199:360e1-360e9.

Table 1. Patient Post-Operative Medication Use and Self-Reported Pain Scores by Randomization Group.

**Note: 1 person lost to follow-up in the Bupivacaine group following PACU stay.*

Variable	Bupivacaine (N=30)		Liposomal Bupivacaine (N=28)		P-value
	N	Median (Min-Max)	N	Median (Min-Max)	
Primary Outcome					
Total Opioid Use (MS equivalents, 0-72 hours)	29	23.3(0-161.3)	28	10 (0-55)	0.007
Secondary Outcomes					
PACU					
Opioid Use (MS equivalents)	30	12.5 (0-35)	28	9 (0-33.3)	0.206
Max Pain Score	30	6 (0-10)	28	5 (0-10)	0.002
Min Pain Score	30	3 (0-6)	28	1.5 (0-6)	0.010
24-48 hours					
Opioid Use (MS equivalents)	29	7.5 (0-68)	28	2.9 (0-.26.7)	0.015
Acetaminophen Use (mg)	29	975 (0-2925)	28	162.5 (0-2600)	0.068
Ibuprofen Use (mg)	29	0 (0-2400)	28	150 (0-2400)	0.753
Max Pain Score	29	5 (1-10)	28	4 (0-8)	0.044
Min Pain Score	29	2 (0-6)	28	2 (0-7)	0.942
48-72 hours					
Opioid Use (MS equivalents)	29	5 (0-40)	28	1.7 (0-11.7)	0.297
Acetaminophen Use (mg)	29	0 (0-2600)	28	0 (0-2275)	0.383
Ibuprofen Use (mg)	29	0 (0-2400)	28	0 (0-3600)	0.796
Max Pain Score	29	5 (0-10)	28	3 (0-8)	0.047
Min Pain Score	29	2 (0-5)	28	2 (0-5)	0.717

Subspecialty Abstracts

Sleep Medicine

S-346.**IMPACT OF MELATONIN ON SLEEP AND PAIN AFTER ORTHOPEDIC SURGERY UNDER REGIONAL ANESTHESIA WITH SEDATION: A DOUBLE BLIND RANDOMIZED PLACEBO CONTROLLED TRIAL**

AUTHORS: M. Kirksey¹, O. Stundner², D. Yoo¹, K. Fields¹, Y. Ma³, T. Danninger², S. Memtsoudis¹

AFFILIATION: ¹Anesthesiology, Hospital for Special Surgery, New York, NY, ²Anesthesiology, Salzburg University Hospital, Salzburg, Austria, ³Epidemiology and Biostatistics, George Washington University, Washington, DC

INTRODUCTION: Sleep disruption is thought to be a common occurrence in the perioperative period. The aims of this study were to determine if sleep disruption occurs after total knee arthroplasty performed under regional anesthesia with sedation and to examine the hypothesis that exogenous melatonin can ameliorate perioperative pain and sleep disruption.

METHODS: After IRB approval, this prospective double blind randomized placebo controlled clinical trial was performed at a single academic hospital. Following informed consent, ASA I-III patients undergoing elective total knee arthroplasty under regional anesthesia with sedation were given tablets of 5mg melatonin or placebo for three nights preoperatively and three nights postoperatively. The primary outcome of sleep efficiency was measured by Actigraph™ actigraphy wrist bracelets. Subjective reports of sleep quality were collected and visual analog scale (VAS) pain scores and total opiate doses were used to evaluate perioperative pain. Outcomes were compared between the two groups using t-test or chi-square test. Correlations between repeated measurements were analyzed using generalized estimating equations (GEE).

RESULTS: Compared to baseline, sleep efficiency was decreased in control patients on the first preoperative night by approximately 3.5% (p=0.025) and on postoperative days 1-3 by approximately 13% (p-values < 0.002) as measured by actigraphy. Sleep efficiency was not significantly decreased in the melatonin group at any timepoint. Compared to baseline, self reported sleep quality was decreased by 1.6 points (on a scale of 1-10) in control patients on the night of surgery (p=0.044) and increased on the third postoperative night by 1.5 points in patients receiving melatonin (p=0.005). Melatonin did not decrease postoperative pain scores or opiate usage.

CONCLUSIONS: Sleep quality and efficiency are significantly impaired after total knee replacement surgery under regional anesthesia with sedation and this may be ameliorated by perioperative administration of melatonin.

S-347.

VALIDATION OF STOP-BANG QUESTIONNAIRE AS A SCREENING TOOL FOR OBSTRUCTIVE SLEEP APNEA PATIENTS AMONG DIFFERENT POPULATIONS. A SYSTEMATIC REVIEW AND META-ANALYSIS

AUTHORS: M. Nagappa, J. Wong, P. Liao, F. Chung

AFFILIATION: Department of Anesthesia, Toronto Western Hospital, University of Toronto, University Health Network, Toronto, ON, Canada

INTRODUCTION: The diagnosis of patients with suspected obstructive sleep apnea (OSA) is important because of the increased risk of perioperative complications. Polysomnography (PSG) – the gold standard for diagnosis of OSA - is time consuming and costly. The STOP-Bang questionnaire is a validated screening tool for obstructive sleep apnea. We conducted this systematic review to compare the effectiveness of STOP-Bang to screen OSA patients in the different population.

METHODS: A search of the literature databases MEDLINE (from 2008 to April 2014), Medline-in-process & other non-indexed citations (up to May 2014), Embase (from 2008 to May 2014), Cochrane central register of controlled trials (up to May 2014) and PubMed (from 2008 to August 2014) was carried out. The search yielded 338 citations. Irrelevant papers were excluded by title and abstract review, leaving 46 manuscripts. Inclusion criteria were: 1) Studies that used STOP-Bang questionnaire as a screening tool for OSA in adult subjects (>18 year); 2) The accuracy of the STOP-Bang questionnaire was validated by polysomnography - a gold standard for diagnosing OSA; 3) OSA was clearly defined as

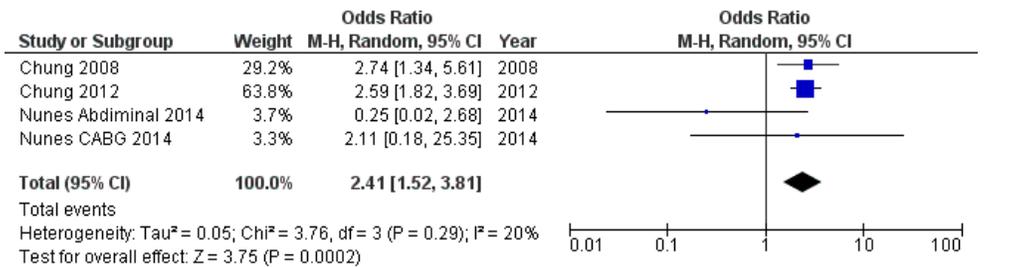
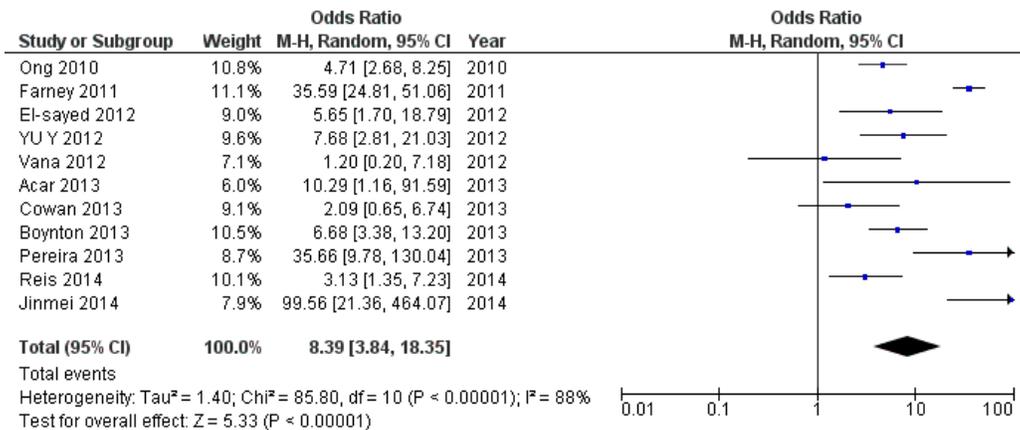
apnea/hypopnea index (AHI) ≥ 5 ; 4) Publications in any language. Statistical analysis was carried out using the Review Manager 5.3 software. The data about predictive parameters was pooled and the diagnostic odd's ratio was estimated.

RESULTS: The systematic review was carried out in 17 studies including a total of 9165 patients (11 studies in sleep clinic patients, n=3134; 3 studies in preoperative surgical patients, n=1004 and 3 studies in other population, n=5027). These prospective studies were conducted in 7 different countries. In sleep clinic patients, pooled sensitivities of STOP-Bang questionnaire for AHI ≥ 5 , ≥ 15 and ≥ 30 were 90.6 (87.1-94.0), 94.7(92.7-96.7) and 97.5 (96.2-98.8) respectively; whereas the corresponding pooled specificities were 40.5 (29.7-51.2), 25.9 (15.9-35.9) and 22.2 (11.9-32.4). The pooled positive predictive values were 85.6(79.6-93.8), 63.45(53.1-73.8) and 47.5(34.9-60.0) and the pooled negative predictive values were 47.5 (35.1-59.8), 70.0 (52.6-88.9) and 87.9 (77.3-98.6). In preoperative patients, pooled sensitivity, pooled specificity, positive predictive value and negative predictive value for AHI ≥ 5 is 88.0 (80.2-95.7), 28.5(-9.1 to 66.1), 62.7(33.7-91.7) and 55.7 (28.1-83.3). The corresponding diagnostic odd's ratio was 8.4 & 2.4 (Figure 1) and AUC was 0.76 & 0.6 respectively in sleep clinic patients and preoperative patients. The heterogeneity was high in sleep clinic patients (I²=88%) and low in preoperative patients (I²=20%).

CONCLUSION: This systematic review and meta-analysis re-confirms the clinical utility of STOP-Bang questionnaire in the different populations. It has high sensitivity and modest specificity with the corresponding diagnostic odd's ratio 8.4 and 2.4 respectively in sleep clinic patients and preoperative patients.

REFERENCES:

- 1 Anesthesiology 2008;108:812-21



S-348.

THE PREDICTIVE PROBABILITY OF MODERATE TO SEVERE OBSTRUCTIVE SLEEP APNEA BY THE STOPBANG QUESTIONNAIRE

AUTHORS: M. Nagappa, P. Liao, F. Chung

AFFILIATION: Department Of Anesthesiology, Toronto Western Hospital, University Health Network, Toronto, ON, Canada.

INTRODUCTION: Diagnosing the patients with moderate-to-severe (Apnea Hypopnea Index [AHI] >15 events/hr) and severe (AHI >30) obstructive sleep apnea (OSA) is important because of the increased risk of perioperative complications. Polysomnography (PSG) – the gold standard for the diagnosis of OSA^o is time consuming and costly. The STOP-Bang questionnaire is a validated screening tool for obstructive sleep apnea¹. We conducted this meta-analysis to determine the predictive probability of moderate-to-severe (AHI >15) and severe (AHI >30) OSA by the STOP-Bang questionnaire.

METHODS: A search of the literature databases MEDLINE (from 2008 to April 2014), Medline-in-Process & other non-indexed citations (up to May 2014), Embase (from 2008 to May 2014), Cochrane Central Register of Controlled Trials (up to May 2014), Cochrane Databases of Systematic Reviews (from 2008 to March 2014), Google Scholar, Web of Sciences (from 2008 to August 2014), Scopus (2008 to August 2014) and PubMed (from 2008 to August 2014) was carried out. The search yielded 340 citations. Irrelevant papers were excluded by title, abstract and full-text review, leaving 5 manuscripts for analysis. Inclusion criteria were: 1) Studies that used STOP-Bang questionnaire as a screening tool for moderate-to-severe and severe OSA in adult subjects (>18 year); 2) The accuracy of the STOP-Bang questionnaire was validated by polysomnography - a gold standard for diagnosing OSA; 3) Availability of data on AHI or respiratory disturbance index (RDI) ≥15; 4) and probability of moderate-to-severe and severe OSA at the different STOP-Bang scores 5) Publications in the English language. Validity criteria assessing the internal and external validity were explicitly described and coded according to the Cochrane methods group on screening and diagnostic tests. The data about the probability of moderate-to-

severe and severe OSA and the different STOP-Bang scores were pooled and presented as a bar graph.

RESULTS: The meta-analysis was carried out in 5 prospective studies including a total of 2,792 patients (3 studies in the sleep clinic patients, 2-4 n=1835 and 2 studies in the surgical patients,^{5,6} n=957). The data on the predictive probabilities for the different severities of OSA with the corresponding STOP-Bang scores were shown in Figure.

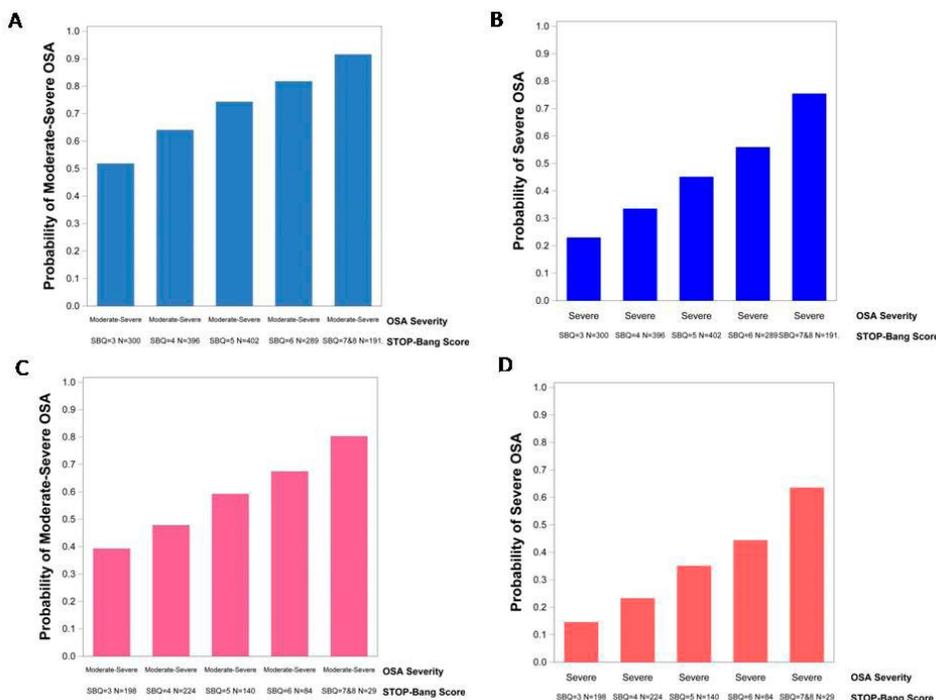
In the sleep clinic population, the probability of moderate-to-severe OSA for a score of 3 is 52%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability rises proportionally to 62%, 72%, 82% and 92% respectively (Fig 1A). Similarly, the same pattern exists for severe OSA. With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA climbs to 35%, 45%, 55% and 75% respectively (Fig 1B).

In the surgical population, the probability of moderate-to-severe OSA for a score of 3 is 40%. With a stepwise increase of the STOP-Bang score to 4, 5, 6 and 7/8, the probability soars proportionally to 48%, 60%, 68% and 80% respectively (Fig 1C). With a stepwise increase of the STOP-Bang score of 4, 5, 6 and 7/8, the probability of severe OSA escalates to 25%, 35%, 45% and 65% respectively (Fig 1D). A higher STOP-Bang score reflects a higher cumulative score of the known risk factors and the greater the probability of moderate-to-severe and severe sleep apnea.

CONCLUSION: In the sleep clinic and the surgical patients, the higher the STOP-Bang score, the greater the probability of patients suffering from moderate-to-severe and severe sleep apnea.

REFERENCES:

1. Anesthesiology 2008; 108: 812-21.
2. J Clin Sleep Med 2011; 7: 459-65
3. Revista Portuguesa de Pneumologia 2014;10.1016/j.rppneu.2014.04.007
4. Chin Med J 2014; 127: 3065-70
5. Brit J Anaesth 2012; 108: 768-75
6. J Clin Sleep Med 2012; 8: 501-6



Subspecialty Abstracts

Technology,
Computing and Simulation,
Equipment Monitoring

S-349.

COMMUNICATION PATTERNS DURING A CRISIS SITUATION IN THE OPERATING ROOM

AUTHORS: P. Sayal¹, M. C. Pian-Smith², R. Phitayakorn³, M. W. Hemingway⁴, E. R. Petrusa³, R. D. Minehart¹

AFFILIATION: ¹Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA, ²Anesthesia, Critical Care and Pain Medicine, MGH, Harvard Medical School, Boston, MA, ³Surgery, Massachusetts General Hospital, Boston, MA, ⁴Perioperative Nursing, Massachusetts General Hospital, Boston, MA

INTRODUCTION: Intraoperative crises require team members to uniformly work towards a common goal. A tenet of crisis resource management ¹, clear communication during an intraoperative crisis is essential, yet communication failures routinely occur in the OR². Different providers also have different patterns of speech during a crisis, with some stating information and plans ('advocacy'), and others asking for them ('inquiry'). During a simulated maternal-fetal crisis, teams of anesthesiologists and obstetricians spoke differently to each other³. We characterized language patterns and critical patient care steps of anesthesiology, surgical and nursing teams during a simulated malignant hyperthermia (MH) crisis occurring during an open ventral hernia repair. We hypothesized that each specialty would communicate differently.

METHODS: With IRB approval, 5 videotaped recordings of interprofessional simulation sessions involving surgical residents, anesthesiology residents, circulating nurses, and scrub technologists were reviewed. Two independent reviewers categorized communication events involving advocacy and inquiry of information and plans, and scored the management of MH according to a checklist.

RESULTS: Surgeons consistently demonstrated all forms of communication (Table 1). Anesthesiology residents rarely inquired plans of their surgical colleagues. Nurses and scrub technicians rarely inquired information or advocated a plan. Teams without an anesthesiology team member inquiring of a surgical plan performed on average 59% of the critical steps in treating MH (range 53%-65%); the team with a surgical plan inquiry performed 76%. The majority of teams without a surgical plan inquiry elected a temporary abdominal closure (3 of 4), while the team with a surgical plan inquiry completed a primary closure.

CONCLUSIONS: This preliminary look at language patterns and critical management steps showed notable findings. Anesthesiology residents' lack of inquiry regarding the surgical plan might be a necessary prompt needed to coordinate care, or it may be a marker for lower situational awareness. Nurses' and scrub technicians' tendencies to not inquire about information or advocate a plan needs more exploration. The link between communication and optimum patient care remains an area in need of further study.

REFERENCES:

1. Gaba D, Howard S, Fish K, Smith B, Sowb Y. Simul Gaming. 2001; 32: 175-93.
2. Lingard L, Espin S, Whyte S, Regehr G, Baker GR, Reznick R, Bohnen J, Orser B, Doran D and Grober E. Qual Saf Health Care 2004;13:330-334.
3. Minehart R, Pian-Smith MCM, Walzer TB, Gardner R, Rudolph JW, Simon R, Raemer D. Simul Healthc 2012; 7(3):166-170.

Table 1

	Advocacy Info	Inquiry Info	Advocacy Plan	Inquiry Plan
Anesthesiology	100%	100%	100%	20%
Surgery	100%	100%	100%	100%
Nursing	80%	20%	20%	60%

S-350.**EFFECT OF ELECTROMAGNETIC GUIDANCE SYSTEM ON EARLY LEARNING CURVE OF ULTRASOUND-GUIDED NEEDLE PLACEMENT****AUTHORS:** H. Byon¹, H. Kim²**AFFILIATION:** ¹Department of Anesthesiology and Pain Medicine, Yonsei University College of Medicine, Seoul, Korea, Republic of, ²Department of Anesthesiology and Pain Medicine, Kangdong Sacred Heart Hospital, Hallym University College of Medicine, Seoul, Korea, Republic of**INTRODUCTION:** An electromagnetic guidance (EMG) system shows the alignment of the needle and the position of the needle tip relative to the imaging plane on an ultrasound screen. The aim of this study was to compare the early learning curve when novices perform ultrasound-guided needle placement on phantom models with EMG (eZGuide™) and without it.**METHODS:** Residents without any experience performing ultrasound (US)-guided procedures were randomized into an EMG group (n=10) and a non-EMG group (n=10). All residents performed 30 ultrasound-guided needle placements with the echogenic stick (diameter 3mm) as a target inside of a phantom model using in-plane and out-of-plane approaches with or without the EMG system according to their group. The 30 trials were divided into six periods (P1:1-5, P2:6-10, P3:11-15, P4:16-20, P5:21-25, P6:26-30 trials), and the time required for needle placement, number of needle advances, and score of the ultrasound view were compared between the two groups.**RESULTS:** There were no differences in gender, age, or training grade between the two groups. Using an in-plane approach, the time required for needle placement in the EMG group was significantly shorter than that of the non-EMG group in P1, P2, and P4, and the number of needle advances of the EMG group was significantly smaller than that of the non-EMG group in P1 and P2. Using out-of-plane approaches, the time required for needle placement and the number of needle advances in the EMG group were significantly shorter and smaller than those of the non-EMG group in all periods. The score of the ultrasound view of the EMG group was higher than that of the non-EMG group using both in-plane and out-of-plane approaches in all periods.**CONCLUSION:** EMG can improve the ultrasound-guided needle placement technique of novices in their early learning period.**S-351.****AN ADAPTIVE AND ROBUST BRAIN-MACHINE INTERFACE ARCHITECTURE FOR CLOSED-LOOP CONTROL OF ANESTHESIA****AUTHORS:** Y. Yang, M. Shanechi**AFFILIATION:** Electrical Engineering, University of Southern California, Los Angeles, CA**INTRODUCTION:** There has been significant work on brain-machine interfaces (BMI), also termed closed-loop anesthetic delivery systems, for automatic control of anesthetic states such as unconsciousness, antinociception and coma. However, a principled BMI architecture that can generalize to control of various anesthetic states does not exist. Current model-based BMIs assume stationary model parameters and require a system identification session to find the parameters, which may be difficult to perform in the operating room. Moreover, model parameters could change with the anesthetic level and are not stationary. In addition, small steady-state variations in the drug infusion rate may be desired for robust control. Finally, while existing work have relied on experimental validation, they have not provided theoretical performance guarantees, which are necessary for clinical viability. Here we develop an adaptive and robust BMI architecture that is generalizable to various anesthetic states and has guaranteed performance. We apply the BMI to the special case of controlling burst suppression in medical coma, a state of profound brain inactivation in which the electroencephalogram (EEG) consists of bursts of activity alternating with suppression periods.**METHODS:** Using a stochastic control framework, we develop a generalizable BMI architecture that tracks the non-stationarity of parameters and achieves robust control without requiring a system identification session. We use a linear two-compartment model for drug dynamics, and build stochastic models for the EEG based on the selected control signal. We build an adaptive estimator by constructing and linearizing a nonlinear state-space model for the concentrations and parameters. We devise a robust controller by using a linear-quadratic regulator strategy that explicitly penalizes large steady-state infusion rate variations. We conduct rigorous system analyses to show the effects of design parameters on performance. As an example, we apply the BMI to control of burst suppression in medical coma, taking the burst suppression probability (BSP) as the control signal. We conduct numerical experiments to evaluate performance.**RESULTS:** Numerical experiments in control of medical coma show that despite non-stationary parameters, the BMI can maintain multiple target BSP levels and reduce 94% of the bias and 74% of the error compared with non-adaptive methods. Also, it reduces 75% of the drug infusion rate variation at fixed BSP levels compared with non-robust methods. Numerical results and theoretical analyses show that the BMI has guaranteed performance for general anesthetic control problems. With appropriate choices of design parameters, low steady-state bias and error, and prompt transitions without overshoot or undershoot are guaranteed.**CONCLUSIONS:** Our theoretical analyses and numerical experiments show that the proposed adaptive BMI achieves robust control of various anesthetic states with performance guarantees. Hence the BMI has the potential to achieve robust and precise control of a broad range of anesthetic brain states in experimental setups.

S-352.

A BENCH STUDY OF NEW ANESTHESIA VENTILATORS: INSPIRATORY AND EXPIRATORY TRIGGER SENSITIVITY IN PRESSURE-SUPPORT MODE

AUTHORS: K. Kawamae¹, Y. Shinohara¹, M. Nakane²

AFFILIATION: ¹Anesthesiology, Yamagata University, Yamagata, Japan, ²Anesthesiology and Critical Medicine, Yamagata University, Yamagata, Japan

INTRODUCTION: There is a new feature of recent anesthesia ventilators those enabled the pressure support ventilation during the spontaneous breathing (SB). It is a highly synchronizing capability with patient's SB. The synchronizing with SB is an important factor for ventilated patients. We investigated the synchronization of new anesthesia ventilators from the point of view of the trigger sensitivity to spontaneous inspiratory breathing in pressure support ventilation.

METHODS: We used the respirator PB840 (COVIDIEN; USA) and three anesthesia machines of Flow-i (MAQUET; Sweden), Primus IE (Dräger; Germany), and Aisys (GE Healthcare; USA), each of them has different ways to recognize a change in flow. Connected to the test lung that can be breathed spontaneously with setting up the respiratory rate and the pressure of muscle(Pmus). We measured the trigger sensitivity, the rate of triggering at the low Pmus and high respiratory rate, and the time lag from the inspiratory effort to inspiration. Three anesthesia machines and one intensive-care ventilator as control were compared.

RESULTS: The PB840 intensive-care ventilator performed best in sensitivity. It turned out, however, that trigger sensitivity in three anesthesia machines was excellent in order of Primus IE, Flow-I, and Aisys.

Trigger rate(0-100%) of spontaneous breath with constant PS(10 cmH₂O) at PEEP 0 cmH₂O, and different levels of Pmus and RR. All ventilators become less sensitive at higher PEEP, lower Pmus, and higher RR. (Bar graphs which have no number label are 0 or 100%)(Fig.)

DISCUSSION: PB840 and Primus IE have the hot wire flow meter, Flow-I has the ultrasonic flow meter, and Aisys does the differential pressure flow meter. There were not so large difference among them, and three of all were considered to be safe in clinical use. However we should know about the distinction of the flow sensors in anesthesia machine.

CONCLUSION: It was shown that the difference in trigger sensitivity came from the different ways of flow triggering mechanisms.

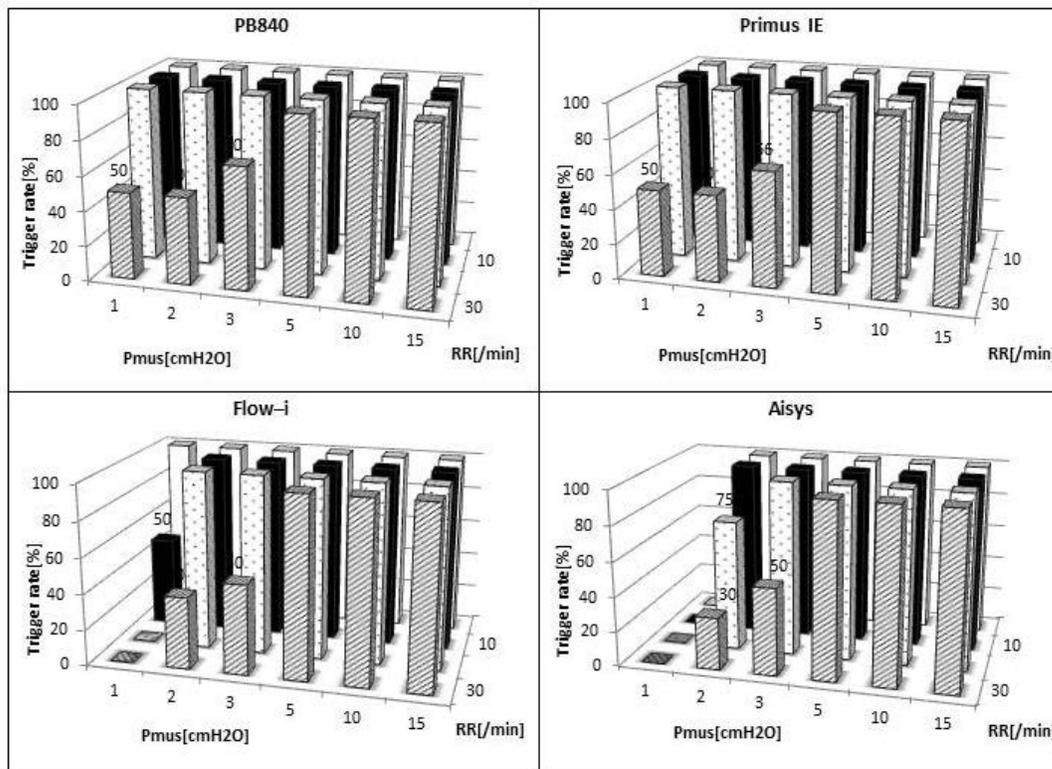


Figure. Trigger rate and Pmus.

Trigger rate(0-100%) of spontaneous breath with constant PS(10 cmH₂O) at PEEP 0 cmH₂O, and different levels of Pmus and RR.

S-353.

THE ANESTHESIA HUB- A MOBILE TOOL LAUNCHED TO IMPROVE ACCESS TO CRITICAL INFORMATION. THE EXPERIENCE OF A LARGE MULTICENTER ANESTHESIA ACADEMIC PRACTICE

AUTHORS: L. I. Rodriguez, F. Gencorelli, D. Lubarsky;

AFFILIATION: Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, FL

INTRODUCTION: During the last couple of decades, the healthcare system has seen a dramatic improvement of information technology (IT), electronic medical records and mobile-based medical applications for patient care. For some providers, this might seem like the perfect world, but for others, it is becoming increasingly difficult to keep up¹. Medical IT can help prevent errors and adverse events by improving communication between providers and allowing knowledge to be readily available², especially in crisis situations.

METHODS: With the use of Hubspring.com, we designed a web platform for mobile devices that contained critical information to the Department of Anesthesia providers -the “Anesthesia Hub”. All information was publicly available in different sites, but not easily accessible during critical events. The information included in the Anesthesia Hub is: contacts, departmental policies and protocols, including ever changing updated Ebola treatment protocols, facility and clinical resources, residency and administrative resources, and all provider schedules.

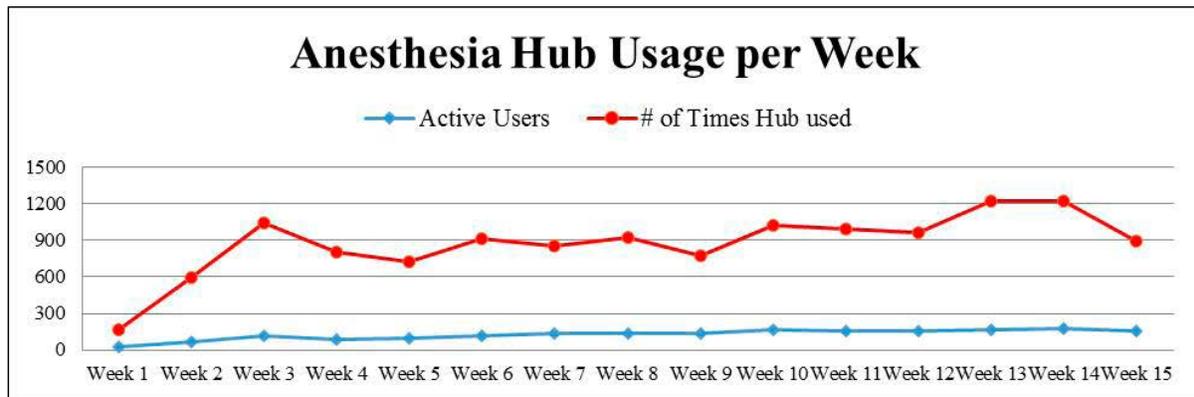
We progressively launched the application after an oral presentation to the residents (CA-1 to CA-3), then proceeded to include all faculty and per diems after 2 weeks. After 1 month of usage, CRNA’s from 3 of our centers were included. We then continued to monitor the daily and weekly individual usage of the application and measured adoption of this new technology.

RESULTS: A steady increase of daily and weekly usage of the information tool has been measured. During week 1, with 21 users, the “Hub” was accessed 141 times. During week 4, 90 active users accessed the application 709 times. At week 9, 136 users accessed the application 636 times. At week 13, 167 active users accessed the “Hub” more than 1000 times .

DISCUSSION: As the healthcare industry adopts some of these mobile technologies, patient safety and the anesthesiologists vigilance is of concern. Recently, the Patient Safety Foundation published an article on the use of mobile devices and risk for distraction³. In this article they discuss the different types of technologies and the concerns they pose, and also discuss solutions. We believe mobile technologies and the applications they carry can most effectively meet the need for updated critical information at every point of care during times of crisis, such as surgical emergencies, consults, evaluations, and epidemics. Our experience during the release of this application is very positive and demonstrates the providers’ need of tools that carry all the latest information in an easily accessible manner.

REFERENCES:

1. NEJM 2007;356:2527-2534
2. NEJM 2003;348:2526-2534
3. APSF Newsletter 2014;29:3-5



S-354.

MISSING PHYSICAL EXAM- AUTOMATIC NOTIFICATIONS USED TO IMPROVE DOCUMENTATION

AUTHORS: L. I. Rodriguez, D. Rico Mora, K. Candiotti;

AFFILIATION: Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, FL

INTRODUCTION: Anesthesia Information Systems (AIS) help by automatically documenting certain events while the anesthesiologists focuses on patient care. This continues to evolve and now improve documentation through automatic process monitoring, alerts and reminders. Despite the fact AIS help to decrease incomplete records, delayed reimbursement due to incomplete records continue to be a problem^{1,2}. These errors and lack of information can be addressed by timely alerts connected to paging systems², but many of them can be ignored by clinicians due to the great amount of irrelevant warnings and saturation. One strategy applied is to modify the design of more serious warnings³.

METHODS: We retrospectively analyzed the records completeness in the period of March-December 2013. We measured the # of cases and pre-operative evaluations with and without physical exam. We focused on evaluations done over the phone with the physical exam to be completed the day of surgery.

We studied 2 automatic notification systems to address physical exam documentation. The first method employed was massive e-mails to all anesthesia providers, reminding of need to document the physical exam. These notifications were sent by the department chair. This method was used once during the month of July and once in October. The second method was the use of an automatic alphanumeric page to physicians in charge of a case with missing physical exam during the pre-operative evaluation. We compared the differences between the initial values and the changes after the implementation of both systems of notification.

RESULTS: During the first 4 months of the study (March- June) the mean of pre-operative evaluations with missing physical exam was 30.3%. After the first e-mail sent, the percentage of missing physical exam dropped from 30.5% in June to 21.8% in July. This pattern was constant during the following months August (23.2%) and September (23%). In October, a second email was sent; the percentage of missing physical exam dropped to 17.3%. We then implemented the automatic notification system, and during the period of November-December the mean of missing physical exam dropped to 10.9%.

CONCLUSIONS: There are different methods used to improve documentation. Of these, the least effective are formal lectures to providers and the most effective is the use of computer generated reminders, incentive rewarding, and sending e-mail reports. Other options are text pagers or using prompts alerting of missing information.^{1,4,5}

We confirmed that automatic reminders improve documentation of incomplete preoperative evaluations. We were able to significantly reduce the number of incomplete records, but we also recognize that reminder saturation or the overwhelming messaging leads to providers ignoring the message can still account for that 10.9% missing data. We plan to modify the messaging system and test a reminder in real-time.

REFERENCES:

1. Anesth Analg 2008;106:192-201
2. Anesthesiology 2007;106:157-63
3. NEJM 2003;348:2526-34
4. Anesth Analg 2006;103:131-6
5. Mt Sinai J of med 2012;79:757-757

Decrease of Incomplete Records after interventions during 2013.

	Total # of Cases	# of Electronic Preops	Preops with Missing Physical Exam	%
March	1364	542	166	30.6
April	1466	609	182	29.9
May	1404	526	158	30
June	1428	584	178	30.5
July (After 1st email)	1482	582	135	21.8
August	1522	582	135	23.2
September	1320	514	118	23
October (After 2nd email)	1561	677	117	17.3
Mid Nov-Mid Dec (Reminders in place)	1318	569	62	10.9

S-355.

ETHNOGRAPHIC STUDY OF RESPIRATORY ACOUSTIC MONITORING IN CHILDREN RECEIVING POSTOPERATIVE OPIOID INFUSIONS

AUTHORS: M. Görges¹, N. C. West², N. A. Christopher², J. L. Koch³, N. Lowlaavar², S. M. Brodie², J. Ansermino²

AFFILIATION: ¹Electrical and Computer Engineering, University of British Columbia, Vancouver, BC, Canada, ²Anesthesiology, Pharmacology, & Therapeutics, University of British Columbia, Vancouver, BC, Canada, ³Neuroscience & Surgery, BC Children's Hospital, Vancouver, BC, Canada

BACKGROUND: Detection of respiratory depression (or apnea) in children receiving opioid infusions following surgery¹ may be improved with the introduction of respiratory rate monitoring². However, the potential gain of earlier apnea detection must be balanced with increased risk of alarm fatigue^{3,4}. The aim of this study is to evaluate two clinical questions: a) what are the causes of false alarms with this monitoring, and b) what are the optimum respiratory rate alert thresholds for children on the ward receiving opioid infusions?

METHODS: An observational mixed methods approach based on a qualitative video ethnographic study⁵ of children receiving postoperative continuous opioid infusions was performed. Research ethics board approval was obtained along with parent, child and nurse informed consent. Following surgery, an acoustic respiratory rate sensor (Masimo Corp., Irvine, CA) was placed on the subject's neck, attached to a Masimo Rad87 monitor, along with standard pulse oximetry. Vital signs data and paging notification logs were obtained from the central monitoring system. A webcam was used to record videos of the subject, infusion pump, and Rad87 monitor. Video segments (10 min before to 10 min after each alarm) were stored on a secure server and subsequently analyzed by two research nurses to identify the alarm reason, response, and effectiveness (Figure 1), implementation of both systems of notification.

RESULTS: Data are reported as median (range) from 49 subjects (30 females), with an age of 14 (3-18) yrs, and a BMI of 19.5 (14.2-27.9). Vital signs data and video were recorded for 41 (6-47) hrs, after a range of surgeries (67% orthopedic) lasting 5 (2-11) hrs. Postoperative analgesia included hydromorphone epidural in 9 subjects, continuous morphine or hydromorphone infusions in 35 subjects and patient controlled analgesia in 5 subjects. On average, 6 notifications per 12 hour shift were observed for each patient; specifically, 491 clinical events and 327 non-clinical events resulted in a page to the subject's nurse. No clinical notifications were observed in 12 subjects; similarly 18 subjects had no notifications related to a non-clinical event (Table 1).

Thus far, videos from 10 subjects, including 32 clinical notifications, have been analyzed. Notifications were deemed effective in 81%, ineffective in 3%, and were ignored in 16% of instances. 22 alarms (55%) were induced by the patient, 11 alarms (28%) followed technical problems and in 7 alarms (18%) the reason could not be uniquely identified. Alarms elicited one or more of 42 identified tasks by the responder: Self-rescue by patients (26%) and parents (33%) were more frequent than nursing interventions (40%).

DISCUSSION: Video ethnographic observations are a useful way to analyze alarm effectiveness in the ward setting. Future work includes modeling of optimal thresholds for low respiratory rate alarms, balancing detection before deep desaturations against an increased false alarm rate.

REFERENCES:

1. Am J Surg. 2005;190(5):752-6.
2. Proc Am Soc Anes Ann Mtg. 2007, A84.
3. Am J Crit Care. 2010;19(1):28-34.
4. Anesthesiology. 2010;112(2):282-7.
5. BMC Health Serv Res. 2010;10(1):348.

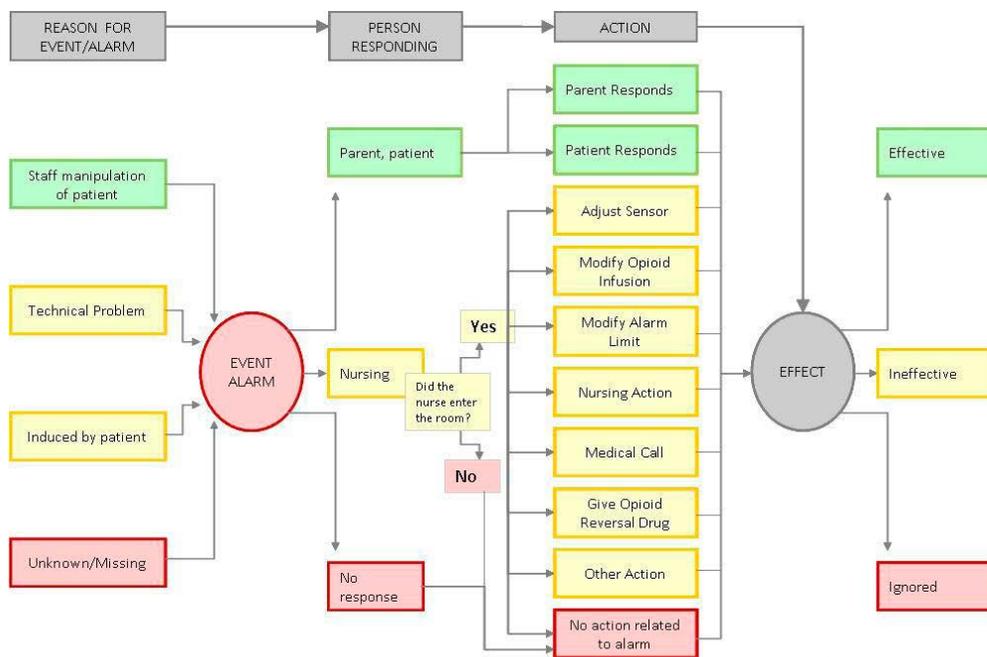


Figure 1: Alarm classification scheme, including alarm reason, alarm response, and alarm effectiveness.

S-355 • continued

Table 1: Overview of alarms resulting in a paging notification to a nurse.

Clinical event	Number of occurrences	Non-clinical event	Number of occurrences
Low RR	79	Patient interference	34
High RR	231	Sensor off	54
Low SpO ₂	76	No sensor	26
Low PR	24	Background interference	19
High PR	81	No communication with device (monitor switched off)	190
		Defective sensor	4
Total	491		327

S-356.

TISSUE OXYGEN INDEX, BUT NOT REGIONAL OXYGEN SATURATION, REFLECTS CHANGES IN FOREARM BLOOD FLOW IN RESPONSE TO AVASCULARIZATION IN HUMANS

AUTHORS: T. Akahori, E. Nakamura, Y. Yasuda, Y. Miyamoto, Y. Fujiwara, H. Kinoshita

AFFILIATION: Anesthesiology, Aichi Medical University School of Medicine, Nagakute, Japan.

INTRODUCTION: According to the manufacturer instructions of tissue oxygen monitors, tissue oxygen index (TOI) is applicable to the measurements of both brain and muscle tissue oxygenation, whereas regional oxygen saturation (rSO₂) solely applies to the evaluation of brain oxygenation¹. It is, however, unclear why this difference between TOI and rSO₂ exists. The present study was designed to examine TOI and rSO₂ values in the same condition upon forearm avascularization in volunteers, and to evaluate whether these parameters reflect changes of forearm blood flow as well as skin tissue oxygenation (StO₂) in response to the tissue ischemia.

METHODS: After institutional approval, informed consent was obtained from 24-35-year-old healthy volunteers. NIRO-200NXTM (Hamamatsu Photonics, Hamamatsu, Japan), INVOS 5100CTM (Covidien, Tokyo, Japan), an optical spectroscopy oxygen monitor C9183TM (Hamamatsu Photonics, Hamamatsu, Japan) or a blood flow monitor MoorFLPI-2™ (Moor instruments, Axminster, Devon, UK) was employed to examine continuous TOI, rSO₂, StO₂ and forearm blood flow values, respectively. The sensors and measurement area (25 mm²) were applied at three cm distal from an elbow joint and two cm lateral (brachioradial muscle) and

medial (flexor carpi radialis muscle) from the midline of the ventral forearm. Avascularization was achieved using a blood pressure cuff applied to the upper arm at 180 mmHg. Continuous TOI, rSO₂, StO₂ and forearm blood flow measurements were performed from the immediately before avascularization for five minutes to ten minutes after the release of a blood pressure cuff. The data were expressed as mean ± SD. Statistical analysis using PASW Statistics 18TM (IBM Japan Inc., Tokyo, Japan) was performed by the repeated-measures analysis of variance followed by Scheffe's test. Differences were considered to be statistically significant when P is < 0.05.

RESULTS: Medial rSO₂ value was significantly lower than lateral rSO₂ and bilateral TOI values at five minutes after the application of avascularization (Fig. 1). In contrast, medial rSO₂ values at one and two minutes after the termination of avascularization were significantly higher than lateral rSO₂ and bilateral TOI values (Fig. 1). Forearm blood flow and StO₂ values quickly decreased or increased according to avascularization and the termination, whereas these medial and lateral values did not differ during and after application of avascularization (Figs. 2 and 3). TOI, rSO₂, StO₂ and forearm blood flow values demonstrated restoration at 10 minutes after the termination of avascularization to those at the commencement of measurements (Figs. 1, 2 and 3).

CONCLUSIONS: In the present human study, TOI and StO₂, but not rSO₂, reflected changes in forearm blood flow in response to avascularization and the termination. The instability of rSO₂ values upon ischemia and reperfusion of skeletal muscle tissues may be one of the reasons why rSO₂ does not apply to the evaluation of muscle tissue oxygenation.

REFERENCES:

1. Anesthesiology 2007; 106: 458-62

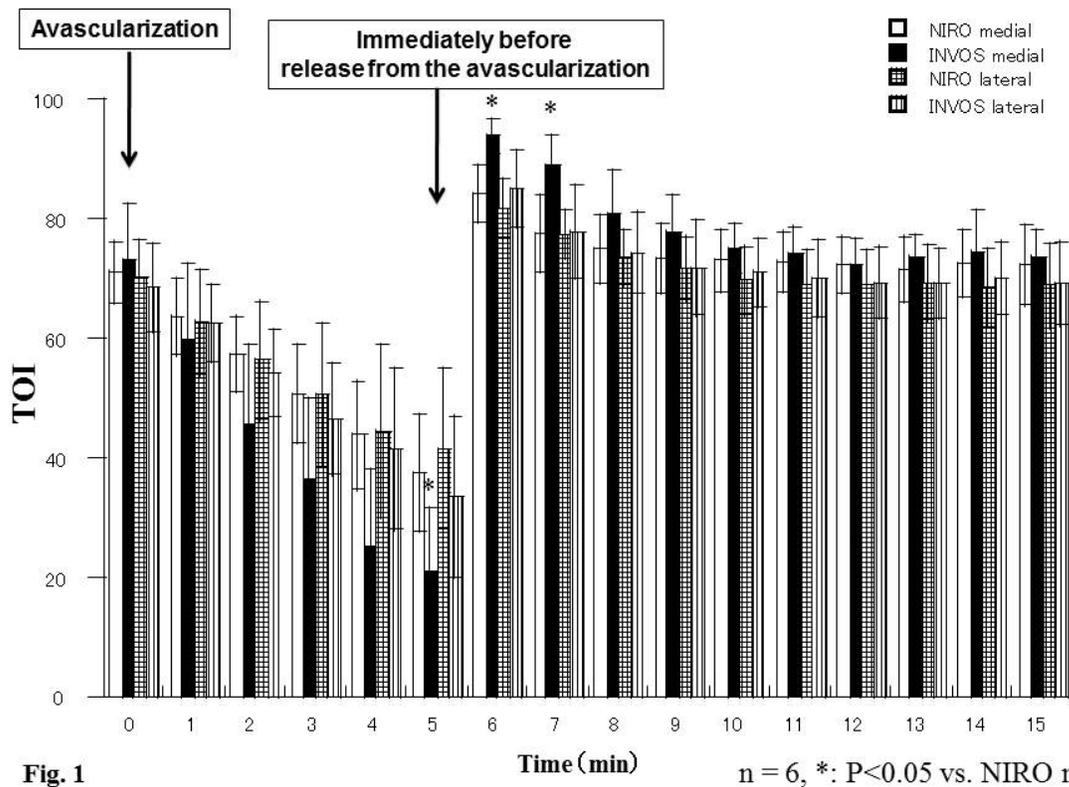
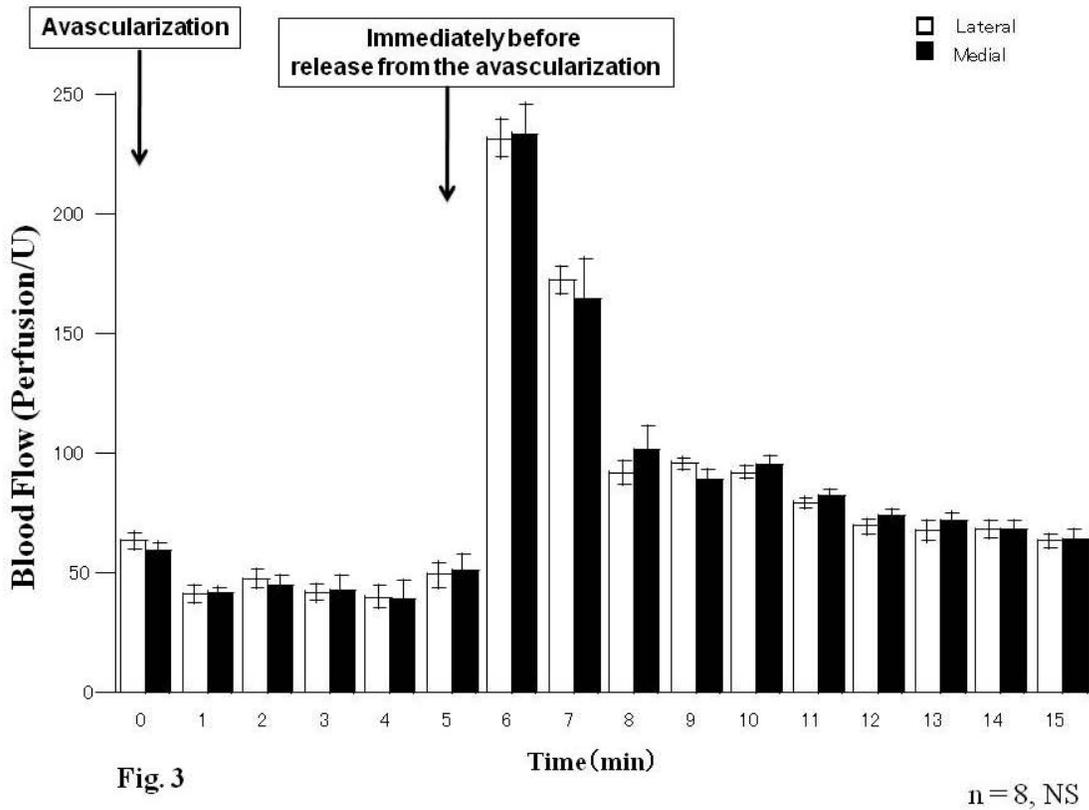
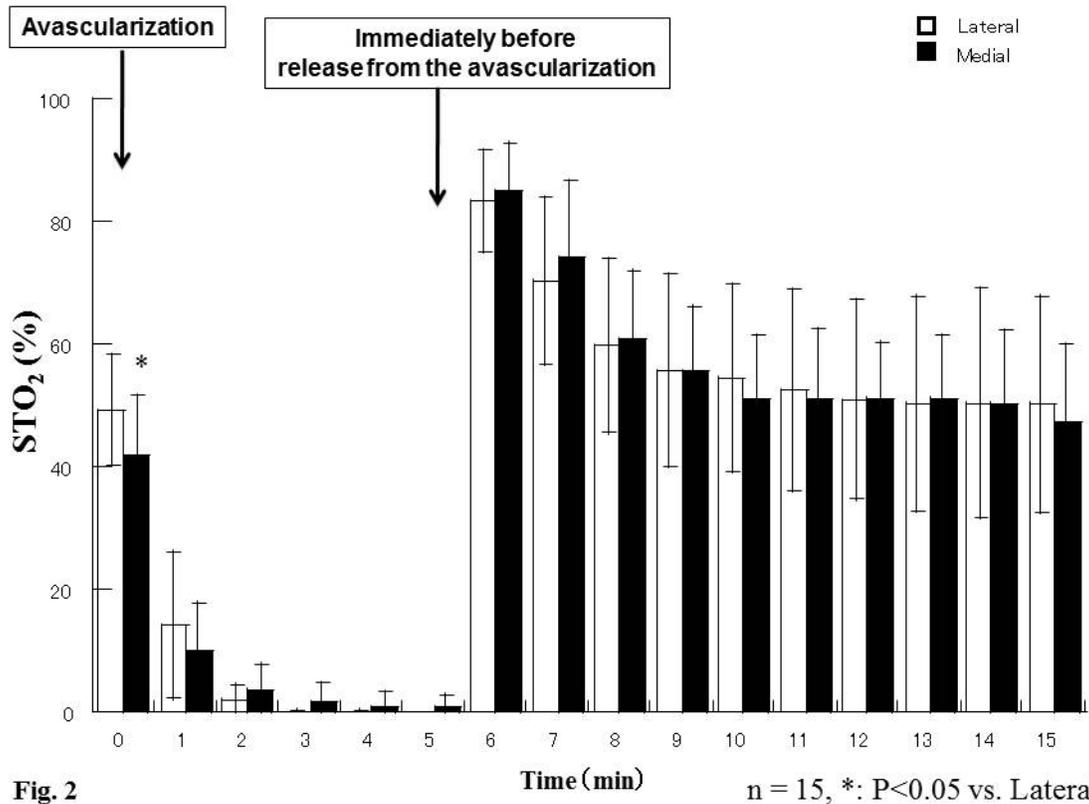


Fig. 1

n = 6, *: P < 0.05 vs. NIRO medial

S-356 • continued



S-357.

CLOSED-LOOP CONTROLLED PROPOFOL ANESTHESIA WITH REMIFENTANIL ADMINISTERED EITHER BY TARGET-CONTROLLED INFUSION OR CLOSED-LOOP CONTROL

AUTHORS: S. M. Brodie¹, N. C. West¹, K. van Heusden², M. Görges², J. Ansermino¹, G. Dumont², R. N. Merchant¹

AFFILIATION: ¹Anesthesia, University of British Columbia, Vancouver, BC, Canada, ²Electrical and Computer Engineering, University of British Columbia, Vancouver, BC, Canada

INTRODUCTION: Closed-loop control of anesthesia uses continuous feedback from a measure of clinical effect to automatically adjust drug infusion rates¹. By delivering drugs at variable rates that are individualized to each patient’s requirements, a more appropriate total dose of drug may be given while providing a more stable anesthetic. Previous work has focused on titrating propofol in response to a processed electroencephalogram (pEEG)-derived depth of hypnosis (DOH) measure². However, the varying occurrence of noxious stimuli during surgery motivates the need for closed-loop control of an analgesic agent, which may further improve stability of the DOH³.

We have recently completed the first phase of a pilot 2-phase clinical trial, which aims to demonstrate the clinical feasibility of closed-loop control of DOH and nociception during routine surgical procedures. In phase 1, propofol was administered by closed-loop control of DOH using pEEG feedback, whereas remifentanil was administered by target-controlled infusion (TCI) based on Minto’s model⁴. Currently, we are evaluating the system in phase 2, in which both propofol and remifentanil are being administered by closed-loop control.

The purpose of this analysis is to compare clinical measures from phase 1 with interim data from phase 2, in order to assess the relative doses of propofol and remifentanil and the stability of the DOH when remifentanil is delivered by closed loop versus TCI.

METHODS: Following Health Canada and local Research Ethics Board approval, and written informed consent, subjects were recruited from a population of ASA I-III adults undergoing routine, elective surgery.

The closed-loop control system, iControl-RP, receives pEEG feedback from the NeuroSENSE DOH measure (WAVCNS) [NeuroWave, Cleveland, USA;⁵], and controls two infusion pumps for propofol and remifentanil administration during both induction and maintenance of anesthesia (Figure 1).

RESULTS: Clinical measures from each phase were compared using the Mann-Whitney U test (Table 1).

CONCLUSIONS: This interim analysis suggests that when both propofol and remifentanil were administered in closed loop (phase 2), mean propofol consumption was comparable whereas remifentanil consumption was significantly increased. The stability of the DOH was not significantly different between phases, however a trend towards a higher proportion of time spent within the desired WAVCNS range, and less wobble⁶ was observed. It is possible that with a larger sample in phase 2, the difference may become more pronounced. These results are consistent with those reported by other studies, which use Bispectral Index guided closed-loop control of propofol and remifentanil³. Future, larger clinical trials will be required to assess relevant physiological variables such as hemodynamic stability and surgical outcomes.

REFERENCES:

1. J Clin Monit Comput. 2014;28(1):5-11;
2. Anesth Analg. 2013;117(5):1130-8;
3. Anes Analg. 2011; 112(3):546-557;
4. Anesthesiology. 1997;86(1):10-23;
5. J Clin Monit Comput. 2011;25(1):81-7;
6. J Pharmacokinet Biopharm. 1992;20(1):63-94.

Table 1: Data summary

		Phase 1 <i>Propofol by closed-loop, remifentanil by TCI</i>	Phase 2 <i>Propofol and remifentanil in closed- loop</i>	P value (2-tailed)
Descriptives	n	51 (20 female)	25 (11 female)	-
	Age	64 yrs [56-69]	59 yrs [50-66]	-
	BMI	28.0 kg/m ² [25.3-31.9]	27.4 [25.5-31.3] kg/m ²	-
	ASA	I: 8%, II: 53%, III: 39%	I: 12%, II: 48%, III: 40%	-
	Length of procedure	98.6 min [56.6-166]	106 min [77.7-144]	0.532
Time to induction	3.83 min [3.27-4.62]	3.98 min [2.93-5.03]	0.761	
Drug doses during maintenance of anesthesia	Mean propofol dose	106 mcg/kg/min [86.0-133]	99.2 mcg/kg/min [85.4-129]	0.547
	Mean remifentanil dose	0.108 mcg/kg/min [0.0803-0.136]	0.154 mcg/kg/min [0.134-0.178]	<0.001*
	Mean propofol Ce	2.95 mcg/mL [2.53-3.72]	2.91 mcg/mL [2.37-3.69]	0.615
	Mean remifentanil Ce	3.76 ng/mL [3.00-4.65]	5.64 ng/mL [4.48-6.15]	<0.001*
DOH stability	Time within 10 of WAVset	83.8% [76.7-91.3]	88.0% [83.9-95.0]	0.101
	Time BSR >10%	6.64% [0-15.8]	6.13% [0.649-16.8]	0.680
	Wobble	7.20 [5.40-8.98]	6.33 [4.00-8.73]	0.091

Values are Median [25th-75th percentile]

(BMI: Body mass index; Time to induction: time from start of infusion to WAV_{CE} < 60 for at least 30 seconds; Ce: Predicted effect site concentration [3,4]; WAVset: WAV_{CE} setpoint; BSR: Burst suppression ratio (data from left hemisphere); Wobble: Varvel measure of WAV variability [6])

S-357 • continued



Figure 1 – Custom closed-loop controller interface, displaying doses (top left) and predicted effect site concentrations (middle left) of propofol (yellow) and remifentanyl (blue), as well as current WAV_{CNS} (orange) relative to the setpoint (grey; bottom left). Patient vital signs are recorded from the monitor, and displayed across the top. Significant events and controller settings are displayed on the right.

S-358.

USE OF HILBERT TRANSFORMATION TO MONITOR PHYSIOLOGIC STRESS RESPONSE TO SIMULATED INTRAOPERATIVE CRISES

AUTHORS: R. Dudaryk¹, J. Bohorquez², C. L. Bennett³, R. R. McNeer⁴

AFFILIATION: ¹Anesthesiology, University of Miami, Miami, FL, ²College of Biomedical Engineering, University of Miami, Miami, FL, ³School of Music, University of Miami, Coral Gables, FL, ⁴Anesthesiology, University of Miami Miller School of Medicine, Miami, FL

INTRODUCTION: Measurement and quantification of physiologic stress response during simulation and real-life crisis scenarios has been recognized as essential tool for improvement in patient safety and well being of caregivers. Heart rate variability (HRV) is a validated marker of the stress response. Previous HRV studies in practicing physicians and medical trainees used conventional methods to measure HRV over extended periods of time (12-24hr) and were not able to discriminate changes related to a particular inciting event. We hypothesized that the Hilbert transformation, could be adapted to measure HRV over much shorter periods of time (1-2min) with minimal delay (few seconds), allowing us to track changes in HRV in response to simulated intra-operative crisis scenarios.

METHODS: Our experimental design and simulation setup is described in detail elsewhere. Simulations involved anesthesia residents giving two 30-minute lunch breaks, the second of which contained three crises scenarios (Fig 1). During experiments a 2-channel ECG was obtained using a biosensor (Shimmer)

A new method that computes the spectral power of the HRV in the three frequency bands, very low (VLF), low (LF) and high (HF), was developed for this project using the Hilbert transform. This method produces HRV power estimation with minimum delay (few seconds) and can track fast changes of the HRV elicited by transitory events.

HRV was measured before (pre), during and immediately after (post) each intraoperative crisis episode (Fig2). As a control, the lunch break with no crises was analyzed at the same time periods. Within-subjects differences were analyzed using Friedman's Test ($P < 0.05$), in HF and LF bands, and post-hoc analysis with Bonferroni adjustment was performed using Wilcoxon signed rank test.

RESULTS: Mean LF and HF-HRV values tended to be lower during crises relative to before (pre) and after (post) periods (Fig 3). These group differences were significant for LF ($P=0.025$). Differences in LF-HRV were significant between pre and during periods ($P=0.009$) and post and during periods ($P=0.003$). The difference between pre and post periods was not significant. Similar analysis of the control lunch break did not show any significant differences in either HF or LF-HRV (Fig 4)

CONCLUSIONS: We demonstrated that Hilbert transformation method can accurately identify decrease in LF-HRV during simulation of intraoperative crisis events. This supports our hypothesis that this method of HRV analysis can be used to discriminate specific stress-inducing events during medical simulation session. Such finding has a broad future application in the arena of medical simulation, stress-inoculation and resilience training for anesthesiologists and other high-stress medical professionals.

REFERENCES:

1. HRV Standards of measurement, physiological interpretation, and clinical use. *Circulation* (1996) 17, 354
2. Decreased heart rate variability in surgeons during night shifts. *Can J Surg*, Vol. 57, No. 5 2014
3. Junior doctors in their first year: mental health, quality of life, burnout and heart rate variability. *Perspect Med Educ* (2014) 3:136-143

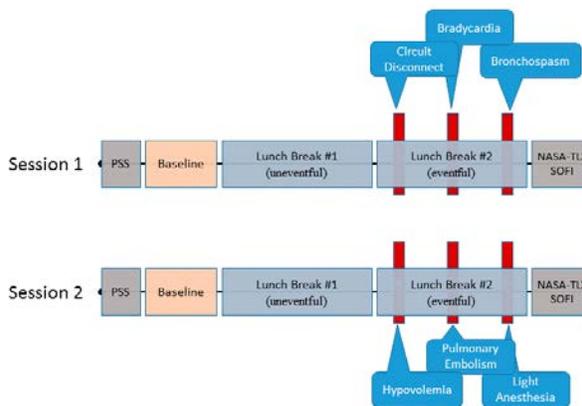


Figure 1. Schematic of simulation sessions showing the temporal relation of the three periods, baseline, uneventful, and eventful.

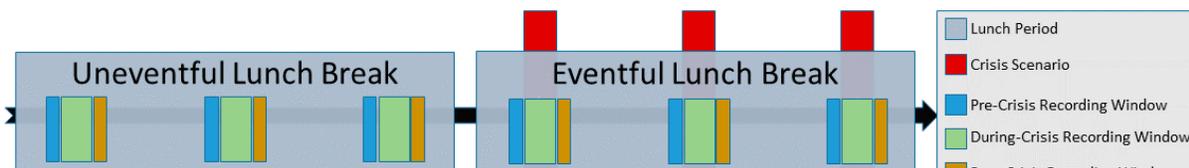


Figure 2

S-358 • continued

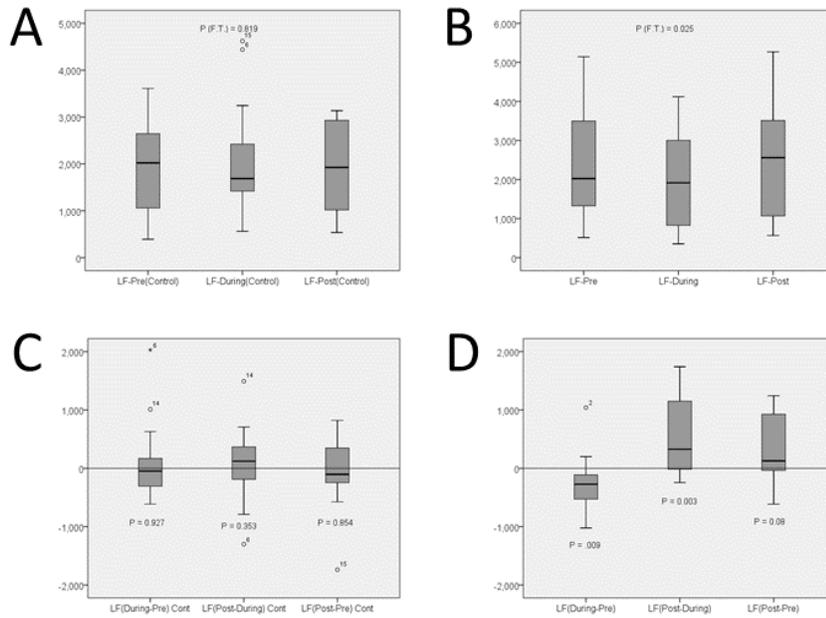


Figure 3. Box plots showing LF-HRV results for control (A and C) and experimental (B and D) recording windows. Hilbert transformation was able to show the transitory changes in HRV in peri-crisis episodes.

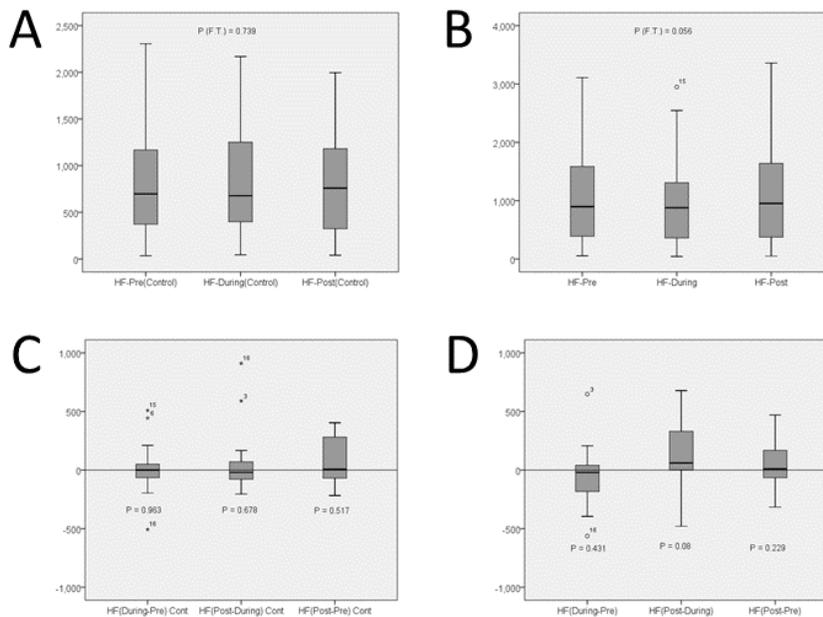


Figure 4. Box plots showing HF-HRV results for control (A and C) and experimental (B and D) recording windows. Transitory changes in HRV during peri-crisis episodes did not reach statistical significance.

S-359.

ANESTHESIA RESIDENT ANTICIPATION DURING SIMULATION EXPERIMENTS MAY AFFECT PHYSIOLOGIC RESPONSES TO STRESS

AUTHORS: R. Dudaryk¹, J. Bohorquez², C. L. Bennett³, R. R. McNeer⁴

AFFILIATION: ¹Anesthesiology, University of Miami, Miami, FL, ²College of Biomedical Engineering, University of Miami, Miami, FL, ³School of Music, University of Miami, Coral Gables, FL, ⁴Anesthesiology, University of Miami Miller School of Medicine, Miami, FL

INTRODUCTION: Anesthesiology is arguably one of the most stressful occupations in medicine. Simulation has been introduced to develop and refine non-technical skills for management of perioperative crisis situations. Heart rate variability (HRV) is a well-established marker of stress and health. We recently measured HRV in residents for 15 minutes (baseline) in a quiet room before initiating two simulated lunch breaks (uneventful followed by eventful) in an operating room (OR) simulator (Fig 1). The design was guided by our assumption and hypothesis that stress response would plateau to a low level during baseline and uneventful periods, thus improving our ability to measure the stress response in the eventful period.

METHODS: Anesthesia CA-1 residents (N = 20) participated in 2 simulation sessions spaced about 1 week apart—each session started with the baseline period followed by the uneventful and eventful periods (the eventful period contained 3 crisis scenarios). A wireless biosensor (Shimmer) (Fig 2) was used to record the electrocardiogram (ECG). Low (LF) and high (HF) frequency HRV was calculated off-line using the open-source Kubios software (Fig 3) and custom Matlab scripts following North American Society of Electrophysiology HRV Task Force guidelines. Within-subjects differences in HRV between the three simulation periods were analyzed using Friedman’s Test (P < 0.05), and post-hoc analysis with Bonferroni adjustment was performed using Wilcoxon Signed Rank Test.

RESULTS: Both LF and HF-HRV values were lowest during the uneventful lunch break period (Fig 4). Friedman’s test was significant (P < 0.001) only for the HF-HRV groups. HF-HRV differences between the rest and eventful group and between the uneventful and eventful group reached significance (P = 0.001 and 0.005, respectively). The difference between the baseline and eventful was not significant (P = 0.243).

CONCLUSIONS: These data suggest the stress response increased during the uneventful period over baseline period levels and then decreased to approximately baseline levels during the eventful period. This finding is contrary to our hypothesis. One reason for this may be due to an anticipatory “what will happen next” stress appraisal which can activate the stress response. Our residents are exposed to simulated crises numerous times in their CA-1 year, and it is possible that the uneventful 30 min lunch break was opposite of their prior simulation experiences. The exposure to intraoperative crises in the second lunch break was more consistent with their prior simulation experiences and, therefore, fully anticipated. Further investigation of this phenomenon is warranted as there are implications for experimental designs, and subject anticipation may have contributed to the negative results obtained in past stress response studies.

REFERENCES:

1. Psychological determinants of the cortisol stress response: the role of anticipatory cognitive appraisal *Psychoneuroendocrinology* 2005 30, 599.
2. Effects of medical training scenarios on heart rate variability and motivation in students and simulated patients, *Med Educ.* 2009 43(6):553.

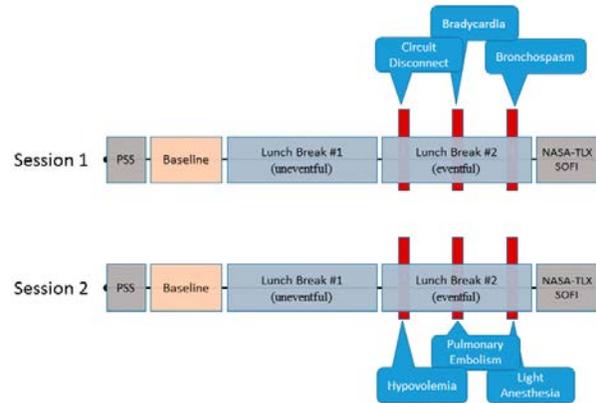


Figure 1. Schematic of simulation sessions showing the temporal relation of the three periods, baseline, uneventful, and eventful.



Figure 2. Shimmer (Bluetooth) 2-channel ECG biosensor used in experiments.

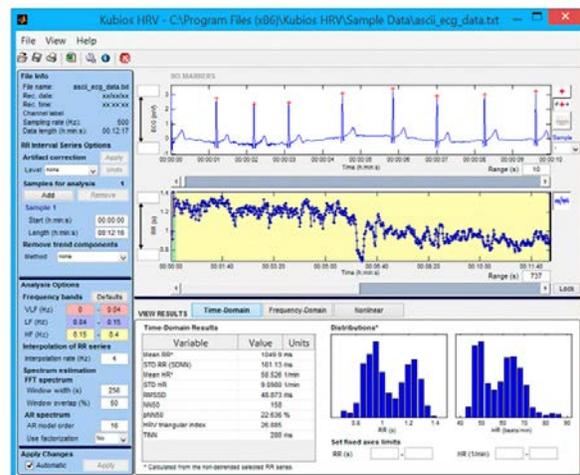


Figure 3. Kubios analysis open-source software used in part to calculate HRV measurements. Screenshot of graphical user interface.



S-360.

**RIGHT VENTRICULAR DYSFUNCTION:
ANOTHER CAUTION FOR FUNCTIONAL PRELOAD
PARAMETERS TO PREDICT VOLUME
RESPONSIVENESS IN A RABBIT MODEL**

AUTHORS: J. P. Bouchacourt¹, J. Riva¹, J. C. Grignola²

AFFILIATION: ¹Anesthesiology, Hospital de Clinicas, Facultad de Medicina, UdelaR, Montevideo, Uruguay, ²Pathophysiology, Hospital de Clinicas, Facultad de Medicina, UdelaR, Montevideo, Uruguay

INTRODUCTION: Pulse pressure variation (PPV) is used to predict fluid responsiveness in mechanically ventilated patients. Right ventricular (RV) dysfunction often occurs in the setting of pulmonary hypertension, making PPV not be an accurate parameter of volume responsiveness. We hypothesized that RV dysfunction avoids the increase of the functional preload parameters after bleeding.

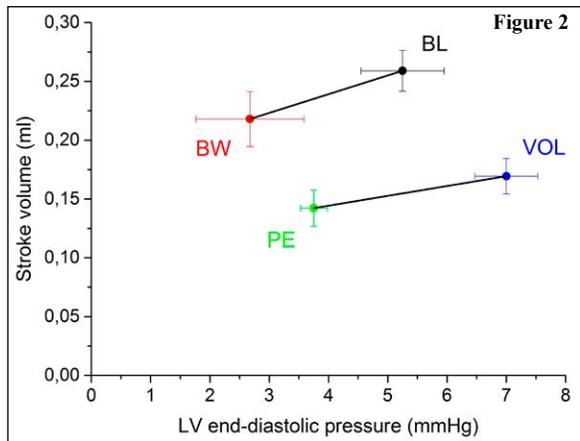
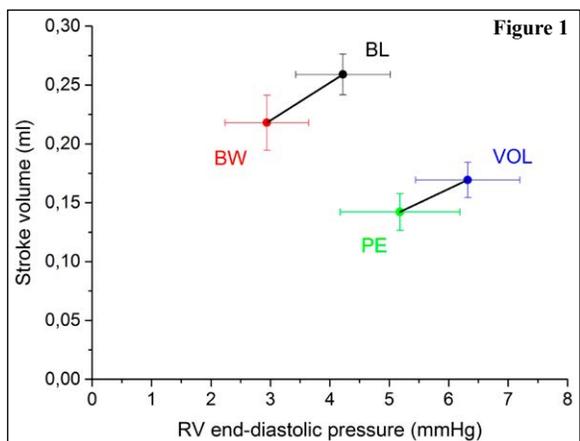
METHODS: Six anesthetized and mechanically ventilated rabbits were studied during normovolemia (BL), after moderate blood withdrawal (15% of volemia, BW), acute pulmonary embolism (PE), and volume replacement (VOL). Central venous, right and left ventricular (LV) pressures, and infra-diaphragmatic aortic blood flow (AoF, Transonic) and pressure (AoP) were measured. Venous embolization with fresh autologous blood-clot was carried out progressively over 30 minutes until systolic RV pressure increase about 50%. PPV and systolic volume variations (SVV) were estimated manually by the variation of beat-to-beat PP and SV, respectively. The vasomotor tone was estimated by total peripheral resistance ($RT=AoP/AoF$), arterial compliance ($C=SV/pulse\ pressure$) and dynamic arterial elastance ($E_{dyn}=PPV/SVV$). We assessed LV and RV preload by end-diastolic pressure (EDP) that allows the analysis of RV and LV function curves through changes in filling pressure related to changes in SV during VOL. We used ANOVA for repeated measurements at the different experimental conditions. A P value < 0.05 was considered statistically significant.

RESULTS: BW increased SVV and PPV (P<0.05), without significant changes in SV and AoF. PE decreased SV and AoF, meanwhile SVV and PPV returned to their BL values. Volume replacement could not restore the decrease of either SV or AoF secondary to PE (Figure 1). This was associated with a down and leftward shift of the RV function curve (Figure 2) and a downward shift of the LV function curve (Figure 3). Although, RT and C showed significant changes during PE and VOL, the E_{dyn} did not significantly change. RV pressure increased significantly after PE with respect to BL (20 ± 1.3 versus 30 ± 2.8 mmHg) and was maintained during VOL (28 ± 5.3 mmHg).

CONCLUSIONS: RV dysfunction secondary to PE blunts the PPV and SVV increase after bleeding and it also prevents the fluid responsiveness. We cannot discard the role of a concomitant LV dysfunction secondary to ventricular interdependence.

REFERENCES:

1. Journal of Cardiovascular and Vascular Anesthesia 2011; 25(6):1051-55
2. Transplantation Proceedings 2010; 42(7):2585-89
3. Critical Care 2010; 14:197
4. Critical Care Medicine 2009; 37(9):2570-75
5. American Journal of Respiratory and Critical Care Medicine 2003; 168(6):671-76



	BL	BW	PE	VOL
AoF, ml/sec	1.17 ± 0.13	0.89 ± 0.11	0.57 ± 0.17*	0.63 ± 0.17*
SV, ml	0.26 ± 0.04	0.22 ± 0.05	0.14 ± 0.04*	0.16 ± 0.03*
R _T , Wood unit	0.9 ± 0.14	1.18 ± 0.22	2.1 ± 0.6*§	1.7 ± 0.4*
C, 10 ⁻³ ml/mmHg	9.3 ± 1.6	7.5 ± 1.7	4.5 ± 1.6*§	5.0 ± 0.8*
E _{dyn}	1.05 ± 0.3	1.07 ± 0.24	1.32 ± 0.6	1.6 ± 0.7
AoP, mmHg	62.8 ± 4.6	62.4 ± 4.8	67 ± 6.4	62 ± 5.2
EDP RV, mmHg	4.2 ± 1.8	2.9 ± 1.6	5.2 ± 2.3	6.3 ± 2.0
EDP LV, mmHg	6.5 ± 3.1	3.6 ± 2.5	4.2 ± 1.0	7.2 ± 1.0
SVV, %	8 ± 3	16 ± 6	8 ± 3§	6 ± 3§
PPV, %	8 ± 4	17 ± 3	9 ± 3§	8 ± 2§

n=6, mean ± SD. * P<0.05 vs BL; § P <0.05 vs BW

Figure 3

S-361.**USING ELECTRONIC MEDICAL RECORDS
FEATURES – ARE HARD-STOPS THE WAY TO IMPROVE
DOCUMENTATION?**

AUTHORS: D. A. Rico Mora, L. I. Rodriguez, D. Sinclair, D. Lubarsky, K. Candiotti

AFFILIATION: Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, FL

INTRODUCTION: The development and meaningful use of Anesthesia Information Systems (AIS) has increased over the past decade, improving timing and accuracy of data recording, compared to handwritten records^{1,2,3}. It is the anesthesiologists' ultimate responsibility to confirm the record's completeness and accuracy. For this reason, some AIMS have developed features to assure completeness through automatic monitoring alerts⁴, messaging⁴, or use of Hard-Stops¹; which prevents the record from being finalized before all critical information is completed.

METHODS: The anesthesiologists of the University provide coverage at multiple centers with different AIMS. We retrospectively analyzed the data for all surgeries and documentation completeness in 3 random months (April-June-September 2014), at 2 different hospitals: Center A uses PICIS and does not allow for hard-stops and Center B, which uses INNOVIAN, and allows for hard-stops.

We measured completeness of documentation at 48 hours, based on 7 variables required by our department for documentation and billing compliance. These variables were: start of anesthesia care, end of anesthesia care, patient re-evaluated immediately prior to induction, attending present for induction, attending present for emergence, attending present for critical events and attending present during positioning.

Because hard-stops utilized in Center B do not allow the record to be printed or closed, we assumed 100% compliance for these 7 events at the end of each case and when reviewed. Further, we found no reports of cases still opened at 24 to 48 hours in Center B.

RESULTS: The number of cases with completed documentation in April 2014 was 1265/1327 (95.3%) in hospital A vs. 992 (100%) patients in hospital B. In June 2014, the number of cases with completed documentation were 1255/1317 (95.3%) in hospital A vs. 938 (100%) patients in hospital B. The number of cases with completed documentation in September 2014 were 1232/1279 (96.3%) in hospital A vs. 976 (100%) patients in hospital B.

CONCLUSION: As the tendency to implement AIMS increases, we must consider the different reporting capabilities and features such as hard-stops that each vendor offers, as this has implications for departments and billing compliance offices. Driscoll et al. stated, "An ideal AIMS should have the ability to detect the absence of essential information"¹.

We compared the use of hard-stops for billing and documentation completeness between 2 different centers with different AIMS, but used by the same group of providers. Although >95% compliance after 48 hours might be considered adequate, the implications for the billing department are important. Being able to customize an AIMS to a center's needs is important, and the value of knowing that anesthesia records are 100% compliant before "case closure" is critical. Ultimately, eliminating errors and missing information, improving billing revenue and enhancing anesthesia performance are all desirable results.

REFERENCES:

1. Anesth analg 2007;104:1454-61
2. AANA J 2001;69:407-10
3. Can J Anaesth 1999;46:122-8
4. Anesth Analg 2006;103:390-5

S-362.**ESTIMATION OF END-SYSTOLIC LEFT VENTRICULAR VOLUME (VED) WITH LEFT VENTRICULAR ARTERIAL COUPLING (EES/EA) AND STROKE VOLUME(SV)**

AUTHORS: M. Hayabuchi¹, Y. Obata¹, T. Hamada², H. Shigemi³, Y. Hayabuchi¹, M. Mizogami⁴, K. Shigemi⁵

AFFILIATION: ¹Anesthesiology & Reanimatology, Faculty of Medical Science, University of Fukui, Fukui, Japan, ²Clinical Laboratory, University of Fukui Hospital, Fukui, Japan, ³Hematology, Faculty of Medical Science, University of Fukui, Fukui, Japan, ⁴Anesthesiology & Reanimatology, Faculty of Medical Sciences, University of Fukui, Fukui, Japan, ⁵Anesthesiology & Reanimatology, University of Fukui, Fukui, Japan

INTRODUCTION: End-systolic ventricular elastance (Ees) and effective arterial elastance (Ea) are calculated with end-systolic arterial pressure (Pes), end-diastolic left ventricular volume (Ved), stroke volume (SV) and end-systolic left ventricular unstressed volume (Vo) as follows : $Ees = Pes / (Ved - SV - Vo)$ and $Ea = Pes / SV$. Combination of these two equations allows to calculate Ved as follows : $Ved = SV (1 + Ea/Ees) + Vo$. Ees/Ea can be estimated with mean arterial pressure (Pm), diastolic arterial pressure (Pad), pre-ejection period (PEP), and ejection time (ET) as follows : $X = Pad/Pm (1 + k ET/PEP) - 1$, $k = 0.59 (Ees/Ea)0.39 (1)$ and $Ees/Ea = 0.7 X - 0.22$. These equations could allow to continuously monitor Ved with Pm, Pad, PEP, ET and SV during general anesthesia and critical care.

METHODS: Thirty six patients, who simultaneously had the arteriosclerosis screening and the examination of transthoracic echocardiogram (TTE) between 2006 and 2011 at our university hospital, were recruited to compare the estimated values with measured values of Ved. Twenty six cases were excluded to analyze since two cases had too large measured Ved more than 150 ml, four cases had too small estimated Ved less than 50 ml which included less than 0 ml, and seventeen cases had too large estimated Ved more than 150 ml. Ees/Ea was estimated with four parameters (Pm, Pad, PEP and ET) which were non-invasively measured with the vascular screening system (VaSera-1000, Fukuda Denshi, Tokyo, Japan). SV was measured with TTE. Vo was assumed to be small enough to be ignored in recruited patients with normal cardiac function. Summarizing the above, Ved was estimated as follows : $Ved = SV (1 + Ea/Ees)$. On the other hand, measured Ved was determined with TTE to compare with estimated Ved.

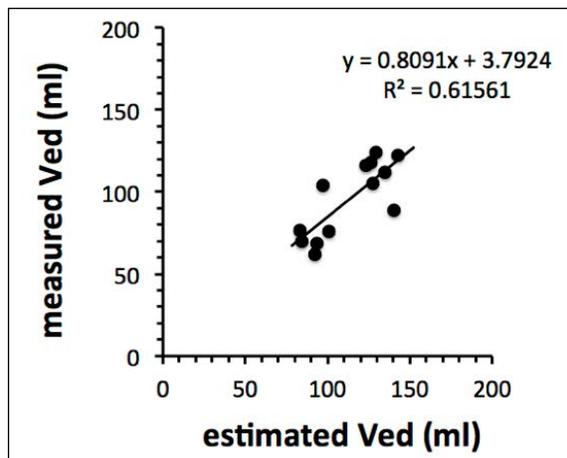
RESULTS: The regression line and correlation coefficient of estimated Ved (x) and measured Ved (y) of thirteen cases (36%), in which both of estimated and measured values were between 50 ml and 150 ml, are as follows : $y = 0.81 x + 4$ and $r = 0.78$ (Fig. 1).

DISCUSSION: Ved directly provides quantitative value of cardiac preload which is one of the main factors to control cardiac output and arterial pressure. Continuous monitoring of Ved would be also contribute the adequate fluid managements of the patients under anesthesia or critical care. The effects of ignored factors in this analysis, such as Vo and end-diastolic left ventricular pressure, on the estimation of Ved need to be studied farther.

CONCLUSION: The measurements of Pm, Pad, PEP, ET and SV allow the precise estimation of Ved especially in normal range, which is between 50 ml and 150 ml.

REFERENCES:

1. Obata et al., Anesth Analg 2014;118(5S):S-308.



S-363.

UNUSUAL CLINICAL CAPNOGRAM DUE TO SIDE-STREAM SAMPLING LEAK: MECHANISM BY NUMERICAL ANALYSIS

AUTHORS: L. F. Breen¹, A. Rosenbaum², P. H. Breen²

AFFILIATION: ¹Surgery, University of California-Irvine Medical Center, Orange, CA, ²Anesthesiology and Perioperative Care, University of California-Irvine Medical Center, Orange, CA

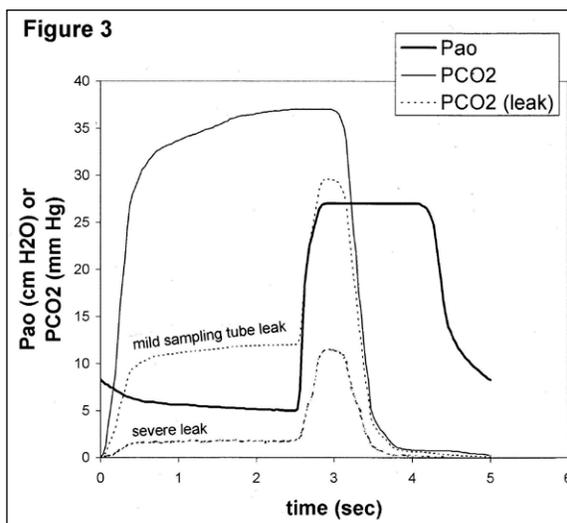
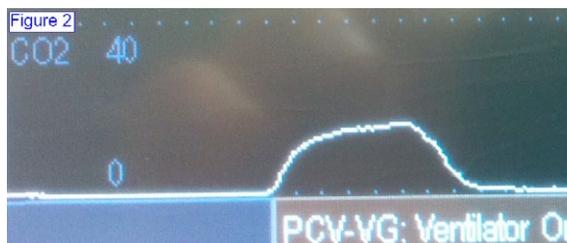
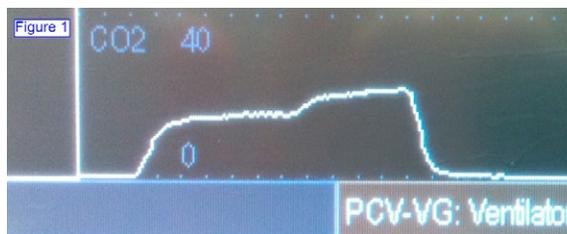
INTRODUCTION: A leak in the sidestream sampling tube generates a characteristic capnogram (Fig.1), where PCO₂ on the first plateau is decreased because of dilution with room air (containing no CO₂) into the sampling tube. Then, during the beginning of the next inspiration (last portion of the capnogram plateau), the increased airway opening pressure (Pao) decreases the leak to increase end-tidal PCO₂ (PetCO₂) and raise the second plateau. In one patient, we observed the capnogram depicted in Fig.2, where the waveform is rather narrow and of significant decreased amplitude (PetCO₂), which also turned out to be caused by a sidestream sampling tube leak. We hypothesized that the characteristic dual-plateau capnogram with sampling tube leak is not visible with a severe leak because the significant inflow of room air (containing no CO₂) dilutes and decreases the first PCO₂ plateau to near zero. Only the second PCO₂ plateau is visible, when increasing Pao at the beginning of inspiration (last portion of the capnogram plateau) decreases the leak of room air into the sampling tube.

METHODS: To test this hypothesis, we developed a numerical analysis model to simulate mild and severe leaks in the sidestream sampling tube, using digital data from a patient capnogram (PCO₂[t]) and Pao[t] (Fig.3), where t is time and PCO₂[t] is temporally advanced to account for transit t down the sampling tube. Equations were developed to calculate the flow through the sampling tube (FLOW_{st}[t]) and the leak flow into the sampling tube (FLOW_{leak}[t]), where FLOW_{leak}[t] is decreased by increasing Pao[t]. Then, at each t, measured PCO₂[t] = FLOW_{st}[t] x actual PCO₂[t] / (FLOW_{st}[t] + FLOW_{leak}[t]) (Eq.1)

Data were plotted for one full capnogram (Fig.3). At any t, if Pao[t] + proximal sampling tube P (sidestream sampling suction) was greater than zero (reverse FLOW_{leak}), then FLOW_{leak}[t] was set to zero in Eq.1.

RESULTS: Sampling tube resistance (R = P / FLOW) was 0.15 mmHg/(ml/min) (proximal sampling tube P of -30 mmHg / sampling FLOW rate of 200 ml/min). For the mild sampling tube leak condition, we used R_{leak} of 0.06 mmHg/(ml/min) generating the dual-plateau capnogram depicted in Fig. 3. For the severe capnometer sampling leak condition, we used R_{leak} of 0.007 mmHg/(ml/min) generating the narrow, low amplitude capnogram also displayed in Fig. 3.

CONCLUSIONS: That the numerical analysis model (Fig. 3) qualitatively generated the dual-plateau capnogram during mild sampling tube leak (Fig.1) and the narrow, low amplitude capnogram during severe sampling tube leak (Fig.2) supports our proposed mechanisms underlying the PCO₂[t] waveforms when air leaks into the sampling tube. For the severe sampling tube leak, the narrow, low amplitude capnogram is similar to the second plateau of the dual-plateau capnogram observed with a mild sampling tube leak. It is important to recognize Fig.2 as a severe leak into the capnometer sampling tube. Otherwise, the resulting narrow, low amplitude capnogram could be confused with low cardiac output (decreased CO₂ delivery to the lung), depression of tissue metabolic activity (decreased CO₂ production), or excessive alveolar ventilation.



S-364.**BROAD SPECTRUM SPECTROSCOPY OF THE PORCINE QUADRICEPTS MUSCLE TO DETECT OXIDATIVE STATE OF CYTOCHROME 2A**

AUTHORS: K. Ikeda, R. H. Thiele

AFFILIATION: Anesthesiology, University of Virginia, Charlottesville, VA

INTRODUCTION: Near infrared spectroscopy (NIRS) was originally developed to assess the oxidation state of cytochrome aa3 (Cyt_{aa3}), the terminal component of the electron transport chain (ETC)¹. When oxygen is supplied to the cell, enters the mitochondria, and passes down the ETC such that energy is produced, Cyt_{aa3} exists in an oxidized state. When any one of these critical steps does not occur, Cyt_{aa3} is reduced and this is detectable using NIRS. Thus, unlike “tissue oxygen saturation,” the oxidation state of Cyt_{aa3} provides information about the health of the cells themselves.

In this research, we constructed a broadband NIRS device designed to measure both StO₂ and Cyt_{aa3} redox state in a porcine model of anoxic quadriceps muscle ischemia and compared the sensitivity and specificity of StO₂ and Cyt_{aa3} redox state for the detection of pathologically confirmed cerebral ischemia. Ultimately it is our expectation that this research will assist cardiothoracic anesthesiologists in determining when low StO₂ values are artifactual versus real (and threatening to the central nervous system).

METHODS: The NIRS device will consist of a single halogen light source (broad spectrum light source), a single emitting fiber optic cable, one receiving fiber optic cables, a spectrometer, CCS175 from Thorlabs (Newton, NJ), and MATLAB (Natick, MA) for analysis. The anesthetized pig was euthanized by way of endotracheal tube clamping, as approved by IACUC. The pig was then allow to desaturate and go into atrial fibrillation. The absorption was calculated using the extinction coefficients for oxy and deoxyhemoglobin measured by Zijlstra et al² and the Cyt_{aa3} extinction coefficients as measured by Moody et al³ by solving the Lambert-Beer equation adapted to solve for the least squares fit of a band of spectra from 600 nm to 900 nm.

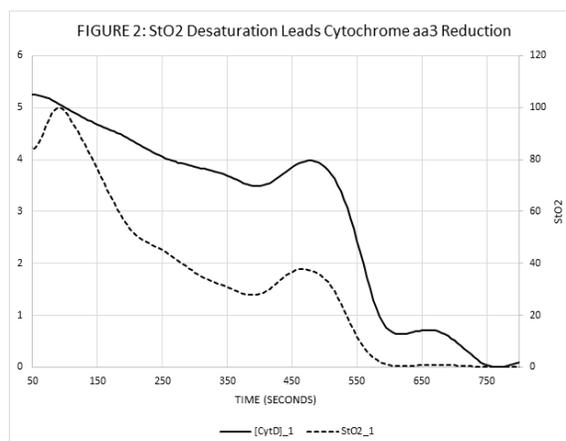
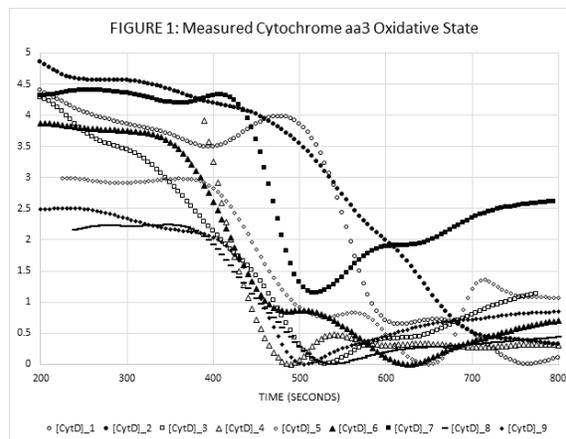
RESULTS: The data showed a precipitous decrease in the difference between oxidized and reduced cytochrome (CytD) over time (Figure 1). We also found that in some animals, the oxygen saturation increased as compensatory mechanisms intervened, while cytochrome difference remained depressed after initial decline (Figure 2).

CONCLUSIONS: The cytochrome aa3 reduction that accompanies hypoxemia is detectable using NIRS. The Cytochrome aa3 reduction follows tissue StO₂ decline suggests that compensatory mechanism such as the Bohr Effect may be allowing for oxygen molecules to be released by the hemoglobin, which then provides more oxygen molecules to the cytochrome aa2.

Additional work is needed to determine the sensitivity and specificity of this measure of cytochrome aa3 reduction severity.

REFERENCES:

1. Science. Dec 23 1977;198(4323):1264-1267.
2. Visible and near infrared absorption spectra of human and animal haemoglobin (VSP: Utrecht). ISBN 90-6764-317-3
3. Biomedical Optics Research Laboratory at University College London, <http://www.ucl.ac.uk/medphys/research/borl/intro/spectra>



S-365.

BROAD SPECTRUM SPECTROSCOPY FOR CHARACTERIZING CYTOCHROME aa3 OXIDATIVE STATE AS AN INDICATOR OF SEPSIS USING THE MICE SEPSIS MODEL

AUTHORS: K. Ikeda, R. H. Thiele

AFFILIATION: Anesthesiology, University of Virginia, Charlottesville, VA

INTRODUCTION: Worldwide, the annual incidence of sepsis is estimated to be between 56-91:100,000 people and the mortality rate is approximately 18-32%.^{1,2,3,4} A recent prospective randomized controlled trial comparing two “goal-directed therapy” endpoints (lactate clearance and central venous oxygenation saturation) to conventional therapy was negative. Additional management strategies and therapeutic endpoints are needed.

Cytochrome aa3 is the terminal component of the electron transport chain and may be more specific for subcellular hypoxia than hemoglobin saturation. In this present study, we aim to relate changes in cytochrome aa3 oxidation state (Cyt_{ox}), as measured using near infrared spectroscopy (NIRS) to the progression of lethal sepsis. Currently, it is not known whether observed changes in NIRS-derived cytochrome signals following the initiation of sepsis^{5,6,7,8} and provide any predictive or actionable information.

METHODS: We utilized a lethal murine cecal ligation and puncture (CLP) polymicrobial sepsis model. We utilized a tungsten halogen lamp as a light source on one side of the mouse and an Ocean Optics (Dunedin, FL) HR200+ES to capture the photons on the other (Figure 1). To calculate Cyt_{ox}, we solved a system of linear equations using 301 wavelengths (600 to 900 nm) using absorption data provided from the Biomedical Optics Research Laboratory (BORL) at University College of London.⁹

RESULTS: Data showed a precipitous drop in Cyt_{ox} (Cytochrome aa3 difference) over time (Figure 2) except for the one mouse that survived. We also found that in some animals, the Cyt_{ox} and the oxygen saturation became uncoupled (Figure 3). Note that profound tissue hypoxia has occurred (StO₂ ~ 20%) by 300 minutes of sepsis, but that Cyt_{ox} temporarily stabilizes, at which point StO₂ begins to increase (? compensation) until both Cyt_{ox} and StO₂ drop precipitously at the time of death (480 minutes).

CONCLUSIONS: The cytochrome aa3 reduction that accompanies sepsis is detectable using NIRS. This is significant because the absorption data used to develop the known absorption spectra of biologically relevant chromophores are independent of species and tissues interrogated. Our results are consistent with the results of other investigators using rodent¹⁰ and porcine¹¹ sepsis models.

We compared Cyt_{ox} to StO₂ and determined that while in some animals the two are tightly correlated, in other animals they are not. This suggests that there is inter-individual variability in the tolerance for hypoxia at the level of the cell.

All animals who died exhibited a cytochrome aa3 reduction of -0.25 arbitrary units or more. Additional work is needed to determine the sensitivity and specificity of this measure of sepsis severity.

REFERENCES:

1. J Glob Health 2012;2:10404.
2. Crit Care Med 2008;36:296-327.
3. JAMA 2014;311:1308-16.
4. N Engl J Med. 2014 May 1;370(18):1683-93.
5. Circulatory shock 1994;43:34-43.
6. J Surg Res 1991;51:382-91.
7. Circulatory shock 1993;40:1-8.
8. Crit Care Med 2000;28:3491-7.
9. Anal Biochem 1995;227:54-68.
10. Circulatory shock 1991;33:17-25.
11. Crit Care Med 2000;28:3491-7.

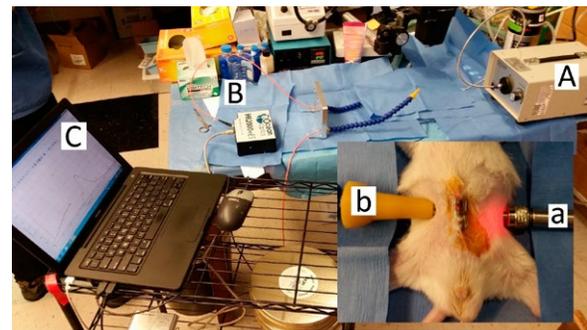


Figure 1. broadband NIRS system utilized in CLP model. A: halogen light source (a: fiberoptic emitter); B: broadband spectrometer (b: fiberoptic receiver); C: data acquisition laptop

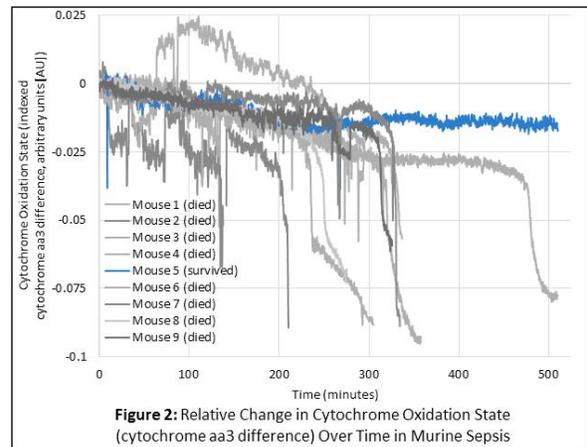


Figure 2: Relative Change in Cytochrome Oxidation State (cytochrome aa3 difference) Over Time in Murine Sepsis

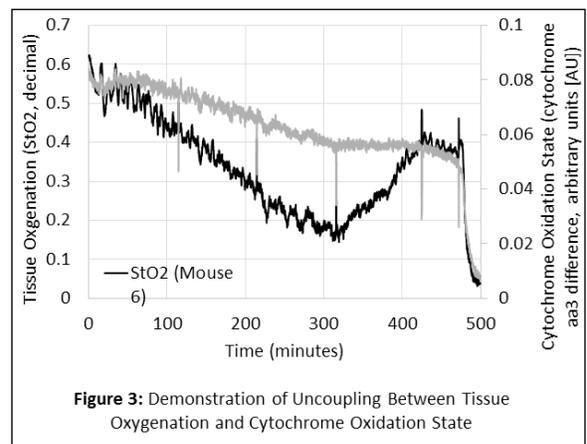


Figure 3: Demonstration of Uncoupling Between Tissue Oxygenation and Cytochrome Oxidation State

S-366.

COMPARISON OF PAPER AND DIGITAL RECORDING OF EVENTS DURING SIMULATED CARDIAC ARREST WITH A NOVEL ELECTRONIC DECISION SUPPORT TOOL

AUTHORS: C. L. Cropsey¹, A. L. Threatt², M. D. McEvoy¹

AFFILIATION: ¹Department of Anesthesiology, Vanderbilt University, Nashville, TN, ²Health Informatics Technologies & Services, Vanderbilt University Medical Center, Nashville, TN

INTRODUCTION: Accurate recording of events during in-hospital cardiac arrest (IHCA) is important and is included as part of the American Heart Association Advanced Cardiac Life Support (ACLS) training. This role is commonly performed by a nurse writing events on paper during or immediately after the event. Several studies have shown that electronic decision support tools (eDST) can improve the management of crisis events¹⁻³. However, the accuracy of such devices for recording actions during an event has not been assessed. The aim of this investigation was to assess the accuracy and cognitive load of nurses recording critical events using paper or an electronic application.

METHODS: Nineteen registered nurses who work in high acuity settings (post-anesthetic care unit, intensive care unit, or emergency department) were recruited for this 2x2 matrix within-subjects designed study. Participants were asked to record the actions of code teams observed in two different videos depicting simulated IHCA. Group A initially documented the events of video one using the standard paper recording form in use at our institution (Figure 1), while group B used a novel iPad-based eDST (Figure 2). Participants then watched and recorded the events of video two using the alternate documentation method. After a period of at least two weeks to minimize recall bias, participants returned and viewed the same two videos but recorded the events utilizing the opposite method used during the first session. Each participant completed a validated survey tool (NASA TLX) after each viewing to assess the cognitive burden of each method. Participants were also asked whether they preferred paper or eDST documentation.

RESULTS: Fifteen participants completed the study. Unfortunately, data loss from the eDST resulted in only nine complete, paired electronic records. For video one, nurses recorded an average of 56.5% of events correctly to within 30 seconds on paper, and 50.2% with the eDST (p = 0.43). For video two, nurses recorded 70.6% correctly to within 30 seconds on paper and 61.7% with the eDST (p = 0.16). The average overall accuracy of paper was 63.5% (± 14.9%) vs. 56.0% (± 11.6%) for eDST. When responding to the NASA TLX (0-100 scale, 0 is best), the eDST was less mentally demanding than paper for video two (34.7 vs. 54.0, p = 0.02) and non-inferior for video one (40.3 vs. 44.0, p = 0.34). Both groups preferred the eDST over the paper method [73% (session two) and 80% (session one)].

CONCLUSIONS: Electronic documentation of critical events was non-inferior to paper recording in a simulated scenario even with minimal prior training. Nurses preferred electronic documentation, and it did not increase their cognitive demands. Surprisingly, even in a controlled setting, the accuracy of critical event recording is quite low. Prior to use in a clinical setting, electronic applications should undergo a rigorous user-centered iterative design process accompanied by a summative usability study to ensure stable and accurate functionality and minimal data loss.

REFERENCES:

1. Resuscitation. 2014(85):138
2. Reg Anesth Pain Med. 2014(9):299
3. Anaesthesia. 2011(66):255

Figure 1: Paper cardiac arrest recording sheet

Figure 2: eDST screenshot demonstrating event summary. Arrows denote documentation of cardiac rhythm, defibrillation, and intubation.

Table 1: Results

	Paper Recording	eDSTRecording	
Accuracy, video 1	56.5% ± 13.9	50.2% ± 11.7	p=0.43
Accuracy, video 2	70.6% ± 13.1	61.7% ± 8.6	p=0.16
Overall Accuracy (video 1 + 2)	63.5% ± 15	56.0% ± 11.6	p=0.14
Mentaldemandon NASATLX,video1	54.0 ± 21.84	34.7 ± 35.64	p=0.02
Mentaldemandon NASATLX,video2	44 ± 29.83	40.3 ± 21.91	p=0.34

S-367.

USE OF A NOVEL MAINSTREAM CAPNOMETER SYSTEM FOR NON-INTUBATED CHILDREN IN THE POST ANESTHESIA CARE UNIT (PACU) NO ANIMAL USED

AUTHORS: M. Nagoshi, P. Ross, R. C. Wetzel

AFFILIATION: Department of Anesthesiology, Children’s Hospital Los Angeles, Los Angeles, CA

INTRODUCTION AND PURPOSE OF THE STUDY: Monitoring of carbon dioxide (CO₂) in non-intubated patients is challenging. A novel mainstream capnometer system which measure EndTidal CO₂ (EtCO₂) value while administering oxygen was evaluated¹. We determined the effect of fresh gas flow on accuracy and compared the new masks to conventional nasal cannulae.

METHODS: A mainstream capnometer system (cap-ONE® and cap-ONE mask; Nihon Kohden) was evaluated. Infant mask for body weight (BW) 7-20kg, and pediatric mask for 20-40kg. Children (ASA 1-2) following minor procedures were enrolled. Children with BW 7-40kg were assigned to control or mainstream group randomly. The control wore nasal cannulae with CO₂ side port (Salter Lab; 4703-F). Infant and pediatric cap-ONE masks were used according to patient BW per manufacture recommendation. After entering PACU, O₂ flow was started at 5 L/min (lpm), and reduced in a stepwise fashion, 2, and 0.25 (minimal flow) after every 3 minutes. Capnogram analysis was performed for records having continuous stable waveforms for at least 60 seconds in each O₂ flow rate. These values were compared in control and mainstream group among different O₂ flow rates.

RESULTS: Fifty-eight children were enrolled and 42 were analyzed (19 controls and 23 mainstream cases). Emergence (14 cases) and mouth breathing (2 controls) caused exclusion. No complications were observed including hypoxia. Both mainstream and control groups showed correlation of peak EtCO₂ at minimal O₂ flow (0.25 lpm) to those at 2 and 5 lpm using Linear regression and Pearson correlation analyses (P<0.01, all; Fig.1). However, Linear regression and Bland–Altman analyses revealed better correlation in mainstream group (Fig.2). Bland–Altman analysis of 5 and 0.25 lpm showed mainstream bias of 2 mmHg (95% CI -4 to 8); control bias of 5 mm Hg (95% CI - 8 to 17). Variances of EtCO₂ in mainstream group were smaller than control in all O₂ flow rate.

CONCLUSION: Because conventional sidestream capnometry with nasal cannula may not accurately measure EtCO₂ due to dilution with high flow O₂. Sidestream capnometers are also limited by potential occlusion of sampling line and mouth breathing. In our study mainstream system showed better correlation of EtCO₂ between minimal O₂ flow (0.25 lpm) to 2 and 5 lpm. We conclude mainstream system is safe and effective option in PACU to measure EtCO₂ regardless of nose or mouth breathing.

REFERENCES:

1. Takatori F. A novel mainstream capnometer system for non-intubated pediatric patients requiring oxygen administration. Conf Proc IEEE Eng Med Biol Soc 2011:1189-92.

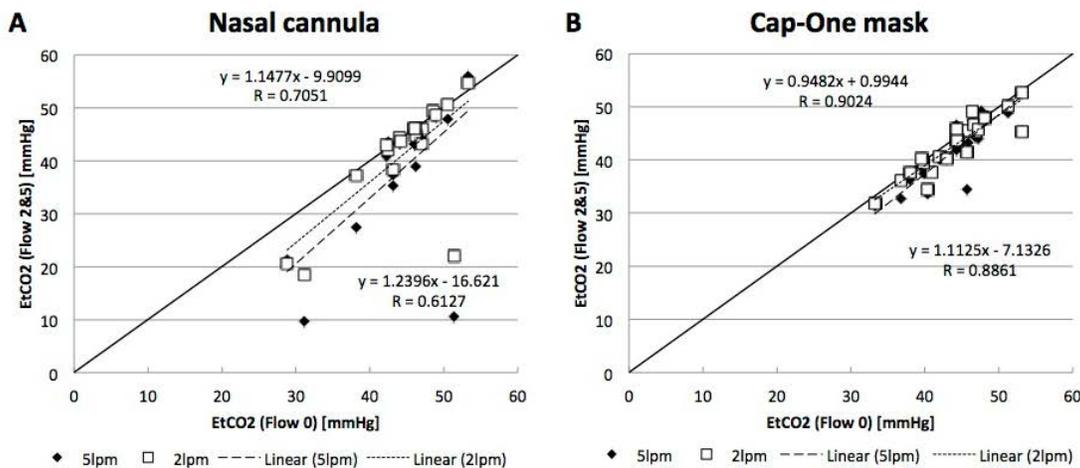


Fig. 1. Correlation between EtCO₂ at minimal flow and EtCO₂ at 5 lpm & 2 lpm. Nasal cannula group (A). Cap-One mask group (B).

S-367 • continued

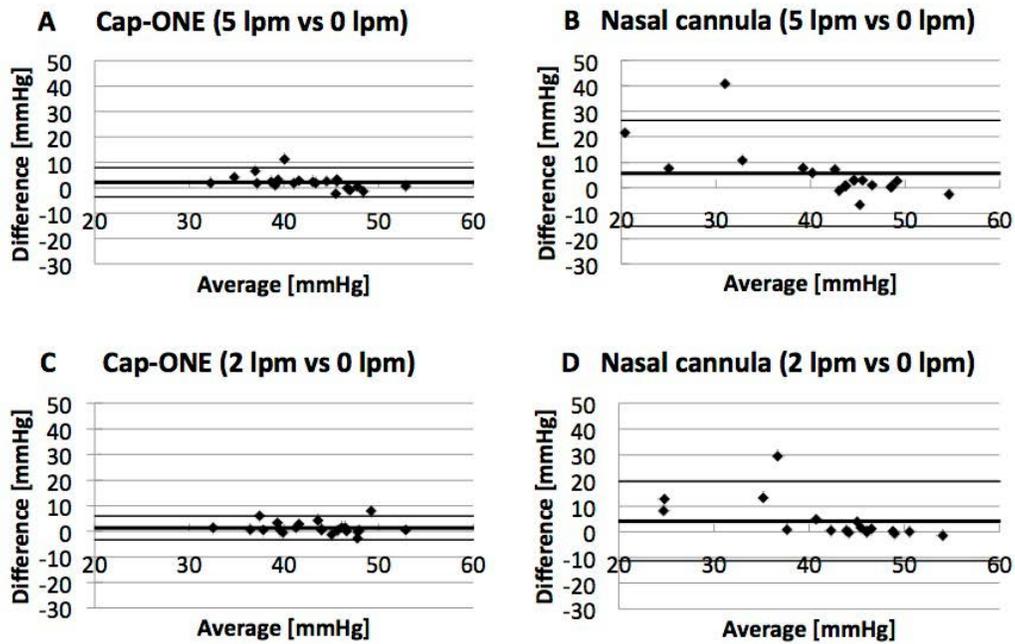


Fig. 2. Bland-Altman plot of Cap-One (A & C), and Nasal cannula (B & D).

S-368.**DEVELOPMENT OF A SYSTEM TO PRE-EMPTIVELY IDENTIFY IMPENDING CO₂ ABSORBENT DEPLETION DURING LOW FRESH GAS FLOW ANESTHESIA****AUTHORS:** R. H. Epstein, D. Gratch, D. Maguire**AFFILIATION:** Anesthesiology, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, PA

INTRODUCTION: There is considerable interest in low fresh gas flows (FGF) during volatile anesthesia to reduce costs and lower pollution.^{1,2,3} A consequence of this is more rapid exhaustion of the CO₂ absorbent that can result in significant rebreathing. We recently switched to a lithium-based absorbent to eliminate carbon monoxide and Compound A production, eliminating the rationale to limit reduction in sevoflurane FGF. Because the new product is 2x as expensive as our previous absorbent, we wanted to avoid premature replacement (i.e., FiCO₂ < 5 mm Hg). However, we also wanted to mitigate intraop canister changes, as these can be disruptive to patient care. We developed a monitoring and notification system to alert our anesthesia techs at the end of cases to preemptively change the absorbent during the turnover. We found that color changes were unreliable as fresh product has a purplish hue and it was hard to see the granules through our cloudy canisters.

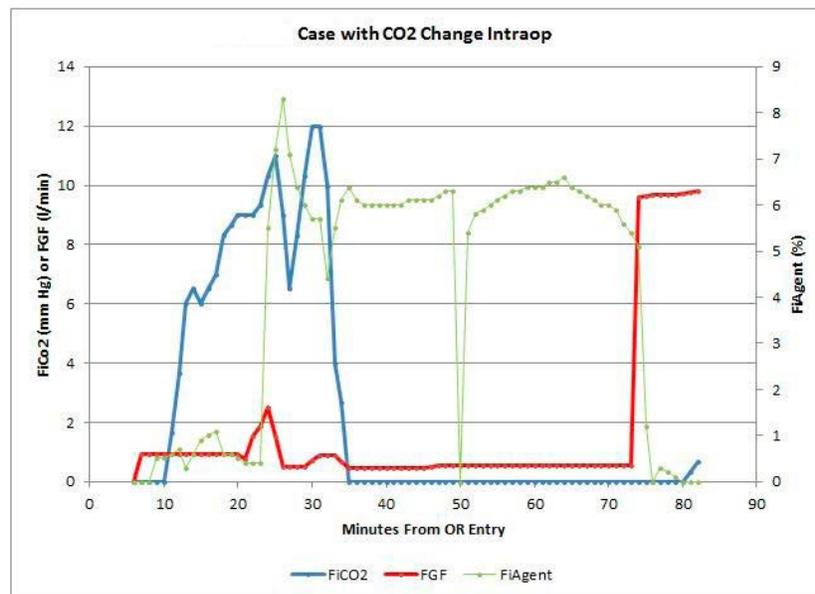
METHODS: As part of a quality assessment (QA) project, we extracted inspired (Fi) and expired (Fe) CO₂ and volatile agent concentrations, FGF, recorded q 1 min, from our anesthesia information management system. There was occasional confusion in the log between FiCO₂ and FeCO₂ (resulting in spuriously high rebreathing). During low FGF, we noted a pattern of gradually increasing FiCO₂ to 3 and 4 mm Hg followed by an increase in the rate of rebreathing. We developed empirical criteria for absorbent replacement between cases (≥10 min with FiCO₂ of ≥5 mm Hg or ≥20 min with FiCO₂ ≥4 mm Hg). We evaluated our algorithm by electronically identifying cases with intraop absorbent changes (Figure). For each such case, we determined if the prior case had generated a change alert.

RESULTS: We evaluated 55 intraop absorbent replacements. An anesthesia tech alert to change the absorbent was ignored in 20 (36.4%) cases, whereas no alert was generated in 35 (63.6%). When the prior case did not exceed the rebreathing threshold and a canister change occurred during the next case, the duration of the following case was longer than when a prior alert was generated (5.9 ± 3.0 SD vs. 3.4 ± 2.8 SD hrs; P=0.0004; 2-sided Students t-test). Of the 20 ignored alerts, 16 (80%) occurred >3 pm, when our anesthesia tech coverage is reduced. 13/20 ignored alerts occurred during the last case of the day in the OR, resulting in intraop replacement during the first case of the next day.

CONCLUSIONS: The data indicate that our empirical alert thresholds to change the absorbent were too high. They also suggest a systems-based issue at the end of the day, possibly due to insufficient anesthesia tech coverage and/or lack of interest by providers who have no more cases to perform. We have lowered our alert thresholds, instituted a process where evening anesthesia techs can notify their colleagues to change out canisters prior to the start of the next day's cases, and educated our staff about the need to change the canister at the end of the day if they notice excessive rebreathing. Ongoing QA monitoring continues.

REFERENCES:

1. Sherman et al. Anesth Analg 2012;114:1088
2. McGain et al. Anesth Analg 2012:1134
3. Nair BG et al. Anesthesiology 2013;118:874



S-369.**REDUCTION IN SEVOFLURANE FGF FOLLOWING INTRODUCTION OF A LITHIUM-BASED CO₂ ABSORBENT****AUTHORS:** R. H. Epstein¹, D. P. Maguire¹, F. Dexter²**AFFILIATION:** ¹Anesthesiology, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, PA, ²Anesthesia, University of Iowa, Iowa City, IA

INTRODUCTION: Excessive fresh gas flow (FGF) during volatile anesthesia results in environmental pollution with greenhouse gases^{1,2} and increases the cost of administration. Minimum fresh gas flow (FGF) during sevoflurane (SEV) use is currently limited by package labeling to the larger of 1 l/min or 2 l/min once 2 MAC hours have been administered. The rationale for this restriction is that under low flow conditions, strong alkali-based CO₂ absorbents can produce clinically significant levels of carbon monoxide and Compound A (a toxic substance in animal studies). Lithium-based absorbents do not produce these compounds, eliminating the basis for the flow restriction. In May, 2014, we changed our absorbent to one such product (Litholyne[®], Allied Healthcare Products) and recommended to our staff via e-mail that 1 l/min flows could be used during the entire maintenance portion of cases without need to increase to 2 l/min. Monthly, personalized follow-up via e-mail to each staff was provided listing their mean FGF during the interval from surgery begin to end and their % deviation from the target FGF. We postulated that our feedback process would result in a reduction in SEV FGF.

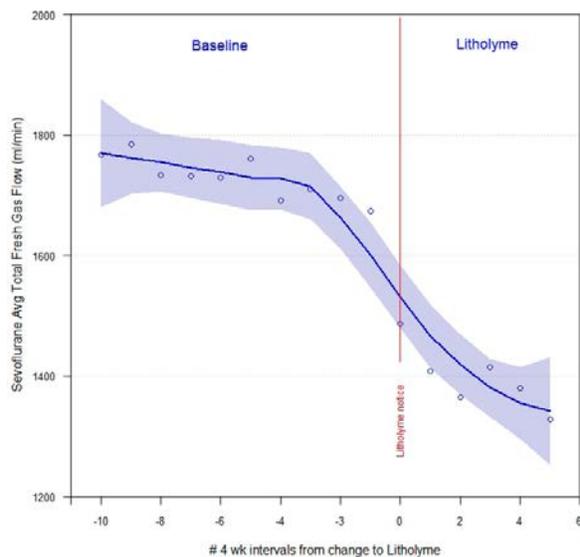
METHODS: In May 2013 we had established an average SEV FGF target of 2 l/min and began providing monthly e-mail reports to all anesthesia providers with their personal metrics. On May 6, 2014, we notified providers that we were reducing the target FGF to 1.25 l/min, consequent to changing all locations to the lithium-based CO₂ absorbent, and informing them that they did not need to increase the FGF to 2 l/min after 2 MAC hours of SEV had been administered. We captured the FGF between surgery begin and end from our anesthesia information management system during SEV use and calculated the average FGF, weighted by the total number of minutes of administration. Data were batched by four-week intervals and data were fit by a LOESS curve (span = 0.75), with calculation of a 99% uncertainty interval as estimated from the weighted polynomial least square fits around each of the data points. We compared the FGF following the change in absorbent to the 10 previous intervals by Student's t-test with unequal variances. The interval during which notification occurred was omitted from the analysis.

RESULTS: Compared to the baseline period, there was a reduction in FGF from 1700 ± 24 ml/min to 1372 ± 18 ml/min (Figure, P<0.0001).

CONCLUSIONS: Through use of a simple e-mail feedback process(3), we were able to substantially reduce the FGF during administration of SEV. However, although the trend of FGF continues to trend downward, our target of 1.25 l/min has not yet been reached. Monitoring and notifications continue as part of an ongoing quality improvement process.

REFERENCES

1. Sherman et al. Anesth Analg 2012;114:1086-90
2. McGain et al. Anesth Analg 20-12;114:1134
3. Anesth Analg 2014 [accepted for publication]



S-370.**THE EFFECTS OF ANESTHETIC AGENTS
ON PUPILLARY REACTIVITY**

AUTHORS: H. Ushio, K. Shirozu, H. Setoguchi, Y. Karashima, K. Tokuda, T. Fujiyoshi, S. Hoka

AFFILIATION: Anesthesiology, Kyushu University, Fukuoka, Japan

INTRODUCTION: Several electro-neurophysiological monitoring tools, for instance electroencephalogram and motor evoked potentials, are widely used to evaluate neural activity and to detect abnormality of neural system in clinical settings. The usage of these monitoring tools during perioperative period, however, has some limitations since neurophysiological activity is interfered by many anesthetic agents. Recently it has been reported that pupillary reactivity measured by quantitative pupillometer was useful in detecting neural damage due to intracranial lesions. Pupillary reactivity could detect elevation of intracranial pressure after traumatic brain injury and predict outcome of the patients. Although the measurement using quantitative pupillometer might be utilized during perioperative period, it remains unclear whether anesthetic agents, which potentially alter electrical activity in central nervous system, affect accuracy of the measurement. Here, we examine the effects of anesthetic agents on pupillary reactivity under anesthetized patients.

METHODS: After approval by the research committee, 16 patients scheduled for breast and thyroid surgeries were enrolled in this study. The Patients were divided into 2 groups and maintained anesthesia with respective anesthetic agents as follows: (A)propofol (2-3 μ g/ml) + remifentanil, and (B)sevoflurane (1MAC) + remifentanil. Pupillary reactivity was measured by NeurOptics®NPi™-100 pupillometer at 1) before induction of anesthesia, 2) five minutes after fentanyl(50 μ g) administration, 3) the time of muscle relaxant administration, 4) after intubation, 5) one hour after start of surgery, and 6) after extubation. Following parameters in both eyes were recorded: Maximum resting pupil size (MAX), minimum pupil size after stimulation by light (MIN), reduction pupil size ratio (%CH), latency duration (LAT), constriction velocity (CV), dilation velocity (DV) and neurological pupil index (NPi) calculated from described above parameters. Bispectral index (BIS) was also measured at each time points.

RESULTS: Both sevoflurane and propofol decreased MAX, MIN, %CH, CV and DV, respectively. On the other hand, LAT was not affected by sevoflurane or propofol. Sevoflurane decreased NPi (4.4 \pm 0.1 \rightarrow 3.7 \pm 0.2)during surgery while propofol did not(4.5 \pm 0.2 \rightarrow 4.2 \pm 0.4). There was no correlation between NPi and BIS.

CONCLUSIONS: It has been reported that NPi value less than 3 indicated increase of intracranial pressure. Although sevoflurane decreased NPi, reduced value was within normal range. Therefore, even though patients were anesthetized with either propofol and remifentanil or sevoflurane and remifentanil, NPi value under 3 would indicate serious intracranial concerns.

S-371.

EFFECT OF NOISE ON ANESTHESIA RESIDENT PERFORMANCE IN AN OPERATING ROOM SIMULATOR

AUTHORS: R. R. McNeer¹, C. L. Bennett², N. Nedeff³, R. Dudaryk¹

AFFILIATION: ¹Anesthesiology, University of Miami Miller School of Medicine, Miami, FL, ²Music Engineering Technology, University of Miami, Coral Gables, FL

INTRODUCTION: Noise has been reported to adversely affect performance of anesthesia residents¹. We decided to test this hypothesis under more controlled and realistic conditions by conducting experiments in an operating room (OR) simulator capable of reproducing high-fidelity OR soundscapes. The results and interpretation of this study are preliminary, but point to the intriguing possibility that music can delay detection of gradual changes in heart rate (HR).

METHODS: Anesthesia residents were randomized into either quiet or noisy groups for the first of two sessions (Fig 1). A week later they were exposed the other condition in session 2. Sessions involved giving simulated lunch breaks. Six custom emergency scenarios designed to play through a custom graphical user interface (GUI) that also annunciated alarms and pulseoximeter, were embedded in the lunch breaks. During experiments, residents entered information about patient state change detection, differential, and desired therapy or intervention in the GUI which had a text box which time-stamped and logged text responses. Global Rating Scale (GRS) and Crisis Management Checklist (CMC) instruments were adapted for this study (Figs 2 and 3) and completed by two blinded experts who rated performance based on subject entries. Group differences were analyzed using nonparametric testing.

RESULTS: Twenty residents were enrolled. Among the six scenarios, between-subjects differences in performance ratings obtained with the GRS were significant for the ‘hypovolemia’ scenario; subjects exposed to noise scored lower on the GRS relative to those exposed to quiet (P = 0.023) (Fig 4).

CONCLUSION: The ‘hypovolemia’ scenario used in this study differed from the other five by featuring an insidious increase in HR up to just below 100bpm, and no audible alarms were triggered until a low blood pressure reading was displayed minutes later. Background music was a component of the noise exposure in this experiment, and we hypothesize that the tempo of the music masked the detection of the slow increases in HR. Subjects exposed to noise detected the increase in HR, formulated their differential and initiated therapy later than those exposed to quiet. The results presented here are preliminary findings and the hypothesis that music can mask detection of changes in HR needs to be tested in further experiments. Since music is usually present during surgeries and the pulseoximeter pulse tone is heavily relied upon in patient monitoring, the results and hypothesis presented here to explain them may have a positive impact on efforts to mitigate the adverse effects of noise in the OR.

REFERENCES:

1. Murphy VS, et al. Auditory functions in anaesthesia residents during exposure to operating room noise. Indian J Med Res 1995;101:213-6.

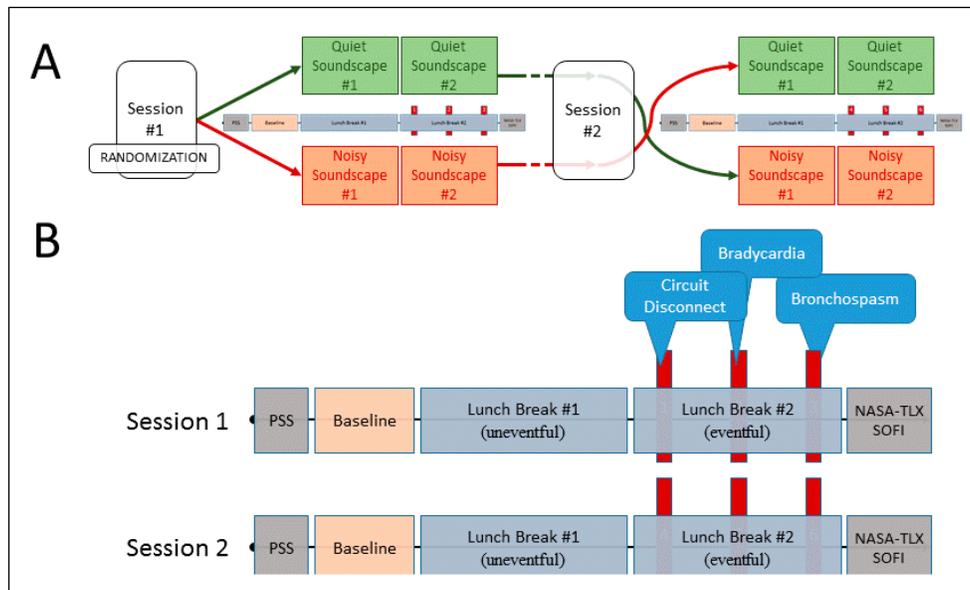


Figure 1

S-371 • continued

SUBJECT STARTING SCORE (6 points)	YES (2 points)	MARGINAL (1 point)	NO (0 points)
STATE CHANGE DETECTION			
Timely/prompt detection			
Complete detection			
Missed detection (negative points)			
SITUATIONAL AWARENESS			
Complete/correct differential			
Prioritized differential list			
Reassesses situation			
One or more incorrect diagnoses (negative points)			
THERAPY/RESOURCE UTILIZATION			
Timely therapy			
Prioritized actions			
Appropriate therapy/action			
One or more inappropriate actions (negative points)			
This area to be filled in by Investigator only:		Subject: _____	
Scenario (circle one):	Circuit Disconnect	Bradycardia	Endo/Bronchospasm
	Hypovolemia	Pulmonary Embolism	Light Anesthesia

Figure 3. Crisis Management Checklist used to rate subject performance.

S-371 • continued

OVERALL PERFORMANCE						
1	2	3	4	5	6	7
Poor			Satisfactory		Excellent	
<hr/>						
I. STATE CHANGE DETECTION						
1	2	3	4	5	6	7
Missed or incorrect detection of state changes			Detection of state changes but either somewhat incomplete or delayed		Prompt and correct detection of state changes	
<hr/>						
II. SITUATIONAL AWARENESS						
1	2	3	4	5	6	7
Incorrect or absent differential			Prioritized and relevant, but either somewhat incomplete or delayed differential		Prioritized, relevant, complete, and timely differential	
<hr/>						
III. THERAPY/RESOURCE UTILIZATION						
1	2	3	4	5	6	7
Missing or incorrect/inappropriate therapy or actions			Reasonable actions but possibly disorganized order, incomplete, or somewhat delayed implementation		Timely and correct actions implemented in appropriate/organized order	
<hr/>						
SUBJECT PERCEPTION OF CRISIS RESOLUTION						
1	2	3	4	5	6	7
Subject felt crisis <u>was not</u> resolved			Subject felt crisis <u>was somewhat</u> resolve		Subject felt crisis <u>was</u> resolved	
<hr/>						
This area to be filled in by Investigator only:			Subject: _____			
Scenario (circle one):		Circuit Disconnect	Bradycardia	Endo/Bronchospasm		
		Hypovolemia	Pulmonary Embolism	Light Anesthesia		

Figure 3. Global Rating Scale used to rate subject performance.

S-371 • continued

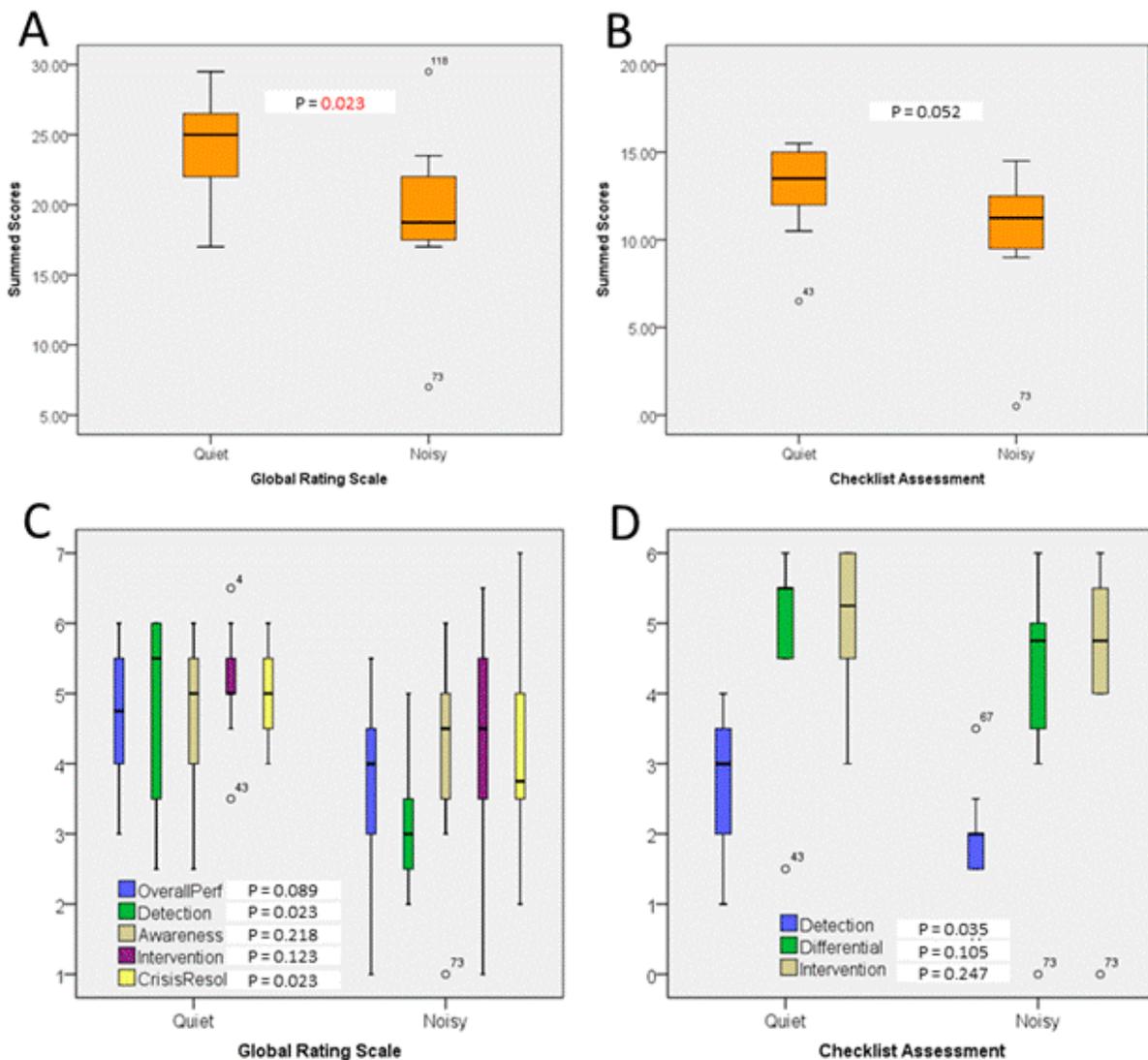


Figure 4. Boxplots of between-subjects comparisons of performance in the 'hypovolemia' scenario as measured by the Global Rating Scale (GRS) and Crisis Management Checklist in quiet and noise. Differences between groups were significant for the GRS.

S-372.

ACOUSTICAL ANALYSIS OF HIGH-FIDELITY AUDIO REPRODUCTION IN AN OPERATING ROOM SIMULATOR

AUTHORS: R. R. McNeer¹, A. L. Ayers², R. Dudaryk¹, C. L. Bennett²

AFFILIATION: ¹Anesthesiology, University of Miami Miller School of Medicine, Miami, FL, ²Music Engineering Technology, University of Miami, Coral Gables, FL

INTRODUCTION: Healthcare simulation is increasingly being used for training, assessment and hypothesis testing. Current simulators realistically simulate clinical environments, patients and associated equipment and monitors. However, attempts to simulate clinical auditory environments are lacking, and current simulators lack the native capability to render immersive clinical soundscapes. Noise in settings such as the operating room (OR) is reported to negatively impact provider health and performance and patient safety¹. Here, we test the feasibility of simulating a soundscape that is representative of the actual OR environment. We also report results of an acoustical analysis of this setup we refer to as NOISE (Noisy OR Immersive Simulation Environment).

METHODS: Four audio speakers were placed in the corners of a fully functional OR simulator and connected to an audio interface (Fig 1). Typical sound sources were recorded from a clinical OR. Pulseoximeter and alarm sounds were not included. Music editing software was used to design multiple discrete audio channels which were routed to the four speaker array creating a quadraphonic (surround sound) soundscape. The pulseoximeter and alarm sounds were generated separately by a computer using a custom program that also presented patient and machine parameters to the workstation monitor display (Fig 2). Soundscape, alarms and soundscape plus alarms were recorded in the OR simulator. Sound pressure levels (SPL) were calculated from these recordings to obtain equivalent continuous sound level (LAeq) and peak sound level (LApeak) in decibels (A scale). SPLs were also calculated as a function of frequency and time.

RESULTS: Qualitative feedback from individuals exposed to soundscapes was favorable. The LAeq was similar between soundscape plus alarm (76.5 dB) and our clinical ORs (76.0 dB, unpublished) (Table 1). There were no significant masking effects of soundscape on alarm sound signals indicating that alarms would remain audible during simulation experiments in the current configuration (Fig 3).

CONCLUSION: Noise pollution is increasingly identified as a significant clinical problem in hospitals and especially ORs. However, interventional clinical trials are difficult to conduct out of concern for patient safety and because of the difficulty in controlling for real-world complexity present in operating suites. OR simulators offer a safer and more controlled setting to test hypotheses and interventions. Unfortunately current OR simulators do not realistically simulate the auditory environment. Our NOISE simulator is an important step toward filling this gap. We have reported the use of NOISE in investigating effects of noise on anesthesia resident perceived fatigue, physiologic response and performance during simulated crises (reported elsewhere). Other potential applications include use of NOISE in simulation-based skill training and assessment, clinical team building and group dynamics.

1. Katz, J. Noise in the operating room. *Anesthesiology* 2014;121:894-8.

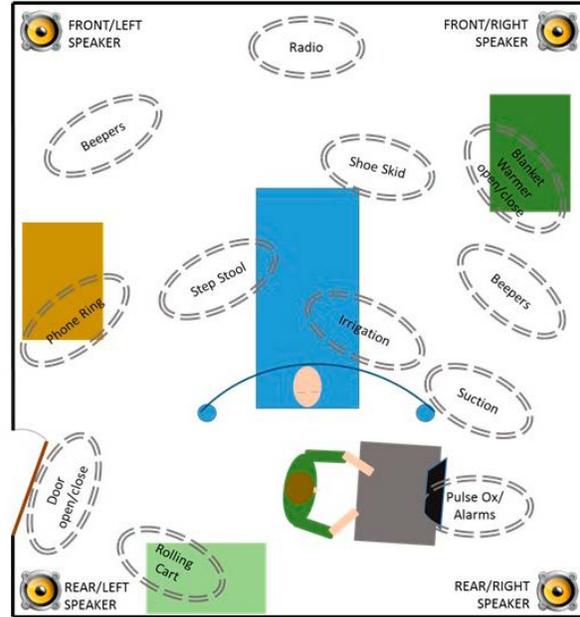


Figure 1. Schematic showing the general layout of the sound sources incorporated in the quadraphonic soundscape relative to the subject, mannequin, workstation and speakers.



Figure 2. Custom graphical user (GUI) interface application run from the anesthesia workstation computer. Pulse-oximeter tone and audible alarms were also generated through the GUI.

S-372 • continued

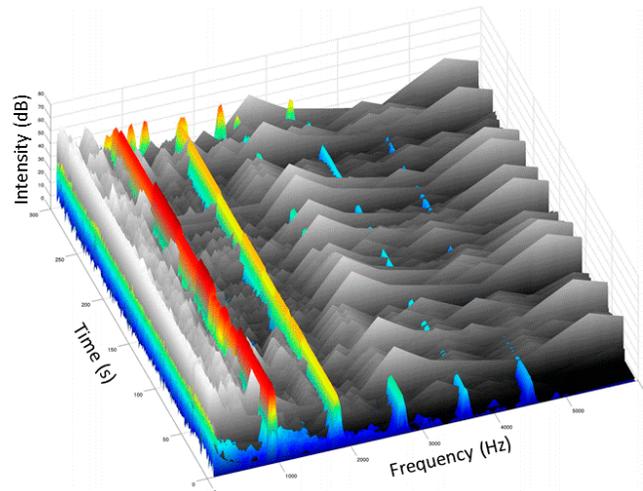


Figure 3. Graph showing sound level as a function of time and frequency. The color plot shows the alarms and pulse-oximeter sounds, while the gray plot shows the masking level of the background noise in the soundscape. The main harmonics of the alarms at about 1000Hz and 2000Hz are not masked by the background levels and therefore remain audible.

	dB LA _{eq}	dB LA _{peak}
Alarms Only	72.2	84.3
Soundscape Only	74.1	93.1
Soundscape + Alarms	76.5	93.1
Orthopedic Case Average	76.0	110.1

Figure 4

S-373.

CHARCOAL FILTERS ARE THE MOST COST-EFFECTIVE METHOD TO PREPARE ZEUS DRAGER ANESTHESIA WORKSTATIONS FOR MALIGNANT HYPERTHERMIA SUSCEPTIBLE PATIENTS

AUTHORS: V. M. Neira¹, K. George², W. Al Madhoun³, N. Barrowman⁴, K. Nolan¹

AFFILIATION: ¹Anesthesiology, University of Ottawa. Children’s Hospital of Easte, Ottawa, ON, Canada, ²Anesthesiology, University of Ottawa. Children’s Hospital of Eastern Ontario, Ottawa, ON, Canada, ³Engineering, University of Ottawa., Ottawa, ON, Canada, ⁴Statistics, University of Ottawa. Children’s Hospital of Eastern Ontario Research Institute, Ottawa, ON, Canada

INTRODUCTION: Malignant hyperthermia (MH) is a potentially lethal pharmacogenetic disease triggered by potent volatile anesthetics (VA) and/or succinylcholine. Anesthesia workstations (anesWs) require preparation for MH susceptible patients (MHS).¹ There is limited information about preparation of Zeus Drager (ZD) AnesWs for MHS.² The objective of this study was to perform a cost-effectiveness analysis of three methods of preparation for MHS in the ZD AnesWs.

METHODS: Three ZD AnesWs were used to study the washout profile of the VA (sevoflurane (Sevo), isoflurane (Iso) and desflurane (Des)). Each anesWs was primed at 1.2 MAC for 2 h using fresh gas flow (FGF) of 2 Lpm, adult circuits and ventilatory parameters. A MIRAN portable ambient gas analyzer was used to determine concentration of the VA during the washout periods. VA concentrations ([VA]) washout profiles were studied in three groups. G1: change disposables (breathing circuit, soda lime, CO2 line, water traps) and washout with a FGF of 10 Lpm to reach a [VA] below 5 ppm for 20 min, then FGF was decreased to 3 Lpm for another 20 min. G2: Same as group 1 plus replacing the breathing system (BS) with an autoclaved one. G3: Same as group 1 but adding two activated charcoal filters (ACF) on the breathing circuit.

Primary outcome: Time to obtain [VA] below 5ppm in each group. Secondary outcomes: 1. Peak rebound [VA] after decreasing FGF to 3 Lpm and 2. In G3, peak rebound [VA] after removal ACF after 90 min. Cost Analyses Institutional OR per minute and sterilization costs was estimated in US\$ 22.00 and US\$60.00 respectively.^{4,5} Retailer prices for the ZD (US\$100,000.00) and BS (US\$7,500.00) were depreciated in 7 and 1 years respectively, assuming one MHS case per week. Estimated cost of preparation for one MHS was performed for each group.

RESULTS: Analysis for the primary outcome found significant differences between groups (p= 0.000). G1 had the longest time for all VA (more than 80 min), followed by G2 (more than 10 min) and the lowest was G3 (Less than 1 min) (Table 1, Fig 1). Analysis of the secondary outcome identified a rebound effect in all groups (p=0.003), G1 and 2 reached [VA] more than 5 ppm (Table 2). Group 3 demonstrated rebound effect after removing the ACF with [VA] less than 10 ppm (p=0.000). There were no significant differences for the primary or secondary outcomes between VA within each group. The cost analysis considered MHAUS recommended options.⁶ Time to prepare the anesWs seems to be the most important factor for the cost. ACF seems to be the most cost effective method of preparation of the ZD. Replacing the BS and spare “vapor free” anesWs have similar costs. G1 is the least cost effective method of MHS preparation for ZD (Table 3).

CONCLUSIONS: ZD anesWs preparation for MHS requires a prolonged washout time. Charcoal filters seem to be the most cost effective and safe alternative to prepare ZD AnesWs for MHS patients. In order to assure that 95% of ZD are “VA free” the longest mean washout time per group plus 2 SD should be considered. Sterile BS may require up to 25 min washout time, and only changing disposables 130 min with FGF 10 Lpm washout and during the case.

Table 1. Zeus Drager Anesthesia Workstation Washout Profiles of Volatile Anesthetics Using Three Met

Experiment	Volatile Anesthetic	Time to 5 ppm Mean (SD)
Group 1	Sevoflurane	80.00 (11.27)
	Isoflurane	82.33 (12.10)
	Desflurane	105.00 (11.13)
Group 2	Sevoflurane	11.33 (6.11)
	Isoflurane	16.00 (2.00)
	Desflurane	10.00 (4.80)
Group 3	Sevoflurane	0
	Isoflurane	0
	Desflurane	0

Table 2. Effect of decreasing FGF from 10 Lpm to 3 Lpm

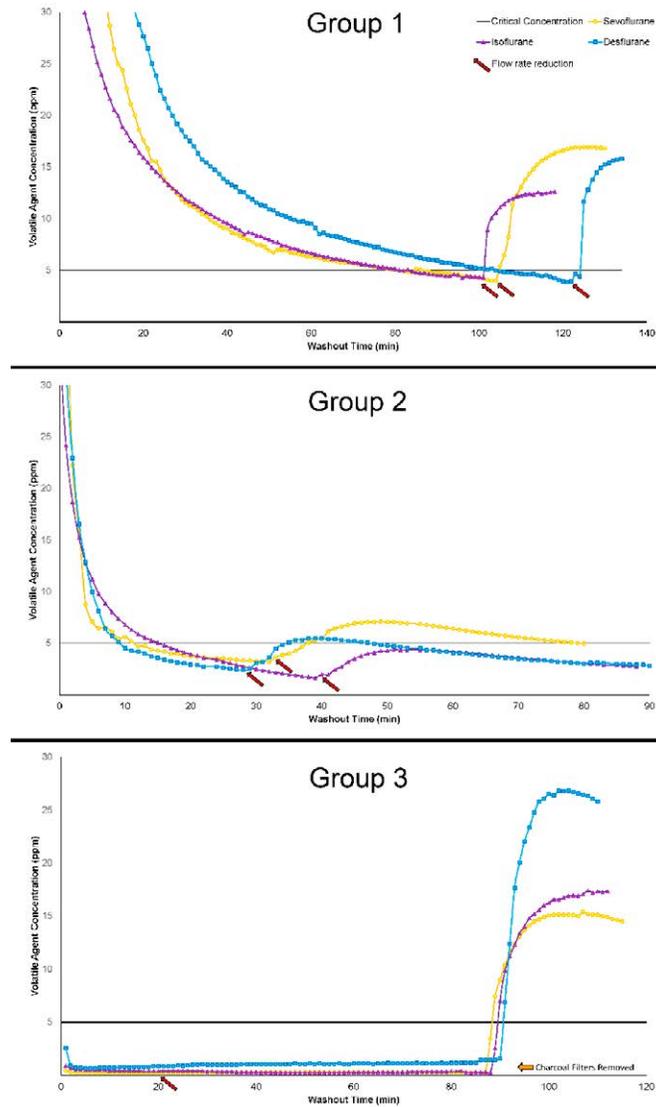
Experiment	[VA] FGF 10 Lpm Mean (SD)	Peak [VA] FGF 3 Lpm Mean (SD)	p	Peak [VA] after ACF removal Mean (SD)	p
Group 1	3.90(4.45)	15.17 (3.69)	0.000	N/A	N/A
Group 2	2.49(0.92)	5.80 (1.51)	0.000	N/A	N/A
Group 3	0.48(0.33)	0.75 (0.60)	0.046	19.82 (6.78)	0.000

Table 3 Estimated Cost per MHS case using Different Method of Preparation

Item	Group 1	Spare Anesthesia Workstation	Group 2	Group 3
Disposables	68.00	68.00	68.00	68.00
Change Time	220.00	660.00	220.00	220.00
Washout Time	2,860.00		550.00	22.00
Depreciation/ Replacement		275.00	144.23	
Sterilization			60.00	
Activated Charcoal Filters				79.00
Total Cost	3,148.00	1,003.00	1,042.23	389.00

S-373 • continued

Figure 1 Zeus Drager Anesthesia Workstation Washout Profiles of Volatile Anesthetics Using Three Methods of Preparation for Malignant Hyperthermia Susceptible Patients.



The washout profile of Sevoflurane (yellow), Isoflurane (purple) and desflurane (blue) in three Zeus Drager anesthesia workstations was investigated after priming at 1.2 MAC for 2h in three groups. (See methods for details). Significant differences between groups (Anova $p=0.000$). No significant differences between anesthetics within groups. Rebound effect after FGF decrease to 3 Lpm significant in all groups ($p=0.000$). Significant rebound after ACF removal in group 3 ($p=0.000$).

S-374.

MASIMO RADICAL-7 PULSE CO-OXIMETER AS A PREDICTOR OF FLUID RESPONSIVENESS TO HEMOHES HES 200/0.5 COMPARED WITH VOLUVEN HES 130/0.4 AND HEMAGEL IN MAJOR SURGERIES

AUTHORS: S. H. Omar¹, M. A. Youssef¹, K. G. Radwan¹, A. S. El Hadidy¹, M. M. Hussein¹, M. F. Mahmoud², M. I. Youssef²

AFFILIATION: ¹Anesthesia, Theodor Bilharz Research Institute, Cairo, Egypt, ²Anesthesia, Faculty of Medicine-Cairo University, Cairo, Egypt

BACKGROUND: Masimo Plethysmographic Variability Index PVI was introduced as safe noninvasive fluid management guide. Volume expansion is a challenge in major surgeries targeting optimizing patient status while avoiding adverse effects of hypo- or hypervolemia¹. The study principle aim was to compare efficacy and safety of PVI using Masimo, Radical-7 pulse co-oximeter, against invasive central venous pressure (CVP), as fluid responsiveness predictor in major abdominal surgery. The second aim was to compare haemodynamic response to variable colloid therapies, Voluven (HES130/0.4) Hemagel with Hemoheh (HES200/0.5) using PVI².

METHODS: Sixty patients scheduled for elective major surgery were randomly allocated into three groups. Group H received Hemoheh, Group V Voluven and Group G Hemagel. Preoperatively CVP was inserted and maintained at 5 cmH2O by administration of fluids or by giving furosemide. In addition to standard crystalloid fluid management guided by PVI, 200ml of Voluven, Hemoheh or Hemagel was given when PVI >13, repeated every 10 minutes until PVI ≤13. Hemodynamic variables [heart rate, mean arterial pressure, central venous pressure and (PVI) data] with urine output were recorded immediately before induction (T0), when PVI >13 (T1), when PVI ≤ 13 (T2). T2 comprised 3 subgroups according to number of colloid boluses (T2a after first bolus, T2b after second and T2c after third bolus) and T3 at end of surgery. Frequency of intravenous colloid administered was recorded. Time elapsed between T1 and T2 was recorded in each group. Results were expressed as means ± standard deviation (SD) or number (%). Comparison between numerical data in the three studied groups was performed using ANOVA with post-hoc LSD test. Comparison between numerical data within the same group relative to baseline was performed using repeated measures ANOVA with post-hoc Bonferroni test. Comparison between numerical data between T1 and T2 within the same group was performed using paired t test. Comparison between categorical data was performed using Chi-square test.

Correlation between different variable was performed using Pearson correlation coefficient test. Data were considered significant at p ≤ 0.05 and highly significant if p< 0.01. Statistical analysis was performed with SPSS computer program (version 16 windows).

RESULTS: In all studied groups there was significant drop in PVI at T2 compared to T1 which was in correlation significantly with the simultaneous rise in CVP at T1 p<0.01 in all groups, while at T2 p<0.01 in group G and H and in group V p<0.05 . Volume required for expansion from T1 to T2 was significantly less for H (100% single bolus), compared to G (70% single, 10 % double , 20% triple) and V (70% single and 30% double) p<0.01. Time lapsed for expansion between T1 and T2 was significantly shorter in group H compared to G p<0.05

CONCLUSION: Masimo is an efficient safe non-invasive monitor for volume expansion responsiveness in major surgeries. HES 200/0.5 proved to be more efficient colloid regarding volume used and time lapsed.

REFERENCES :

1. Clin Colon Rectal Surg. 2009;22(1):28-33
2. Eur J Anaesthesiol. 2010 Jun;27(6):555-61

S-375.

THE RISK FACTORS FOR ARTERIAL LINE INACCURACY DURING GENERAL ANESTHESIA: A RETROSPECTIVE OBSERVATIONAL COHORT STUDY

AUTHORS: K. Minami, Y. Sugiyama, H. Iida

AFFILIATION: Department of Anesthesiology and Pain Medicine, Gifu University hospital, Gifu, Japan.

BACKGROUND: Invasive arterial pressure monitoring is widely used in the operating room during general anesthesia, but arterial line inaccuracy (AI), arterial cannula kinking or overdamping of the pressure waveform, is often experienced. We retrospectively investigate the risk factors for AI during general anesthesia.

METHOD: Between April 2014 and September 2014, 435 patients undergoing surgery with general anesthesia and being inserted invasive arterial pressure monitoring via radial artery were enrolled. Patient characteristics, risk factors for atherosclerosis, characteristics of operator who inserted the arterial catheter were collected. AI was defined as a difficulty in blood drawing or an overdamping of the pressure waveform. Patients with AI during surgery were defined as group AI+, and without as AI-. Univariate analyses to compare the two groups were performed with two-tailed unpaired t test for continuous variables and chi-square test for categorical variables. The variables that emerged with p values of less than 0.2 were included in multiple logistic regression models with stepwise model selection. P value less than 0.05 was considered as statistically significant. Statistical analyses were performed with SPSS software Ver. 11.0.1J (IBM SPSS Inc., Chicago, IL, USA).

RESULT: AI occurred in 96 patients (22%). Univariate analyses identified weight, body mass index (BMI), needle type, and an arterial line inserted by resident as risk factors for AI (Table 1). Multivariate analysis identified BMI and an arterial line inserted by resident as risk factors for AI (Table2).

CONCLUSION: The result of the present study identified that patient's BMI and an arterial line inserted by resident as risk factors for AI.

Table 1. The results of univariate analyses.

Risk factor	AK+ (n=96)	AK- (n=339)	p value	Odds ratio	95% CI
Age	63.3 ± 14.2	60.7 ± 16.8	0.124		
Male sex	50 (52%)	171 (50%)	0.818	0.936	0.60-1.47
Weight	60.7 ± 14.3	57.3 ± 13.1	0.037		
Height	159.5 ± 9.8	159.1 ± 9.9	0.689		
Body mass index	23.7 ± 4.3	22.5 ± 3.7	0.011		
Number of attempts	1.50 ± 0.96	1.38 ± 0.75	0.252		
Needle type insight™ / angiocath™	35 / 61	180 / 159	0.005	1.973	1.24-3.15
Hypertension	49 (51%)	135 (40%)	0.061	1.575	0.99-2.48
Inserted by resident	63 (66%)	159 (47%)	0.001	2.161	1.35-3.47

Table 2. The results of multivariate analysis.

Risk factor	Odds ratio	95% CI	p value
Body mass index	1.076	1.016 - 1.141	0.013
Inserted by resident	3.128	1.802 - 5.431	0.000

S-376.

EVALUATION OF A NEWLY DEVELOPED MONITOR OF DEEP BODY TEMPERATURE

AUTHORS: S. Tachibana¹, N. Hirata¹, M. Yamakage²

AFFILIATION: 1Department of Anesthesiology, Sapporo Medical University, School of Medicine, Sapporo, Japan, 2Department of Anesthesiology, Sapporo Medical University, School of Medicine, Sapporo, Japan.

INTRODUCTION: Core temperature is usually monitored in the ear, rectum, or bladder. However, these temperatures often poorly reflect the real values and changes of the central body core temperature. Fox and Solman 1) first described the use of an electronic servo-controlled system to achieve almost complete thermal insulation. Although the monitoring of deep body temperature is noninvasive, clinical application of the monitor is limited by the slow response time for rapid internal temperature changes and by the big and hard probe 2). Recently, equipment used for deep temperature monitoring has been improved with release of a new instrument (Spot On™; 3M, St. Paul, MN). We therefore evaluated this monitor in comparison with esophageal temperature during general anesthesia.

METHODS: This study was approved by our hospital's ethical committee on human research, and informed consent was obtained from each patient. Ten ASA physical status 1 or 2 adult patients who required general anesthesia for surgery on the body surface were enrolled in this study. The ambient temperature was maintained at 23.0°C and the ambient relative humidity at 40% during the study period. After admission into operation rooms, an i.v. catheter was inserted into the antecubital vein on the left arm, and bicarbonated Ringer's solution at room temperature was infused at 5 mL•kg-

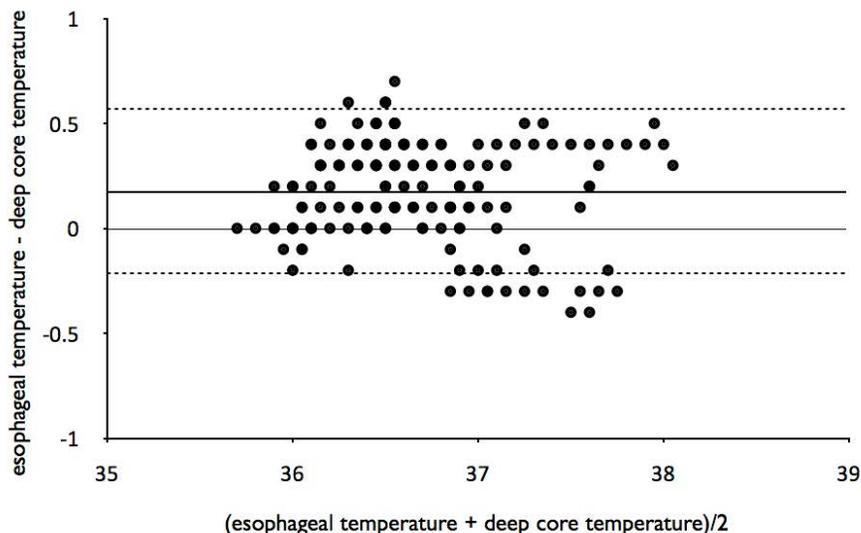
1•hr-1. Anesthesia was induced by 1-2 mg•kg-1 propofol with 0.9 mg•kg-1 rocuronium, and the trachea was intubated. Anesthesia was maintained with 1.5% sevoflurane in air (2 L•min-1) and oxygen (1 L•min-1) with some doses of fentanyl. Immediately after anesthetic induction, an esophageal temperature probe was inserted to a depth of approx. 30 cm from the mouth and taped in place, which was taken to represent the core temperature, was monitored continuously during the operation. A probe of a newly developed core temperature monitor (Spot On™) was also placed on the patient's forehead. The position of the probe (left or right) was randomized. The measured temperatures were recorded in a personal computer every 5 min. Statistical analysis was performed by Bland-Altman analysis.

RESULTS: We obtained 388-point data from 10 enrolled patients, and there were no complications related to the site of probe on the forehead. Figure 1 shows the Bland-Altman plot comparing esophageal and forehead deep temperatures. The average temperature measured with the forehead deep temperature was 0.20°C below the esophageal temperature with ±0.48°C 2 SD.

CONCLUSIONS: Bland-Altman analysis of temperature data obtained from patients during general anesthesia revealed that temperature measurements obtained by the newly developed deep temperature monitor Spot On™ could be reliable for core temperature monitoring. This would be more precise compared with the conventional one (CM-210™; Terumo Co., Tokyo, Japan²). Because this device is noninvasive, core temperature can also be measured before the induction of anesthesia as well as during monitored anesthesia care.

REFERENCES:

1. Fox RH, Solman AJ: J Physiol 1971; 212: 8-10.
2. Yamakage M, et al: J Anesth 2002; 16:354-7.



S-377.

RELATIONSHIP BETWEEN OXYGEN RESERVE INDEX AND ARTERIAL PARTIAL PRESSURE OF OXYGEN DURING SURGERY

AUTHORS: R. Applegate¹, I. Dorotta¹, P. Applegate², G. Andrews¹, M. Olson¹, M. H. Um¹

AFFILIATION: ¹Anesthesiology, Loma Linda University School of Medicine, Loma Linda, CA, ²Cardiology, Loma Linda University School of Medicine, Loma Linda, CA

INTRODUCTION: The relationship between arterial oxygen partial pressure (PaO₂) and oxygen saturation (SaO₂) is not linear. In normal humans, pulse oxygen saturation (SpO₂) is ~100% for all PaO₂ >75 mmHg and thus not able to provide warning of impending desaturation until PaO₂ <75 mmHg, below which the slope of SaO₂ to PaO₂ decrease is steep. Multiple wavelength pulse co-oximetry can be used to detect SpO₂, carboxyhemoglobin, methemoglobin, and total hemoglobin (Hb). Engineering advances have provided an index of oxygen reserve during hyperoxia (PaO₂ 100 – 240 mmHg) called the oxygen reserve index (ORI). While SpO₂ will not change at PaO₂ >100 mmHg, falling ORI may detect declines in PaO₂ between 240 and 100 mmHg and could provide early warning of impending desaturation events. We evaluated the relationship between ORI and PaO₂ during surgery.

Methods: Data was obtained from IRB approved studies of consenting patients undergoing surgery in which arterial catheterization was planned. Multiwave pulse co-oximetry data (Radical-7, Masimo, Irvine, CA) was continuously monitored and collected to computer (multiple sensors per patient) and later processed for intraoperative ORI. Regression analysis was used to compare PaO₂ from clinically indicated arterial blood gas samples to ORI and calculated changes in ORI (ΔORI) to calculated changes in PaO₂ (ΔPaO₂).

Results: 1540 ORI samples from 103 patients (Table) during a total of 2377 monitored hours was analyzed; ORI could be calculated ~91.5% of monitored time. ORI and PaO₂ values were positively correlated for PaO₂ ≤ 240 mmHg (r² = 0.59), but not for PaO₂ >240

mmHg (r² = 0.002; Fig 1). PaO₂ was ≥150 mmHg in 96.5% of ORI >0.54 (Fig 2A). PaO₂ was >100 mmHg for all ORI >0.24 (Fig 2B).

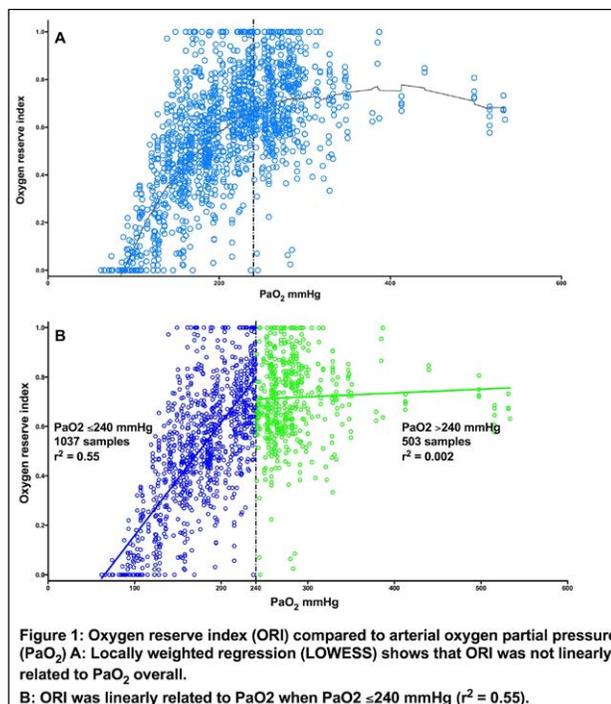
For the PaO₂ ≤240 mmHg subset: ΔORI was positively correlated with ΔPaO₂ (r²=0.43; Fig 3). For PaO₂ changes at least ±30 mmHg, decrease in ORI was 92.8% sensitive and 84.8% specific for decrease in PaO₂. Hb was not related to ORI (r² = 0.06) overall.

Conclusions: For intraoperative PaO₂ between 240 and 100 mmHg, decrease in ORI appears to provide a clinically useful indication of falling PaO₂ before desaturation. Our ability to evaluate the potential utility of ORI and ΔORI when PaO₂ is between 60 and 100 mmHg is limited by the small number of samples obtained in such events. An ORI decrease to near 0.24 (Fig 2) may provide early warning of declining PaO₂ approaching 100 mmHg (Fig 4; e.g. during procedures that mandate apnea or one lung ventilation; during difficult intubation; trauma patients with pulmonary contusion or massive resuscitation). Further research is needed to clarify the role of ORI in the perioperative period. The ability to detect PaO₂ ≥150 mmHg by ORI >0.54 may prove useful for titrating FiO₂. Additionally, use of this technology could allow for early detection of impending hypoxia in the critical care setting, particularly in patients with congestive heart failure, which would lead to more rapid treatment and possibly mitigate the need for intubation and mechanical ventilation.

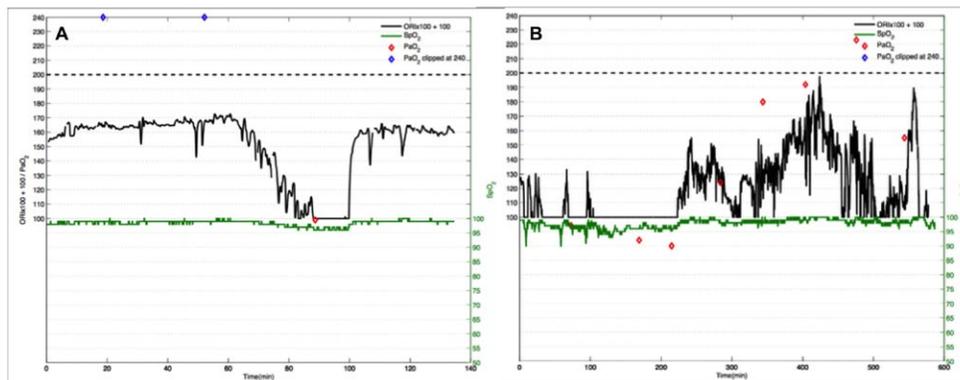
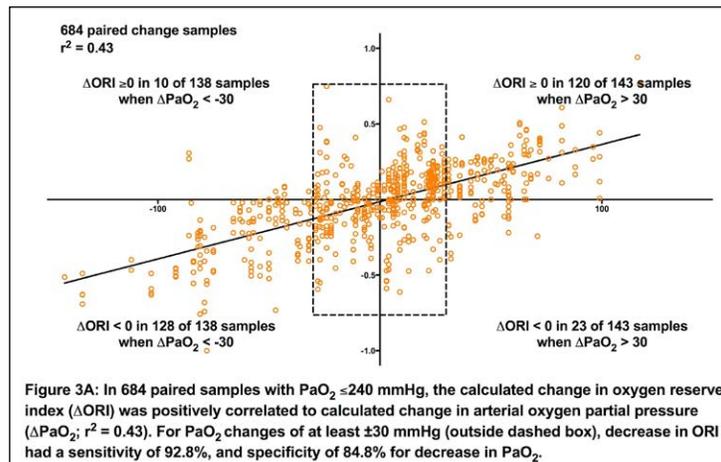
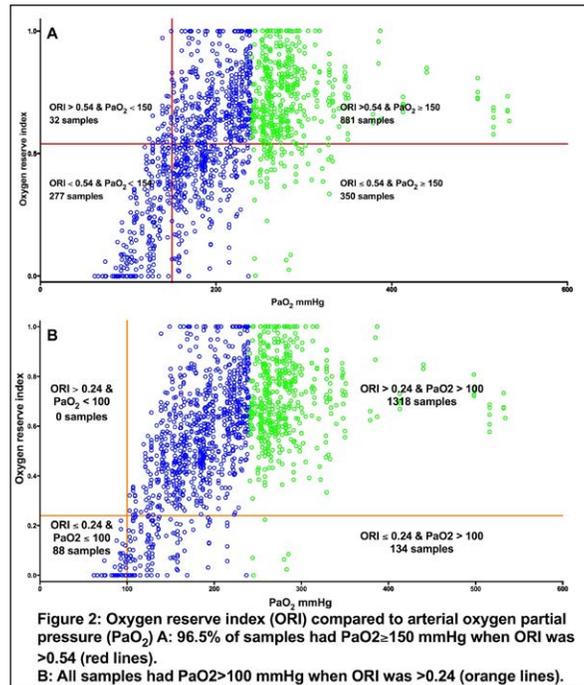
Table: Patient Characteristics

Gender # (%) Female	50 (48.5%)
Age years range	54.0 ± 21.0 9 to 86
Body mass index kg/m ²	27.8 ± 8.4
Intraoperative ABG samples #	4.1; 3.7 to 4.5
Intraoperative hemoglobin g/dL	10.5 ± 2.1 5.2 to 17.3

Continuous data given as mean ± standard deviation or median; 95% confidence interval



S-377 • continued



S-378.

WITHDRAWN.

S-379.**CLOSED LOOP RESUSCITATION OF AN OVINE MULTI HEMORRHAGE MODEL USING FUZZY LOGIC, PROPORTIONAL INTEGRAL AND DECISION TABLE CONTROLLERS****AUTHORS:** N. Ribeiro Marques¹, B. Ford¹, M. Kinsky¹, M. Khan¹, M. Salter¹, H. Ying², G. Kramer¹**AFFILIATION:** ¹Anesthesiology, University of Texas Medical Branch, Galveston, TX, ²Electrical and Computer Engineering, Wayne State University, Detroit, MI**BACKGROUND:** Hemorrhagic shock often occurs in the first hours after major trauma and is a leading cause of trauma-related mortality. Prompt hemostasis and restoration of adequate blood volume and blood pressure for end-organ perfusion are the treatments of choice.¹ Arterial blood pressure (ABP) is often the best endpoint variable to guide early resuscitation. Different ABP target are needed to ensure cerebral perfusion pressure after traumatic brain injury² or hypotensive resuscitation of an internal uncontrolled bleeding³. In the present study we compared the performance of three closed loop algorithms that directed infusion of fluids to restore and maintain mean arterial pressure to a target level. We conducted a performance comparison of closed-loop fluid resuscitation of a hemorrhaged sheep model using a decision table (DT), proportional-integral (PI) controller and fuzzy logic (FL) controller. The primary objective was to assess effectiveness, the ability to maintain blood pressure on target, and efficiency, the amount of fluid required.**METHODS:** Studies were performed on 15 conscious sheep. Animals were instrumented with femoral artery and vein catheters, flow probe on the common pulmonary artery, and central venous catheter on external jugular vein. Seven days later the animals were submitted to a hemorrhagic protocol of 35 ml/kg over three separate bleeds. All events are referenced to the start of the first hemorrhage, T = 0 minutes. The first hemorrhage of 25 ml/kg was performed over 15 minutes (T = 0 to 15 min). Closed-loop resuscitation was started at T = 30 minutes. The second and third bleeds were 5 ml/kg over 5 minutes starting at T = 50 and T = 70 minutes, respectively. The fluid resuscitation was implemented for 3 automated closed-loop treatments (5 sheep per group): DT, PI controller and FL controller. All algorithms were designed to restore and maintain a MAP of 80 mmHg by controlling the infusion rate of Lactated Ringer's.**RESULTS:** FL and PI algorithms restored MAP before the second hemorrhage and only FL group was able to increase MAP to target before and after the third hemorrhage. DT effectiveness was unsatisfactory and was not able to restore MAP at any time during the study, Figure 1. However, the better control with FL and PI came at the cost of greater volume requirements. FL was more efficient than PI, utilizing less fluid and improving MAP. The total volume infused was 26 ml/kg for FL, 30 ml/kg for PI and 22 ml/kg for DT. The percentage of time that MAP was within 5, 10, 15, and 20 mmHg from target was greater for FL and PI groups, Figure 2.**CONCLUSION:** Continuous assessment of ABP and adjustment every 5 second of the infusion rate using either FL or PI algorithm were effective at restoring MAP during a multi-hemorrhage model.**REFERENCES:**

1. Early fluid resuscitation in severe trauma. *BMJ* 2012;345:e5752.
2. Guidelines for prehospital management of traumatic brain injury, 2nd edition. Brain trauma foundation 2nd edition, 2007.
3. Fluid resuscitation in trauma patients: what should we know? *Curr Opin Crit Care* 2014;20:444-450.

S-380.**SIMULATION MANIKIN MODIFICATIONS FOR HIGH FIDELITY TRAINING OF ADVANCED AIRWAY PROCEDURES**

AUTHORS: J. Hirsch¹, J. R. Generoso², C. Klopovic², R. Latoures², R. L. Fidler¹

AFFILIATION: ¹Anesthesia Service, UCSF-San Francisco VAMC, San Francisco, CA, ²Simulation Center, UCSF-San Francisco VAMC, San Francisco, CA

INTRODUCTION: Advanced airway maneuvers, such as fiberoptic intubation, insertion of double lumen tubes or endobronchial blockers, provide a challenge in anesthesia training¹⁻³. Complications from incorrect use can be devastating⁴, while mastery may be life-saving in trauma and surgery. There is currently no simulation manikin available to train these maneuvers. Current manikins provide bronchial tree fidelity down to the carina, with straight tubes in lieu of main bronchi and no further representation of the bronchial tree. This is insufficient for the training of many advanced airway situations especially in thoracic anesthesia, such as dislodging of a double lumen tube during patient positioning, intubation of the main stem bronchus, and bronchoscopic evaluation of tube or bronchial blocker position.

METHODS: Using commercially available parts from other training systems, a Laerdal ALS Simulator manikin (Laerdal USA, Wappingers Falls, NY, #205-05050) was modified by adding bronchial trees down to the fourth generation (Fig. 1). The bronchial tree modules (Laerdal # 381130) were inserted distally from the manikin's carina (Fig. 2). The air from the modules was captured in ventilation reservoir bags. These were mechanically restricted in size and connected with the manikin ventilation system using silicone tubing. This allowed maintaining the full functionality of the breathing, auscultation, cricothyrotomy and chest tube insertion features, as well as the electronic manikin ventilation sensors.

RESULTS: Overall cost of the modification was \$695, time for completion was two hours. The modified ALS Simulator allowed mask ventilation, orotracheal and nasotracheal intubation by direct and video laryngoscopy and fiberoptic bronchoscopy. Endotracheal tubes up to 8.0 mm could be inserted and combined with endobronchial blockers (Arndt, Cohen, Univent) (Fig. 3). Blockers were positioned into lobar bronchi under fiberoptic guidance. Left and right 35 Fr double lumen tubes could be inserted (Fig. 4) and their position verified fiberoptically (Fig. 5) and by auscultation. The simulator could be connected to a ventilator for double and single lung ventilation and typical rescue maneuvers (CPAP to the non-ventilated lung). Other procedures trainable with the modified manikin were insertion of a regular endotracheal tube in the left main bronchus⁵ and the fiberoptic exchange of a 37 Fr Combitube for an endotracheal tube⁶. Use of the simulator is now a regular part of training for first year anesthesia residents.

CONCLUSION: The cost-effective and straightforward modification using commercially available parts transformed the ALS Simulator into a high fidelity tool for task training and simulation scenarios of many procedures that are necessary in thoracic anesthesia and emergency situations.

REFERENCES:

1. Dalal PG. *Can J Anaesth.* 2011 Sep;58(9):802
2. Marsland C. *Br J Anaesth.* 2010 Mar;104(3):375-81
3. Ovassapian A. *Br J Anaesth.* 1988 Aug;61(2):217-20
4. *Anesth Analg.* 2000 Jun;90(6):1458-9
5. Gaitini LA. *Anesth Analg.* 1999 Jan;88(1):193-6
6. Bair AE. *Acad Emerg Med.* 2004 Oct;11(10):1105-7

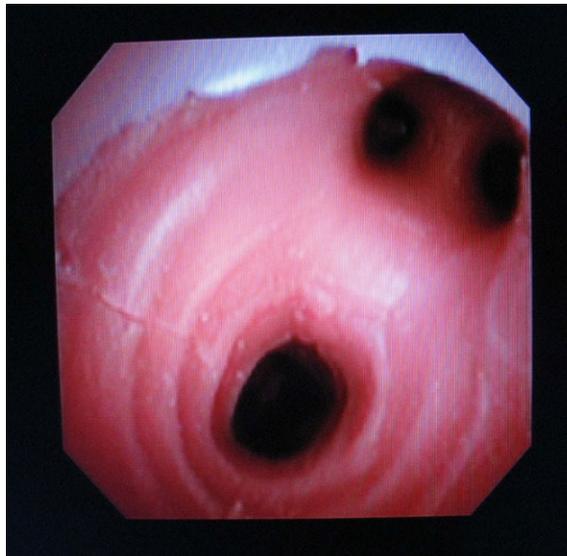


Figure 1

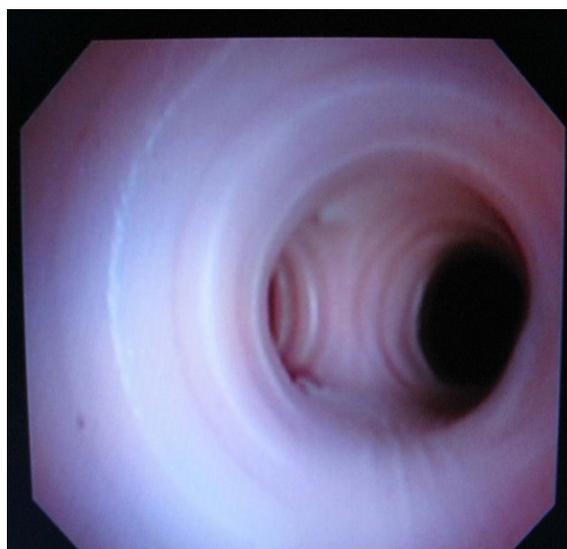


Figure 2



Figure 3

S-380 • CONTINUED ON NEXT PAGE

S-380 • continued



Figure 4

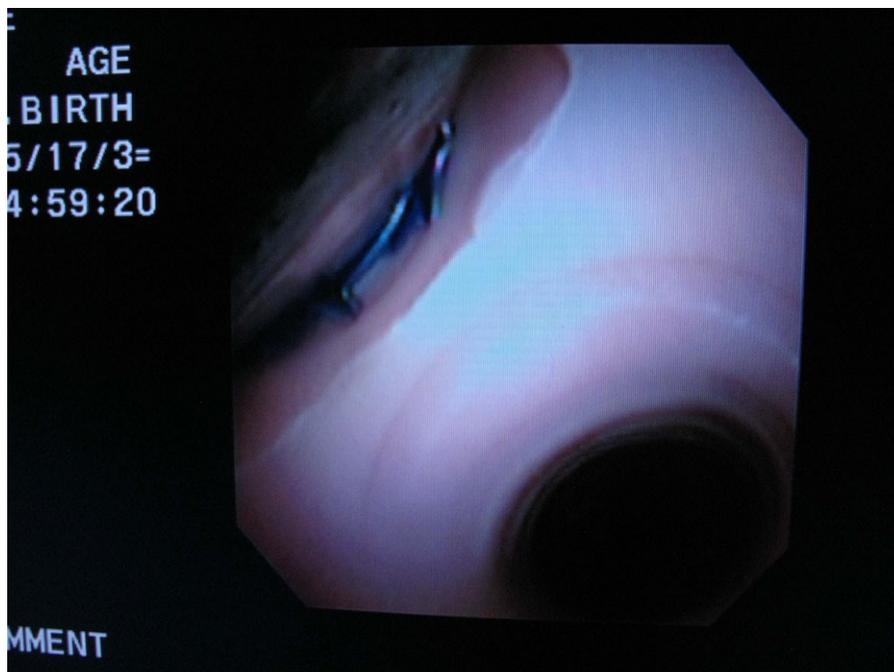


Figure 5

Subspecialty Abstracts

Trauma

S-381.

WITHDRAWN.

S-382.**DEVELOPMENT OF A NATIONAL RECOMMENDATION ON OUT-OF-HOSPITAL EMERGENCY ANESTHESIA****AUTHORS:** B. Hossfeld¹, M. Bernhard²**AFFILIATION:** ¹Department of Anesthesiology and Intensive Care Medicine, German Armed Forces Hospital Ulm, Ulm, Germany, ²Emergency Department, University of Leipzig, Leipzig, Germany.*on behalf of the out-of-hospital anesthesia working group collaborators****INTRODUCTION AND GENERAL PURPOSE OF THE STUDY:** Inducing anesthesia to facilitate intubation of the trachea in an out-of-hospital emergency setting is an important therapeutic intervention in a physician based EMS-system. In the German EMS-system only a minority of EMS-physicians are anesthesia trained. Currently there are no recommendations how to perform anesthesia in an out-of-hospital emergency.**METHODS:** Coordinated by the German Society on Anesthesiology and Intensive Care Medicine (DGAI) 14 authors formulated recommendations how to perform anesthesia in an out-of-hospital emergency setting based on available evidence in the literature. Initial results were discussed several times in a standardized delphi-method and reviewed by the DGAI emergency medicine study group.**RESULTS:** The out-of-hospital anesthesia working group recommend the following: Prior to out-of-hospital induction of anesthesia patient-, scene- and operator-specific factors need to be considered. Every spontaneously breathing emergency patient should receive pre-oxygenation for at least 4 min with high-flow oxygen and a tight-sealing facemask, or an oxygen-demand valve. Prior to induction of prehospital emergency anesthesia, secure peripheral IV or IO access is mandatory. Parallel to pre-oxygenation the standardized preparation process includes preparation and labeling drugs/syringes, checking the bag-valve mask, preparing the endotracheal tube with a stylet and blocking syringe, as well as having a stethoscope and material to secure the tube at hand. It also includes immediate access to alternative means of airway management, as well as a suction unit, ventilator, and monitoring devices including capnography. Basic monitoring for prehospital emergency anesthesia includes EKG, automatic NIBP, and pulse oxymetry. Continuous capnography is used to confirm ventilation, to detect possible disconnections/dislocations, and for hemodynamic monitoring. As there is a wide spectrum of possible drugs to induce anesthesia the authors add possible examples for special out-of-hospital situations and diagnoses (e.g. multi system trauma, cardiac failure).**CONCLUSIONS:** This national recommendation provides a standard for how to perform emergency anesthesia in an out-of-hospital setting, primarily benefiting non-anesthesia-trained physicians.**REFERENCES:**

1. Braun P, Wenzel V, Paal P. Anaesthesia in prehospital emergencies and in the emergency department. *Curr Opin Anesthesiol* 2010; 23: 500-506
2. Cook T, Behringer EC, Bengner J. Airway management outside the operating room: hazardous and incompletely studied. *Curr Opin Anesthesiol* 2012; 25: 461-269
3. Cowan GM, Burton F, Newton A. Prehospital anaesthesia: a survey of the current practice in the UK. *Emerg Med J* 2012; 29: 136-140

This national recommendation does not claim to be complete: important subjects such as the out-of-hospital anesthesia of children have not yet been integrated into the guideline, but there are plans to include them in the next revision.

S-383.**HYPEROXIC RESUSCITATION IMPROVES SURVIVAL BUT WORSENS NEUROLOGIC OUTCOME IN A RAT POLYTRAUMA MODEL OF TRAUMATIC BRAIN INJURY PLUS HEMORRHAGIC SHOCK****AUTHORS:** G. Fiskum**AFFILIATION:** Anesthesiology, University of Maryland School of Medicine, Baltimore, MD

INTRODUCTION: Many traumatic brain injury (TBI) victims suffer from additional injuries, including those that result in hemorrhagic shock (HS), which negatively impact neurologic outcome. Interactions between HS and TBI can include reduced brain O₂ delivery, resulting in partial cerebral ischemia. While supplemental O₂ may improve O₂ delivery to the brain and other organs, excessive oxygenation can result in oxidative stress, secondary tissue injury, and worse outcomes. This study tested the hypothesis that inspiration of 100% O₂ during resuscitation following TBI and HS in rats improves survival, reduces brain lesion volume and improves neurologic outcome compared to what occurs in the absence of supplemental O₂.

METHODS: The adult male rat polytrauma model consisted of controlled cortical impact (CCI)-induced TBI followed by 30 min of HS (MAP = 35-40 mm Hg) induced by blood withdraw. The HS phase was followed by a one hr "Pre-Hospital" Hextend fluid resuscitation phase and then a one hr "Hospital Phase" when shed blood was re-infused. Rats were randomized on the day of surgery to 4 groups with 10 rats per group: A. Sham Normoxic. B. Sham Hyperoxic. C. Polytrauma Normoxic. D. Polytrauma Hyperoxic. Normoxic animals inspired room air and Hyperoxic animals inspired 100% O₂ during both resuscitation phases. Neurobehavioral tests were conducted weekly until the rats were perfused with fixative at 30 days post injury. Brain sections were stained with Fluorojade B (FJB) and used for quantification of contusion plus penumbral lesion volumes. P<0.05 was considered significant.

RESULTS: Survival was greater following hyperoxic compared to normoxic resuscitation (84 vs 57%). Composite neuroscores were higher with normoxic resuscitation at 3 weeks (32±0.5 vs 29±0.6) and balance beam foot faults were lower with normoxic resuscitation at 2 weeks (0.6±0.2 vs 1.9±0.3). There was no difference in cortical neuropathology between the Normoxic and Hyperoxic groups.

CONCLUSIONS: The survival of rats following CCI plus HS was greater following hyperoxic resuscitation. In contrast, neurologic outcomes were better following normoxic resuscitation. A study employing a mouse CCI plus HS polytrauma model found that hyperoxic resuscitation improved hippocampal neuronal survival at 7 days post-injury but also depleted brain levels of the antioxidant ascorbate, and increased brain inflammatory cytokine levels¹. Two recent retrospective clinical studies found worse neurologic outcomes and increased mortality in hyperoxic TBI patients^{2,3}; however, there were no attempts to differentiate between isolated TBI and polytrauma. Prospective clinical trials are needed to resolve this important issue.

REFERENCES:

1. Effect of hyperoxia on resuscitation of experimental combined traumatic brain injury and hemorrhagic shock in mice. *Anesthesiology*. 2013 118:649-663
2. Association between early hyperoxia and worse outcomes after traumatic brain injury. *Arch Surg*. 2012 147:1042-1046
3. Normobaric hyperoxia is associated with increased cerebral excitotoxicity after severe traumatic brain injury. *Neurocrit Care*. 2014 epub Aug 29

Resident Abstracts

Airway Management

S-400.

VALIDATION OF A NOVEL TECHNIQUE FOR LMA INSERTION: A RANDOMIZED COMPARISON OF LARYNGEAL MASK AIRWAY INSERTION METHODS INCLUDING A NEW EXTERNAL LARYNX LIFTING – INFLATING AIR (ELLIA) TECHNIQUE ON POSTOPERATIVE PHARYNGOLARYNGEAL COMPLICATIONS

AUTHORS: O. S. Leavitt, R. J. McCarthy, L. Hu

AFFILIATION: Anesthesiology, Northwestern University, Chicago, IL

INTRODUCTION: Postoperative pharyngolaryngeal complications (PC) have been reported in up to 50% of patients following laryngeal mask airway (LMA) insertion¹. A variety of methods including limiting cuff pressure², rotating 90 degrees,³ pre-inflating vs not pre-inflating the cuff⁴ have been investigated in searching for ways to decrease PC. After induction, the larynx drops with gravity which may contribute to difficulty in placement of LMAs. The novel External Larynx Lifting-Inflating Air (ELLIA) method was designed to avoid collision of LMA with laryngeal structures thereby decreasing airway trauma. The purpose of this study was to validate the safety of LMA insertion via the ELLIA technique. The primary outcome was the composite PC of sore throat, dysphagia and dysphonia.

METHODS: LMA Unique is routinely used at our institution and was used in all subjects. Subjects were randomized to one of three insertion method groups: 1) classic insertion technique as recommended in manual + deflated LMA, 2) classic insertion + pre-inflated volume from manufacturer, 3) novel ELLIA method. In ELLIA group, a pre-inflated LMA was first placed above patient’s tongue, stopping when increased resistance occurred. Then, operator’s left hand lifted the larynx against gravity while pressure was applied with right hand on LMA until sudden lost of resistance was felt. Cuff pressures were adjusted to a leak pressure of 20 cm H₂O. LMA was removed without deflating the cuff to avoid suctioning. N₂O was avoided. Blinded PC assessments on a 0 to 100 scale were made at 1, 2 and 24 hours. A score >0 in any PC assessment was considered positive.

RESULTS: 441 subjects were studied. Clinical characteristics, types of procedures, surgical duration, perioperative narcotic usage, recovery and home discharge times were similar among groups. There was no difference in the incidence of PC among groups: G1-57%, G2-55%, G3-52%, (P=0.77) (Table 1). Logistic regression identified female gender, blood on LMA, neck circumference, LIMPA-LIMBA, total LMA time, and cuff pressure as predictors of PC. Classification tree analysis determined LMA time of >95 min and cuff pressure over 78 cmH₂O as significant cutoff values. LMA insertion times were similar; however, blood on the LMA was less frequently observed in G3 compared with G1 and G2 in aggregate.

CONCLUSIONS: ELLIA method is equivalent in efficiency to classic methods as evidenced by similar insertion times. No difference in PC was observed among insertion methods confirming the validity of ELLIA as an alternative LMA insertion technique that does not create additional complications. Using the ELLIA technique was associated with a lower incidence of blood on the LMA at removal. Given that blood on LMA was identified as one of predictors for PC and ELLIA technique resulted in less blood on cuff, it is possible that a larger study may show decreased PC with ELLIA method.

REFERENCES:

1. Anesthesiology 2010; 112: 652-7.
2. Anesthesiology 1997; 87:63-7
3. Can J Anesth 2010; 57: 211-5.
4. Anaesthesia 1999;54:444-53

Table 1

	LMA insertion method			P
	Deflated cuff (n=147)	Pre-inflated cuff (n=145)	ELLIA (n=149)	
Composite PC	83 (57)	80 (55)	78 (52)	0.77
Sore throat	71 (48)	71 (49)	67 (45)	0.76
Dysphagia	45 (31)	38 (26)	34 (23)	0.32
Dysphonia	39 (26)	31 (21)	25 (17)	0.12
Insertion time (s)	54 (49 - 67)	54 (44 - 65)	56 (46 - 65)	0.12
Neck circumference (cm)	38 (34 - 41)	38 (35 - 41)	38 (34 - 41)	0.81
Female	58 (39)	60 (41)	67 (45)	0.62
Blood on LMA	26 (18)	24 (17)	13 (9)	0.05
Cuff pressure (cm H ₂ O)	120 (65 - 120)	120 (65 - 120)	120 (76 - 120)	0.82
LIMPA-LIMBA angle	24 (17 - 30)	24 (18 - 29)	24 (18 - 31)	0.76

Data presented as median (IRQ) or n(%)

† = ELLIA versus composite of deflated cuff and pre-inflated cuff, P=0.02

S-401.

QUALITY AUDIT REVEALS ENDOTRACHEAL TUBE CUFF INFLATION PRESSURES WELL ABOVE RECOMMENDED RANGE

AUTHORS: T. Armour¹, S. Dhillon²

AFFILIATION: ¹School of Medicine, Virginia Commonwealth University, Richmond, VA, ²Anesthesiology, Virginia Commonwealth University, Richmond, VA

INTRODUCTION: The fingertip estimation technique for evaluating endotracheal tube cuff inflation pressure involves palpation of the firmness of the pilot balloon by the anesthesia provider and has been reported to result in pressures outside the recommended range of 20-30mmHg. Pressures below the recommended range increase the risk of aspiration while those above it lead to progressive occlusion of tracheal blood flow and may result in damage to surrounding structures. This is supported by both endoscopic and histologic evidence of tissue malperfusion and injury. This study was undertaken as a quality audit at an institution where the fingertip estimation technique predominates. The goal was to establish the distribution of current cuff inflation pressures ahead of an effort to introduce manual cuff manometry to the operating room environment.

METHODS: A single auditor measured the endotracheal tube cuff inflation pressure on 62 intubated patients over a period of six days using a hand held manometer. Data collection was limited to patient age and gender, operative procedure, anesthesia attending, and assigned resident/CRNA. Providers were informed of the manometer readings at the time they were taken, reminded of the recommended range, and invited to make adjustments using the manometer at their discretion. A variable of particular interest, measurement number, was derived from the data and represents the number of patients previously assessed for a given provider.

RESULTS: Mean age across the 62 patients was 53.5 years (range 16-81, SD 15.4) and 42% were male. Providers included 25 attendings and 32 residents/CRNAs. Surgeries included 17 abdominal, 17 thoracic, 9 back, 7 head, 5 extremity, 4 pelvic, and 3 neck procedures. The mean cuff pressure across all patients was 74mmHg (range 24-120+, SD 28.8) and included eight (13%) readings where the pressure exceeded the upper limit (120mmHg) of the manometer. Five (8%) cases were within the recommended range of 20-30mmHg. Figure 1 shows the remainder of the distribution.

The weighted mean drop in pressure across sequential measurements was 2.5mmHg among attendings and 14.2mmHg among residents/CRNAs.

CONCLUSIONS: As has been previously reported, the fingertip estimation method of assessing endotracheal tube cuff inflation pressures is unreliable and in this case resulted in mean pressures far in excess of the recommended range. Of particular interest is the finding that attending providers seemed to be more resistant to changing their practice than did residents or CRNAs as evidenced by serial measurement. Whether this discrepancy is due to personal preferences or idiosyncratic patterns that become engrained after years of practice, it represents a known entity that must be overcome when introducing seasoned providers to changes in standard institutional practice. It would be imprudent to simply inform providers of unsafe practice without follow-up assessment to ensure changes have in fact occurred.

Figure 1: Case count by cuff inflation pressure range

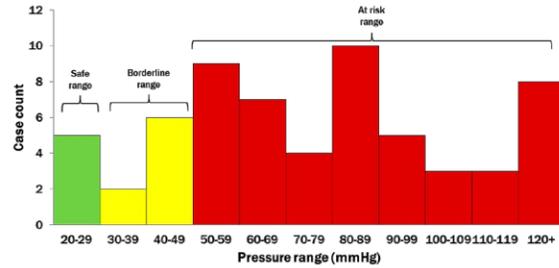


Figure 2: Effect of repeated measurement on mean cuff inflation pressure among attending anesthesiologists

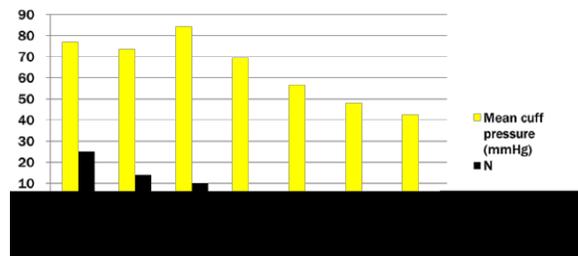
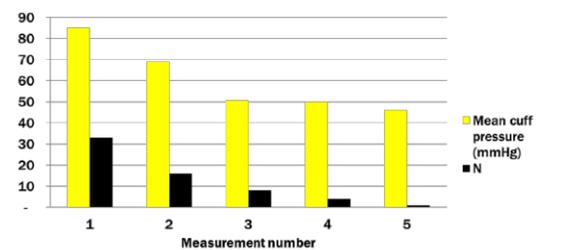


Figure 3: Effect of repeated measurement on mean cuff inflation pressure among residents and CRNAs



S-431.**IMPROVING THE SETUP FOR AWAKE FIBEROPTIC INTUBATION: LEAN METHODOLOGY'S APPLICATION IN THIS COMPLEX MEDICAL PROCEDURES****AUTHORS:** A. B. Lyons, W. A. Weigel;**AFFILIATION:**Anesthesiology, Virginia Mason Medical Center, Seattle, WA.

ABSTRACT: Background: Businesses around the world have embraced lean methodology as a means to reduce waste and improve efficiency without compromising quality. Significant variability amongst anesthesia providers in technique, equipment used, and success when performing an awake fiberoptic intubation (AFOI) is not uncommon at our institution. There is a paucity of scientific literature that describes how the setup for a complex medical procedure, like an AFOI, can be simplified, standardized and made more reliable using a manufacturing philosophy such as lean methodology. The goal of this project was to create a standard process using both lean methodology and literature supporting best practice for AFOI, which would allow for the efficient and accurate setup of equipment necessary to perform an AFOI.

METHODS: AFOI simulations were performed prior to the application of lean methodology. An evidence-based user-friendly AFOI protocol was then drafted by a group of attending anesthesiologists. Using this protocol, a multidisciplinary team refined the AFOI setup process over a period of two days; all ideas were considered and trialed with ongoing feedback from end-users. Simulations were again performed at the conclusion of this two-day event. The total time, non-value-added time and accuracy of each AFOI setup was measured in a group of 20 anesthesia technicians; this consisted of 20 timings before and 20 timings after the implementation of lean methodology [post-timing data is preliminary].

RESULTS: The mean setup time for an AFOI in a group of 20 anesthesia technicians before and after the application of lean methodology was 23 minutes and 12 minutes respectively. This process resulted in a 50% reduction in an AFOI setup time. The accuracy of the equipment setup was also improved by 90%. The changes incurred by this project were well received by the end-users in our department who adopted its implementation.

CONCLUSIONS: Application of lean methodology significantly improved both the efficiency and accuracy of an AFOI. These improvements were primarily a result of materials and equipment standardization as well as waste reduction in anesthesia technician movement. Lean methodology can be effectively used to simplify the setup necessary to perform complex medical procedures such as an AFOI.

Resident Abstracts

Ambulatory Anesthesia

S-403.

TRENDS IN THE PROVISION OF ANESTHESIA FOR CATARACT SURGERY IN THE UNITED STATES AMBULATORY SETTING

AUTHORS: I. Rabizadeh¹, N. Godwin², G. Munguba³, N. Landy², J. Banta⁴, D. Landy⁵, K. E. Fischler²

AFFILIATION: ¹Anesthesiology, University of Miami, Miller School of Medicine, Miami, FL, ²Anesthesiology, University of Miami/Jackson Memorial Hospital, Miami, FL, ³Miller School of Medicine, University of Miami/Jackson Memorial Hospital, Miami, FL, ⁴Ophthalmology, Bascom Palmer Eye Institute, Miami, FL, ⁵Orthopedic Surgery, University of Chicago Medical Center, Chicago, IL

INTRODUCTION: Cataract, a clouding of the eye’s lens, is a leading cause of visual impairment in the United States (US).¹ Cataract removal is among the most common surgical operations in the US with more than one million cases performed annually since the 1990’s (Table 1). Despite this frequency, there is no standard anesthesia practice and few clinical trials to guide recommendations. We sought to describe trends in the provision of anesthesia for cataract surgery in the US ambulatory setting.

METHODS: Data from the 1996 and 2006 administrations of the National Survey of Ambulatory Surgery, a nationally representative survey of ambulatory surgical facilities in the US, was analyzed using survey statistics procedures in SAS to describe the types of anesthesia used for cataract surgery. Patients less than 20 years old or undergoing procedures other than phacoemulsification with aspiration of a cataract and insertion of intraocular lens were excluded. Predictors of anesthesia use including sex, age, facility type, and expected payer were examined.

RESULTS: From 1996 to 2006, the provision of systemic anesthesia increased from 69% to 88% with MAC increasing from 48% to 66% while use of IV and general anesthesia remained stable. At the same time, the use of invasive forms of local anesthesia decreased from 35% to 19% including retrobulbar blocks from 16% to 12% and peribulbar blocks from 13% to 5%. Topical anesthesia was provided for 41% of cases in 1996 and 48% of cases in 2006 (Table 2). Anesthesia providers are increasingly involved in these procedures (Table 3). There was little to no association between either age or sex and anesthesia. However, freestanding ambulatory surgery centers were more likely to use retrobulbar and peribulbar anesthesia as well as IV anesthesia than hospital-based centers and less likely to use general anesthesia (Table 4).

CONCLUSIONS: There is significant variation in the provision of anesthesia for cataract surgery. There has been a trend towards increased use of systemic anesthesia, primarily MAC, with a decrease in the use of invasive forms of local anesthesia. This variation appears independent of patient age and sex but is associated with the type of ambulatory surgical center. While complications are rare, the high volume of cases performed annually would mean that even small risk reductions could result in significant gains for the population. Additionally, consideration of costs and provider experience may also be relevant to guiding decision making.

REFERENCES

1. Ko, Fang, et al. Prevalence of Nonrefractive Visual Impairment in US Adults and Associated Risk Factors, 1999-2002 and 2005-2008. JAMA: The Journal of the American Medical Association, 2012; 308 (22): 2361.

Table 1: Characteristics of adult ambulatory surgery patients undergoing phacoemulsification with aspiration of a cataract by NSAS sample year.

Characteristic	1996 (N*=1,148,682) N (%)	2006 (N*= 1,620,039) N (%)
Sample Year		
Sex		
Female	716,168 (62%)	716,168 (62%)
Male	432,514 (38%)	432,514 (38%)
Age, years		
20-64	195,077 (17%)	333,517 (21%)
65-74	394,819 (34%)	566,415 (35%)
75-84	451,116 (39%)	595,864 (37%)
>84	107,670 (9%)	124,243 (8%)
Facility		
Hospital-based	730,280 (64%)	827,034 (51%)
Freestanding	418,402 (36%)	793,005 (49%)
Expected Payer		
Medicare	870,278 (78%)	1,197,333 (74%)
Private	193,133 (17%)	328,016 (20%)
Medicaid	27,649 (2%)	35,519 (2%)
Other/Unknown	22,584 (2%)	57,369 (4%)
Surgery Time, minutes		
<16	--	842,415 (52%)
16-30	--	582,330 (36%)
31-60	--	134,520 (8%)
>60	--	19,720 (1%)
Missing	--	41,054 (3%)

* Weighted frequencies are presented, with the 1996 and 2006 samples having included 10,119 and 3,724 subjects, respectively.

Table 2: Anesthesia by NSAS sample year.

Anesthesia	1996 (N*=1,148,682) N (%)	2006 (N*= 1,620,039) N (%)
Sample Year		
MAC	548,125 (48%)	1,072,289 (66%)
IV	376,403 (33%)	535,260 (33%)
General	20,892 (2%)	47,017 (3%)
Topical	467,242 (41%)	785,148 (48%)
Retrobulbar	185,447 (16%)	188,420 (12%)
Peribulbar	147,107 (13%)	82,726 (5%)
Block	68,685 (6%)	38,438 (2%)
Other / Not Specified	49,152 (4%)	56,323 (4%)

S-403 • continued

Table 3: Anesthesia provider by NSAS sample year.

Provider		
Sample Year	1996 (N*=1,148,682) N (%)	2006 (N*= 1,620,039) N (%)
Anesthesiologist	361,102 (31%)	620,383 (38%)
Nurse Anesthetist	277,774 (24%)	500,920 (31%)
Surgeon/Physician	87,348 (8%)	88,189 (5%)
Anesthesiologist + Nurse Anesthetist	186,663 (16%)	113,144 (7%)
Anesthesiologist + Surgeon/Physician	70,475 (6%)	120,827 (7%)
Nurse Anesthetist + Surgeon/Physician	5,354 (<1%)	60,423 (4%)
Other/Unknown	159,966 (14%)	108,053 (7%)

Table 4: Logistic regression models by NSAS sample year.

MAC Predictors		
Sample Year	1996 OR (95% C.I.)	2006 OR (95% C.I.)
MAC Predictors		
Female vs. Male	1.03 (0.89-1.18)	0.95 (0.75-1.20)
Age increase 1 year	1.00 (0.99-1.01)	1.00 (0.99-1.02)
Freestanding vs. Hospital-based	0.98 (0.87-1.11)	0.80 (0.63-1.01)
Medicare vs. Private	0.99 (0.94-1.05)	1.02 (0.94-1.10)
IV Predictors		
Female vs. Male	0.98 (0.84-1.15)	0.88 (0.70-1.12)
Age increase 1 year	0.99 (0.98-1.00)	1.00 (0.98-1.01)
Freestanding vs. Hospital-based	1.61 (1.40-1.84)	3.74 (2.88-4.86)
Medicare vs. Private	1.03 (0.96-1.09)	0.95 (0.88-1.03)
General Predictors		
Female vs. Male	1.14 (0.61-2.13)	1.87 (0.94-3.71)
Age increase 1 year	0.97 (0.94-1.01)	1.02 (0.98-1.07)
Freestanding vs. Hospital-based	0.48 (0.28-0.83)	0.22 (0.11-0.44)
Medicare vs. Private	0.92 (0.75-1.14)	0.80 (0.64-0.99)
Topical Predictors		
Female vs. Male	0.92 (0.80-1.07)	1.02 (0.81-1.29)
Age increase 1 year	1.00 (0.99-1.01)	1.00 (0.99-1.02)
Freestanding vs. Hospital-based	0.76 (0.67-0.87)	2.03 (1.62-2.54)
Medicare vs. Private	1.00 (0.94-1.06)	0.99 (0.92-1.07)
Retrobulbar Predictors		
Female vs. Male	1.02 (0.87-1.20)	0.84 (0.60-1.16)
Age increase 1 year	1.00 (0.99-1.01)	1.00 (0.98-1.02)
Freestanding vs. Hospital-based	1.61 (1.39-1.86)	2.60 (1.83-3.69)
Medicare vs. Private	0.96 (0.90-1.03)	0.92 (0.82-1.03)
Peribulbar Predictors		
Female vs. Male	0.88 (0.70-1.09)	0.96 (0.65-1.43)
Age increase 1 year	0.99 (0.98-1.00)	1.00 (0.98-1.02)
Freestanding vs. Hospital-based	2.51 (2.01-3.12)	2.36 (1.42-3.94)
Medicare vs. Private	0.92 (0.85-1.01)	1.07 (0.95-1.20)
Block Predictors		
Female vs. Male	1.13 (0.86-1.49)	0.54 (0.33-0.88)
Age increase 1 year	1.01 (0.99-1.03)	0.97 (0.94-1.01)
Freestanding vs. Hospital-based	1.42 (1.08-1.86)	1.06 (0.65-1.72)
Medicare vs. Private	0.93 (0.83-1.05)	0.78 (0.65-0.94)

Resident Abstracts

Anesthetic Pharmacology

S-404.**INFLUENCE OF DESFLURANE, SEVOFLURANE AND PROPOFOL ON NEUROMUSCULAR BLOCKING EFFECT OF ROCURONIUM BROMIDE INFUSED CONTINUOUSLY IN JAPANESE PATIENTS**AUTHORS: K. Hazama¹, H. Nakatsuka²AFFILIATION:¹Department of Anesthesiology & Intensive Care Medicine, Kawasaki Medical School, Kurashiki, Japan; ²Anesthesiology, Kawasaki Medical School, Kurashiki, Japan

BACKGROUND: Inhalation anesthetics are known to potentiate the neuromuscular blocking effect of muscle relaxants. There are some studies that have compared neuromuscular interactions of sevoflurane and desflurane with a single dose of rocuronium. However, comparative studies of the interactions after continuous infusion of neuromuscular blocking agents are few. Especially, the study under anesthesia with remifentanyl is lacking. Moreover, recovery using sugammadex was not evaluated before. We have compared the influence of desflurane, sevoflurane and propofol on the neuromuscular potency of continuous infusion of rocuronium with remifentanyl. In addition, we have evaluated reversal of neuromuscular blockade by sugammadex.

METHODS: In a prospective, randomized study thirty ASA 1-2 patients were allocated to anesthesia with desflurane (0.6-0.8 MAC), sevoflurane (0.6-0.8 MAC) or total intravenous anesthesia using propofol. They all received fentanyl, remifentanyl for anesthesia. Neuromuscular blockade was monitored using acceleromyography (TOF-Watch SX[®]) after train-of-four stimulation at the ulnar nerve. Rocuronium was administered 0.6 mg/kg in a bolus. When TOF recovered to 3% T1, continuous rocuronium infusion was started at 7 µg/kg/min. Infusion rate was adjusted to maintain T1 within 3-10%. A single dose of 2 mg/kg sugammadex was administered at the end of surgery. We recorded the time required for T1 to recover from 25 to 75%(recovery index).

RESULTS: After 30 minutes, the infusion rate of rocuronium was 6.2 µg/kg/min, 6.35 µg/kg/min, 7.4 µg/kg/min in desflurane, sevoflurane and propofol groups, respectively (fig. 1). In propofol group, the infusion rate of rocuronium was greater compared with the desflurane group ($P<0.05$). After 45 minutes, the infusion rate of rocuronium was lower in sevoflurane than propofol group ($P<0.01$). There were no differences between desflurane and sevoflurane groups for 75 minutes. The mean recovery time from T1=25% to 75% were 189 seconds, 169.5 seconds, 148.5 seconds in desflurane, sevoflurane and propofol groups (fig. 2). There were no significant differences of reversal after sugammadex between groups.

CONCLUSIONS: Interaction of rocuronium and 0.6-0.8 MAC of inhalation anesthetics resulted in augmentation of the neuromuscular blocking effects, whereas sugammadex after continuous rocuronium infusion was equally effective.

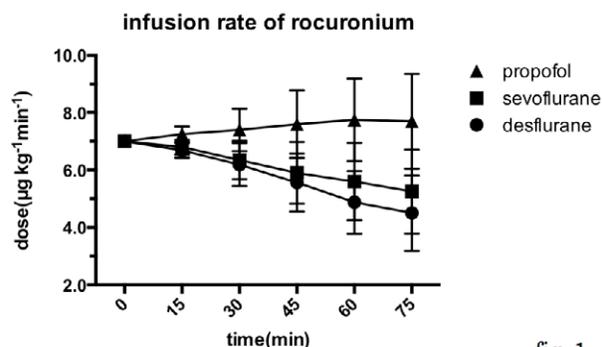


fig. 1

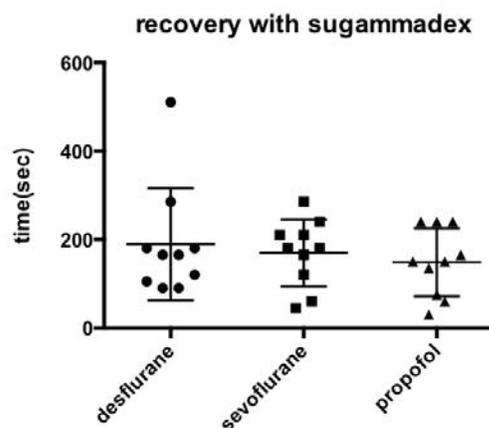


fig. 2

S-405.**COARSE-GRAINED MODEL OF GENERAL ANESTHETIC INTERACTION WITH GLOEOBACTER VIOLACEOUS****AUTHORS:** T. T. Joseph, J. S. Mincer**AFFILIATION:** Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY

INTRODUCTION: Despite having similar effects on consciousness, general anesthetics represent a molecularly diverse class of drugs. The mechanism of their convergent behavior remains incompletely elucidated. However, there is both experimental^{1,2} and theoretical evidence³, the latter in the form of all-atom molecular dynamics simulations, that general anesthetics modulate the function of ligand-gated ion channels. We hypothesize that the mechanism of this action is highly general, requiring little atomic-level selectivity.

METHODS: To probe this hypothesis, we developed a simplified model of the Gloeobacter violaceus ligand-gated ion channel (GLIC), a homolog of the nicotinic acetylcholine receptor. Using the MARTINI force field^{4,6} and a crystal structure of GLIC⁷, a coarse-grained model of GLIC embedded in a lipid bilayer was constructed. Several microsecond-scale molecular dynamics simulations were run, using a simplified model of propofol⁸ and a xenon-like generic ligand model. We also examined the correlations among the per-residue thermal fluctuations⁹ in GLIC to determine which residues were most likely to be important in internal allosterics in the setting of general anesthetic binding.

RESULTS: In flooding simulations, our model identifies a binding site for both propofol and a generic ligand analogous to xenon, which is consistent with the crystallographically determined site of propofol binding⁷ and prior docking studies¹⁰ with propofol. Our simulations show that both propofol and generic ligand binding at this site results in tilting of transmembrane alpha-helices lining the pore, consistent with an allosteric effect of the propofol on the pore. Finally, a number of GLIC residues embedded in the lipid bilayer, in the binding region and at the interface of the extracellular and transmembrane domains, are found to have fluctuations highly correlated with the dynamics of the rest of the structure, suggesting that these residues are important in mediating the GLIC conformational change seen to occur in response to nonselective general anesthetic binding.

CONCLUSIONS: These behaviors are observed even though the coarse-grained model includes only a rudimentary treatment of electrostatics. We believe the ability of our simplified model to produce these results for both propofol and a generalized xenon-like ligand is consistent with a mechanism of general anesthetic function that requires minimal atomic-level selectivity.

REFERENCES:

1. D. C. Chiara, J. F. Gill, Q. Chen, T. Tillman, W. P. Dailey, R. G. Eickenhoff, Y. Xu, P. Tang, and J. B. Cohen, "Photoaffinity labeling the propofol binding site in GLIC," *Biochemistry (Mosc.)*, vol. 53, no. 1, pp. 135-142, Jan. 2014.
2. D. N. LeBard, J. Hénin, R. G. Eickenhoff, M. L. Klein, and G. Brannigan, "General Anesthetics Predicted to Block the GLIC Pore with Micromolar Affinity," *PLoS Comput Biol*, vol. 8, no. 5, p. e1002532, May 2012.
3. B. Ghosh, K. A. Satyshur, and C. Czajkowski, "Propofol binding to the resting state of the gloeobacter violaceus ligand-gated ion channel (GLIC) induces structural changes in the inter- and intrasubunit transmembrane domain (TMD) cavities," *J. Biol. Chem.*, vol. 288, no. 24, pp. 17420-17431, Jun. 2013.
4. X. Periole and S.-J. Marrink, "The Martini coarse-grained force field," *Methods Mol. Biol. Clifton NJ*, vol. 924, pp. 533-565, 2013.
5. T. A. Wassenaar, H. I. Ingólfsson, M. Prieß, S. J. Marrink, and L. V. Schäfer, "Mixing MARTINI: Electrostatic Coupling in Hybrid Atomistic-Coarse-Grained Biomolecular Simulations," *J. Phys. Chem. B*, vol. 117, no. 13, pp. 3516-3530, Apr. 2013.
6. S. O. Yesylevskyy, L. V. Schäfer, D. Sengupta, and S. J. Marrink, "Polarizable water model for the coarse-grained MARTINI force field," *PLoS Comput. Biol.*, vol. 6, no. 6, p. e1000810, Jun. 2010.
7. H. Nury, C. Van Renterghem, Y. Weng, A. Tran, M. Baaden, V. Dufresne, J.-P. Changeux, J. M. Sonner, M. Delarue, and P.-J. Corringer, "X-ray structures of general anaesthetics bound to a pentameric ligand-gated ion channel," *Nature*, vol. 469, no. 7330, pp. 428-431, Jan. 2011.
8. S. Ahmad, B. F. Johnston, S. P. Mackay, A. G. Schatzlein, P. Gellert, D. Sengupta, and I. F. Uchebgu, "In silico modelling of drug-polymer interactions for pharmaceutical formulations," *J. R. Soc. Interface*, vol. 7, no. Suppl 4, pp. S423-S433, Aug. 2010.
9. T. T. Joseph and R. Osman, "Convergent Transmission of RNAi Guide-Target Mismatch Information across Argonaute Internal Allosteric Network," *PLoS Comput Biol*, vol. 8, no. 9, p. e1002693, Sep. 2012.
10. R. Liu, J. M. Perez-Aguilar, D. Liang, and J. G. Saven, "Binding site and affinity prediction of general anesthetics to protein targets using docking," *Anesth. Analg.*, vol. 114, no. 5, pp. 947-955, May 2012.

S-406.

INITIATION OF AN INSTITUTIONAL PRACTICE GUIDELINE AFFECTING FLUID MANAGEMENT AND INTRAOPERATIVE ACID-BASE OUTCOMES IN RENAL TRANSPLANT PATIENTS

AUTHORS: K. S. Tseng, Y. Beilin

AFFILIATION: Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY.

INTRODUCTION: When compared with a physiologically balanced crystalloid solution (Plasma-Lyte A), excessive intraoperative use of 0.9% normal saline (NS) can lead to hyperchloremic metabolic acidosis and is associated with postoperative morbidity - possibly including respiratory failure and renal injury.¹ Patients requiring renal transplantation may be more susceptible to the metabolic derangements from fluid resuscitation with NS.² After several renal transplant patients at our institution developed acute respiratory failure requiring re-intubation postoperatively in the recovery room, an institutional practice guideline for the management of renal transplant patients was initiated on December 1, 2009, in an attempt to optimize metabolic profiles prior to tracheal extubation and avoid re-intubation. This policy included frequent intraoperative blood gas analyses, avoidance of NS unless there was evidence of hyperkalemia, use of ½ NS with sodium bicarbonate (NaHCO₃) for patients with acidosis, and stricter criteria for tracheal extubation.

METHODS: Charts of consecutive adult renal transplant patients from January 2005 to December 2013 were reviewed. Patient anesthetic records were queried for administered fluids, acid-base lab values, and tracheal extubation status. Exclusion criteria included patients who were intubated prior to coming to the operating room (OR). Data were compared between patients whose surgeries occurred before and after December 1, 2009.

RESULTS: A total of 1,378 patients – 714 and 664 before and after the practice guideline, respectively – had complete fluid administration data (see table 1). After the practice guideline was issued, the amount of NS administered decreased significantly, the use of Plasma-Lyte increased overall, and the use of ½ NS with NaHCO₃ increased for patients who had evidence of severe acidosis (see table 2). Among patients who had evidence of acidosis on their first intraoperative blood gas analysis, there was a significant decrease in the proportion of patients who still had evidence of persistent acidosis on their last blood gas analysis (75 vs. 44%, p = 0.031, table 2). Among patients who did not have evidence of acidosis on their first intraoperative blood gas analysis, there was a significantly smaller proportion who developed evidence of acidosis on their last blood gas (13 vs. 2%, p < 0.001, table 2).

CONCLUSIONS: The creation of an institutional practice guideline for the intraoperative fluid management during renal transplantation at a busy, academic center was associated with a decrease in the proportion of patients who had persistent acidosis at the end of the surgery; a higher proportion of those patients who did have acidosis at the end of the case were taken to the recovery room intubated. It is hoped that this ultimately led to a decrease in the number of patients requiring re-intubation. Further analysis to determine if fewer patients required tracheal reintubation in the recovery room is underway.

REFERENCES:

1. Ann Surg 2012 May;255(5):821-9.
2. Anesth Analg 2008 Jul;107(1):264-9.

Table 1. Demographic and clinical characteristics of patients undergoing renal transplantation

	Prior to practice guideline (n=714)	After practice guideline (n=664)	P-value (Rank-sum test except where noted)
Median BMI, kg/m ² (IQR)*	26.3 (23.1-30.4)	26.9 (23.7-31.0)	0.068
Median anesthesia time, min (IQR)	127 (81-262)	136 (94-252)	0.223
Median starting pH (IQR)§	7.44 (7.39-7.49)	7.45 (7.40-7.49)	0.105
No. with starting pH < 7.25 (%) No. with starting pH ≥ 7.25 (%)	20 (4.0) 479 (96.0)	4 (0.7) 597 (99.3)	< 0.001 (chi-squared)
Median starting base excess (IQR)	1.3 (-3.2-4.8)	3.3 (0-6.2)	< 0.001
No. with starting BE < -7 (%) No. with starting BE ≥ -7 (%)	57 (10.7) 476 (89.3)	18 (3.0) 586 (97.0)	< 0.001 (chi-squared)
Extubation status upon exiting OR (%)			
Intubated Extubated	69 (9.7) 645 (90.3)	61 (9.2) 603 (90.8)	0.762 (chi-squared)

*Footnotes available upon request

S-406 • continued**Table 2. Fluid administration and acid-base changes before and after practice guideline**

	Prior to practice guideline (n=714)	After practice guideline (n=664)	P-value (Rank-sum test except where noted)
Median total fluids administered, L (IQR)	4.0 (3.5-5.0)	3.5 (3.0-4.0)	< 0.001
Median NS administered, L (IQR)	4.0 (3.0-4.5)	1.0 (0-2.0)	< 0.001
Mean Plasma-Lyte administered, L (IQR)‡	0.5 (0-0)	1.5 (0.5-3.0)	< 0.001
No. patients with first pH < 7.25 and/or	7.44 (7.39-7.49)	7.45 (7.40-7.49)	0.105
No. given NS (%)	56 (93.3)	12 (63.2)	0.001 (chi-squared)
No. given NS+bicarb (%)	8 (13.3)	13 (68.4)	< 0.001 (chi-squared)
No. with first and last pH < 7.25 and/or	1.3 (-3.2-4.8)	3.3 (0-6.2)	< 0.001
No. with only last	24 (75.0)	8 (44.4)	0.031 (chi-squared)
No. given NS (%)	42 (97.7)	7 (77.8)	0.020 (chi-squared)
No. given NS+bicarb (%)	4 (9.3)	2 (22.2)	0.270 (chi-squared)
Total no. with last pH < 7.25 and/or BE < -7 (%)	67 (19.0)	17 (3.1)	< 0.001
No. extubated with last pH < 7.25 and/or BE < -7 (%)††	55 (82.1)	11 (64.7)	0.119

‡Footnotes available upon request

Resident Abstracts

Cardiovascular Anesthesiology

S-407.

NONCARDIAC SURGERY IN PATIENTS WITH HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY

AUTHORS: T. L. Behrend, D. W. Barbara, J. A. Hyder, W. Mauermann

AFFILIATION:Anesthesiology, Mayo Clinic, Rochester, MN

Introduction: With advances in clinical practice, patients with hypertrophic obstructive cardiomyopathy (HOCM) can have nearly normal lifespans¹. As a result, more of these patients are requiring anesthesia for noncardiac surgery (NCS). The purpose of this study was to examine the perioperative management and outcomes of patients with HOCM undergoing anesthesia for NCS at a single, large tertiary referral center.

METHODS: Electronic medical records from January 1, 1996 - January 31, 2014 were retrospectively reviewed to identify patients with HOCM undergoing NCS. Patients were included if preoperative echocardiography demonstrated evidence of obstruction (resting or provoked peak instantaneous left ventricular systolic gradients of >30 mmHg). Patients with apical-variant HOCM or prior surgical correction were excluded. Demographic features, preoperative laboratory and echocardiographic data, intraoperative events and medications, postoperative complications, and 30-day mortality and readmissions were recorded. Rao-Scott testing was performed to identify associations between preoperative echocardiographic characteristics and death as well as emergency surgery and death.

RESULTS: Fifty-seven patients underwent 96 NCS under general anesthesia except for 1 patient who had spinal anesthesia with concomitant sedation. A variety of NCS were performed (Table 2) with eight operations (12%) being emergent in nature. Demographic and preoperative characteristics including echocardiographic data are shown in Table 1. Intraoperative findings for the 96 NCS are listed in Table 2. Three patients (3%) died within 30 days of NCS, but none of the deaths were attributable to cardiac causes (Table 3). One patient was readmitted within 30-days of NCS with worsening heart failure. Statistical analysis revealed only emergent surgery to be significantly associated with death following NCS (Table 4).

CONCLUSIONS: In this clinical series, patients with HOCM safely underwent a variety of NCS with few intraoperative and postoperative complications. An observed mortality rate of 3% was lower than the reported mortality in other series (4-9%)^{2,3}. Death following NCS was not significantly associated with preoperative echocardiographic findings but was associated with emergent surgery.

REFERENCES:

1. JAMA 1999; 20:1-18
2. Chin Med Sci J 2007; 22(4):211-15
3. JAMA 1985;254(17):2419-21

Table 1: Demographic and perioperative findings for 96 noncardiac surgeries

Age (y)	62±16, median 65, range 30-94
LVEF (%)	71 ± 7, median 72, range 40-82
Resting gradient (mmHg) ¹	39 ± 28, median 29, range 3-130
Provoked gradient (mmHg) ²	75 ± 32, median 76, range 30-196
Basal septal thickness (mm)	18 ± 5, median 18, range 9-28
Mitral regurgitation severity	29 (30%) none/trivial 36 (37.5%) mild 19 (20%) moderate 12 (12.5%) severe
Hemoglobin (g/dL)	12.2 ± 2.3, median 12.6, range 7.3-18.9
Creatinine (mg/dL)	1.5 ± 1.2, median 1.2, range 0.4-8.9 61 (64%) normal sinus 15 (16%) normal sinus with 1st degree AV block 10 (10%) atrial fibrillation or atrial flutter
Preoperative ECG rhythm	5 (5%) sinus bradycardia with 1st degree AV block 3 (3%) ventricular paced 1 (1%) sinus bradycardia 1 (1%) sinus tachycardia
New York Heart Association classification	54 (56.3%) class I 32 (33.3%) class II 9 (9.4%) class III 1 (1.0%) class IV
History of cardiac arrest	2 (2%) yes 94 (98%) no
History of syncope	6 (6%) yes 90 (94%) no
History of congestive heart failure	7 (7%) yes 89 (93%) no
History of stroke/TIA	7 (7%) yes 89 (93%) no
Diabetes mellitus requiring insulin	10 (10%) yes 86 (90%) no
Chronic kidney disease with creatinine > 2 mg/dL	17 (18%) yes 79 (82%) no

Atrioventricular (AV), electrocardiogram (ECG), left ventricular ejection fraction (LVEF), transient ischemic attack (TIA)

¹Performed in 56/57 patients

²Performed in 37/57 patients

S-407 • continued

Table 2: Procedure type and intraoperative findings for 96 noncardiac surgeries.

Procedure type	27 (28.1%) intraabdominal 24 (25.0%) orthopedic (extremity or joint) 13 (13.5%) endoscopy/superficial/ cystoscopy 9 (9.4%) otorhinolaryngology/dental 6 (6.3%) gynecological 5 (5.2%) intrathoracic 4 (4.2%) intracranial 3 (3.1%) endovascular 3 (3.1%) transplantation ¹ 1 (1.0%) Cesarean section 1 (1.0%) spine
Surgical duration (minute)	195 ± 103, median 163, range 25-454
Estimated blood loss (cc) ²	47 Not documented 49 Documented (303 ± 455, median 200, range 5-3000)
Phenylephrine bolus	67 (70%) yes 29 (30%) no
Vasopressin bolus	1 (1%) yes 96 (99%) no
Ephedrine bolus	33 (34%) yes 63 (66%) no
Esmolol bolus	16 (17%) yes 80 (83%) no
Esmolol infusion received	2 (2%) yes 94 (98%) no
Metoprolol bolus	12 (12.5%) yes 84 (87.5%) no

¹Two kidney transplantations and one pancreas transplantation were performed.

²As documented in anesthesia record.

Table 3: Deaths and unplanned readmissions within 30-day of noncardiac surgeries

Patient	Procedure	Outcome	Reason or Cause
80y F with recurrent bowel obstructions	Exploratory laparotomy, lysis of adhesions, umbilical hernia repair	Death	Aspiration on postoperative day 2
87y M with obstructing gastric mass	Esophagogastroduodenoscopy	Death	Aspiration during procedure
76y F with lymphoma and necrotic bowel	Exploratory laparotomy	Death	Septic shock with withdrawal of support at family's request
95y F with hip fracture	Left hip hemiarthroplasty	Readmission	Worsening heart failure
88y F with hip fracture	Left hip hemiarthroplasty	Readmission	Subdural hematoma
76y M with parathyroid mass	Right parathyroidectomy	Readmission	Urosepsis
51y M with infected abdominal mesh	Exploratory laparotomy, removal of infected mesh with primary abdominal closure	Readmission	Non-healing abdominal wound

Female (F), male (M), year (y).

S-408.**INCIDENCE OF POSTOPERATIVE ACUTE KIDNEY INJURY AND TRANSFUSION OF BLOOD PRODUCTS AFTER SYNTHETIC COLLOID ADMINISTRATION DURING CARDIAC SURGERY****AUTHORS:** R. Nanayakkara¹, Z. Li², S. Truong¹, H. Liu¹**AFFILIATION:** ¹Anesthesiology and Pain Medicine, UC Davis Medical Center, Sacramento, CA, ²Internal Medicine, UC Davis Medical Center, Sacramento, CA**INTRODUCTION:** Hydroxyethyl starches (HES) are synthetic colloids that are commonly used to maintain hemodynamic stability while limiting crystalloid administration. A number of studies that have shown higher incidence of acute kidney injury (AKI) and overall adverse events in critically ill patients receiving these products have questioned their safety^{1,2,3}. HES' safety in the perioperative setting, specifically in cardiovascular surgery, remains unclear due to few meta-analyses consisting of small, single outcome studies, and conflicting data^{4,5}. This larger study seeks to assess the effect of two different types of HES on renal integrity and transfusion of blood products in patients who underwent cardiac surgery.**METHODS:** After obtaining IRB approval, colloid administration of patients who underwent cardiac surgery from 2007 to 2013 was recorded. Inclusion criteria included coronary artery bypass graft (CABG) and/or valve surgeries that underwent cardiopulmonary bypass with aortic cross clamping. Exclusion criteria included pediatric patients, emergency surgeries, circulatory arrest, and other cardiac surgeries not included in inclusion criteria. Total of 1265 patients met these criteria. Variables included a colloid group that received various volumes of two different types of HES-- Voluven® (6% hydroxyethyl starch 130/0.4) and Hextend® (6% hydroxyethyl starch 670/0.75) and a non-colloid group. Primary endpoints were incidences of acute kidney injury and intraoperative blood product usage. Secondary endpoints were operative mortality and postoperative complications. Propensity weighted adjusted odds ratios (ORs) were calculated for assessment of risk for developing these mentioned endpoints.**RESULTS:** Overall 70.1% of cases utilized colloids, and the average colloids administration were 641±612ml (mean ± SD). There was no difference in the development of AKI between the colloid and the non-colloid group, and no difference when the colloid group was further divided into Voluven and Hextend groups. There was no difference in the administration of fresh frozen plasma, cryoprecipitate, and platelets between the two groups except with PRBC unit transfusion with 1.92 [95% CI: 1.77-2.08] units in colloid group vs. 2.24 [2.00-2.49] units in non-colloid group (P=0.028). Odds ratio for complications rate was significantly higher in the colloid group. However, overall operative mortality was not significant between the colloid and non-colloid group.**CONCLUSION:** Results from this study failed to show any association in the development of AKI between patients who received and did not receive synthetic colloids. Analysis does not show increased blood product transfusion in the HES group. Although overall complication rate was higher in the synthetic colloid group, it did not lead to a difference in operative mortality between the two groups.**REFERENCES:**

1. New Eng J Med 2012; 367: 124-34
2. New Eng J Med 2012; 367: 1901-11
3. JAMA. 2013 Feb 20; 309(7):678-88
4. J. Anesth 2014; 112: 25-34
5. Anesth & Analg 2013; 116: 35-48

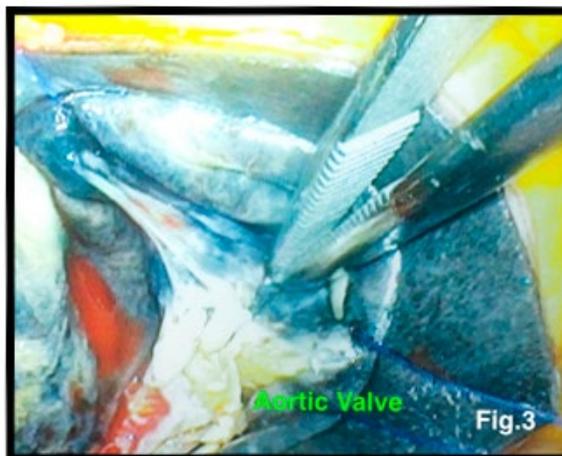
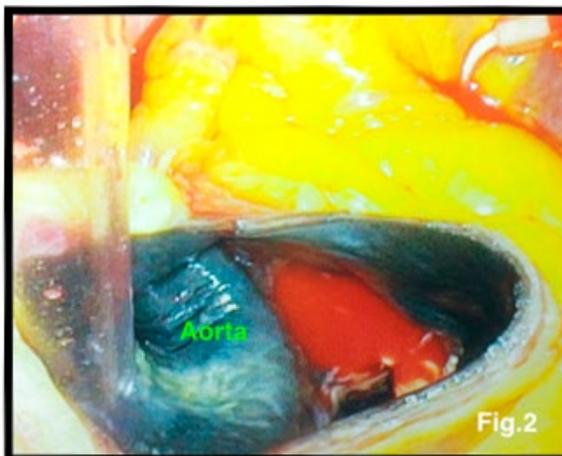
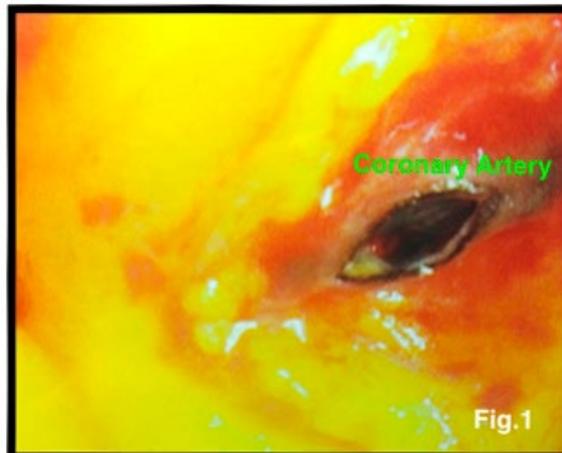
S-409.**MINOCYCLINE INDUCED DISCOLORATION OF VASCULAR STRUCTURES MIMICKING DISSECTION****AUTHORS:** J. Lee¹, D. Palaniappan²**AFFILIATION:** ¹Anesthesiology, University of Connecticut, Farmington, CT, ²Anesthesiology, Hartford Hospital, Hartford, CT

INTRODUCTION: A 56yo male with known endocarditis secondary to tooth extraction was referred for valvular replacement. Blood cultures were positive for streptococcus viridian's, and a TEE demonstrated a bicuspid aortic valve with severe aortic and moderate mitral regurgitation secondary to endocarditis. Vegetations were noted on both the aortic and mitral valves consistent with endocarditis. The patient was treated with IV antibiotics and after negative blood cultures were obtained, a subsequent cardiac catheterization revealed LAD, LCx and RCA disease and 4+ aortic insufficiency with an otherwise normal ejection fraction.

CASE REPORT: The patient was later prepared for surgery with the initial plan of bypass and valve repair. After entering the chest through standard median sternotomy and pericardial reflection, the aorta and coronary arteries were noted to have a bluish discoloration raising the suspicion of occult aortic dissection (Fig1). Due to the difficulty in assessing the aortic arch, TEE could not rule out an abnormal wall arising from the distal ascending aorta extending through the aortic arch. Axillary cannulation was then performed due to the possible need for aortic arch repair and coronary artery re-implantation. Occult dissection of the aorta and coronary arteries is a condition of significant morbidity and mortality and requires complex repair and circulatory arrest. Dissection with CABG and double valve repair would likewise carry a synergistic increase in the risk of complications. Although gross anatomical analysis demonstrated the likely presence of dissection, the lack of consistency with clinical history and previous imaging resulted in regular aortotomy. The interior of the aorta, cardiac valves, coronary arteries, venous grafts and valvular structures were all subsequently noted to have a smooth and even blue-black discoloration (Fig2/3). No site of dissection could be identified. CABG x3 was then performed with replacement of the aortic valve and repair of the mitral valve. The patient was transferred to the CVICU where he recovered uneventfully.

CONCLUSIONS: Pigmentation of the vasculature is an uncommon phenomenon that can occur secondary to alkaptonuria (ochronosis), heavy metal accumulation, and particular pharmaceutical agents. Review of the patients history with his primary care physician elucidated a four year history of minocycline use for acne. Later physical examination revealed a slight bluish tinge of the sclera, apical teeth and nailbeds. Subsequent pathological examination showed accumulation of minocycline induced pigment within macrophages, stroma and the lamina propria of the specimens.

Although previously identified in the literature, we believe this to be the first case of minocycline-induced vascular pigmentation that appeared consistent with aortic and coronary artery dissection that could have resulted in inappropriate and possibly lethal management of the patient. This case underscores the need to carefully examine and review the patients history with thorough collaboration among all members of the health care team.



S-410.

IMPACT OF RETAINED BLOOD IN PERICARDIAL AND PLEURAL CAVITIES ON OUTCOME AFTER CARDIAC SURGERY

AUTHORS: F. Balzer, M. Habicher, V. Mezger, M. Sander, C. von Heymann

AFFILIATION: Department of Anesthesiology and Intensiv Care Med, Charite –Universitaetsmedizin Berlin, Berlin, Germany

INTRODUCTION: Pleural and pericardial effusion, tamponade and hemothorax and thereof resulting interventions are serious complications despite chest tubes are placed in every patient after cardiac surgery^{1,2}. The clogging of chest tubes may contribute to the occurrence of such like complications. Purpose of this study was to identify the incidence of complications associated with the retention of blood in pericardial and pleural cavities in a large database and to determine its impact on patient outcome after cardiac surgery.

METHODS: Single center, retrospective, observational cohort study at Charité- University Medicine Berlin, Germany. After IRB approval, electronic records from all adult patients undergoing cardiac surgery between 2006 and 2013 were extracted from the patient data management system. Statistical analyses of the anonymized dataset were undertaken with a p value below 0.05 regarded as significant. Significance among groups was univariately analyzed by the exact nonparametric Mann-Whitney U test. Exact Chi-Square tests were used for qualitative data. Logistic regression adjusted for all variables using stepwise backwards selection was performed for multivariate analyses.

RESULTS: Data from 6,909 adult patients admitted were included in analyses. Retention of blood defined as pleural and pericardial effusion, tamponade and hemothorax requiring thoracostomy or re-exploration was diagnosed in 1125 (16.3%) patients after cardiac surgery. Basic patient characteristics, surgery related data, and preexisting medical conditions are presented in table 1. Pleural effusions were found in 613 (8.9%) patients, pericardial effusions in 73 (1.1%) patients, hemothorax in 226 (3.3%) patients, and tamponade in 40 (0.6%) patients. Surgical re-exploration was required in 464 (6.7%) patients. Patients with retained blood related complications showed increased mortality (17.6% vs. 4.8%, p<0.001), length of stay (ICU: 14 [7;31] vs. 5 [3;7] days, p<0.001; hospital: 27 [16;48] vs. 12 [9;18] days, p<0.001), time of ventilation (72 [24;277] vs. 20 [9;43] hours, p<0.001), incidence of hemodialysis (41.7% vs. 11.2%, p<0.001) and postoperative transfusion of packed red blood cells (52.2% vs. 11.9%, p<0.001). Adjusted odds ratios are shown in figure 1.

CONCLUSIONS: Complications related due to retained blood in pleural and pericardial cavities are common after cardiac surgery. The use of active clearing techniques to prevent clogging of chest tubes may treat the underlying cause and counteract preventable events³. This could result in better outcome after cardiac surgery and requires prospective and controlled evaluation.

REFERENCES:

1. Kuvin JT, Harati NA, Pandian NG, Bojar RM, Khabbaz KR. Postoperative cardiac tamponade in the modern surgical era. *Ann Thorac Surg* 2002;74:1148-53
2. Čanádýová JI, Zmeko D, Mokráček A. Re-exploration for bleeding or tamponade after cardiac operation.
3. Shiose A, Takaseya T, Fumoto H, Arakawa Y, Horai T, Boyle EM, Gillinov AM, Fukamachi K. Improved drainage with active chest tube clearance. *Interact Cardiovasc Thorac Surg.* 2010;10(5):685-8

	[ALL] N=6909	No Retained Blood N=5924	Retained Blood N=985	p
Basic data:				
Age [y]	69.0 [61.0;75.0]	69.0 [61.0;74.0]	71.0 [64.0;77.0]	<0.001
Sex: F	1964 (28.4%)	1615 (27.3%)	349 (35.4%)	<0.001
Body Mass Index (BMI)	26.9 [24.3;30.1]	27.0 [24.3;30.2]	26.1 [23.8;29.4]	<0.001
Surgery:				
Type of surgery:				<0.001
CABG	3954 (57.2%)	3552 (60.0%)	402 (40.8%)	
Valves	2093 (30.3%)	1691 (28.5%)	402 (40.8%)	
Both	862 (12.5%)	681 (11.5%)	181 (18.4%)	
Duration of surgery [m]	195 [160;240]	195 [159;240]	205 [165;255]	<0.001
Priority of surgery:				
Elective	4361 (76.8%)	3783 (78.1%)	578 (69.6%)	<0.001
Urgent	519 (9.15%)	430 (8.88%)	89 (10.7%)	
Emergency	795 (14.0%)	632 (13.0%)	163 (19.6%)	
RBC transfusion (pat. %)	1829 (29.6%)	1441 (27.0%)	388 (45.6%)	<0.001
RBC transfusion [units]	1.95 (1.05)	1.90 (1.01)	2.15 (1.18)	<0.001
ACEF score	1.28 [1.13;1.60]	1.27 [1.12;1.55]	1.44 [1.22;1.95]	<0.001
APACHE II	18.0 [14.0;24.0]	18.0 [14.0;24.0]	20.0 [16.0;26.0]	<0.001
Preexisting medical conditions:				
Coronary heart disease	5383 (77.9%)	4674 (78.9%)	709 (72.0%)	<0.001
Left heart failure (>NYHA II)	2069 (29.9%)	1629 (27.5%)	440 (44.7%)	<0.001
COPD	1184 (17.1%)	955 (16.1%)	229 (23.2%)	<0.001
Endocrine disease	6334 (91.7%)	5392 (91.0%)	942 (95.6%)	<0.001
Peripheral vascular disease	1333 (19.3%)	1087 (18.3%)	246 (25.0%)	<0.001
Atrial fibrillation	2054 (29.7%)	1571 (26.5%)	483 (49.0%)	<0.001
Chronic renal insufficiency	1684 (24.4%)	1336 (22.6%)	348 (35.3%)	<0.001
Hematocrit pre op	41.0 [37.0;43.0]	41.0 [37.0;43.1]	39.0 [35.0;43.0]	<0.001
Hemostatic disorder	754 (10.9%)	627 (10.6%)	127 (12.9%)	0.036
Anticoagulation:				
None	1666 (32.8%)	1442 (32.6%)	224 (34.8%)	
ASS (mono)	2309 (45.5%)	2035 (45.9%)	274 (42.6%)	
ASS (dual)	1097 (21.6%)	952 (21.5%)	145 (22.6%)	

Figure 1.

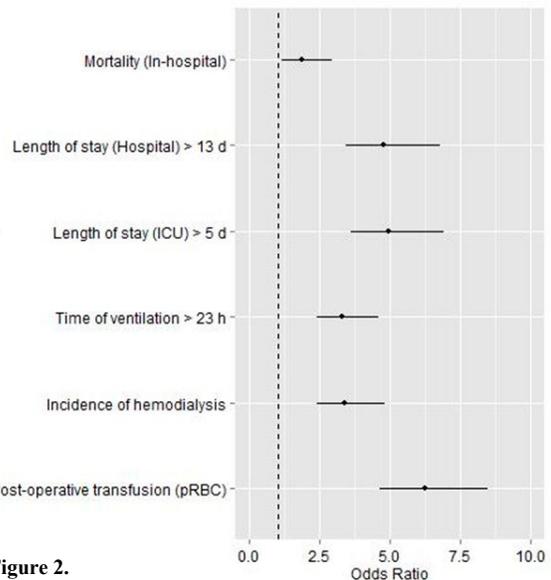


Figure 2.

S-411.**THE USE OF DEXMEDETOMIDINE AND INTRAVENOUS ACETAMINOPHEN FOR THE PREVENTION OF POSTOPERATIVE DELIRIUM IN CARDIAC SURGERY PATIENTS OVER 60 YEARS OF AGE: A PILOT STUDY**

AUTHORS: J. O'Neal¹, S. Dighe¹, K. Gray¹, A. Lerner¹, D. Talmor¹, E. Marcantonio², B. Subramaniam¹

AFFILIATION: ¹Anesthesia, Critical Care and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA, ²Medicine, Beth Israel Deaconess Medical Center, Boston, MA

BACKGROUND: Following cardiac surgery, up to 50% of patients older than 60 years of age experience postoperative delirium¹. Delirium is associated with many negative hospital outcomes, including a 10-fold increased risk of death, a 5-fold increased risk of nosocomial complications², poor one year functional recovery, and postoperative cognitive decline³. Postoperative sedation and opiate administration may contribute to delirium in this patient population. A meta-analysis suggested that the use of dexmedetomidine for sedation in cardiac surgery patients may reduce the incidence of delirium⁴. However, the studies which formed the basis of the meta-analysis were poorly designed with inconsistent measurements of delirium. Consequently, clinical practice is unlikely to change with the reported results. The use of intravenous acetaminophen (IVA) has been shown in multiple studies to reduce the amount of opiates consumed by surgical patients⁵, but no study has investigated its role in postoperative delirium. We hypothesize that these medications may lead to a reduction in opiate consumption and the sparing of delirigenic receptor stimulation, and thereby decrease the incidence and/or duration of postoperative delirium. This pilot study aims to a) assess feasibility of using dexmedetomidine and IVA in the cardiac surgical intensive care unit, and b) to obtain effect size estimates for primary study outcomes—incidence and duration of delirium.

METHODS: A total of 12 adult patients >60 years of age undergoing coronary artery bypass graft surgery (CABG) or combined CABG/valve surgery were recruited for the study with IRB approval. The subjects were randomized into 4 groups: 1. usual care, propofol only (PROP) 2. propofol with IVA (PROP+IVA) 3. dexmedetomidine only (DEX) 4. dexmedetomidine with IVA (DEX+IVA). Baseline cognition was evaluated preoperatively and postoperative delirium was assessed daily until discharge using the Mini Mental State Examination (MMSE) and the Confusion Assessment Method

(CAM, CAM-Intensive Care Unit and verbal). The feasibility of the study was tested by the number of patients who completed the study. A descriptive data analysis on the incidence and duration of postoperative delirium is presented. No formal statistical analysis was completed due to the limited number of subjects in the pilot.

RESULTS: All patients completed the study protocol successfully. The incidence of delirium in all groups was 42%. The DEX and PROP groups each had an incidence of 67% while DEX+IVA had an incidence of 33%. The PROP+IVA group had no occurrences of delirium. Interestingly, only 17% of the subjects receiving IVA were diagnosed with delirium compared to 67% in the subjects not receiving IVA. The duration of delirium ranged from 1 to 3 days among patients found to have delirium. Secondary outcomes including opiate consumption, length of stay, and time to extubations were similar between the groups. One patient expired after surgery, unrelated to the study protocol. Only one patient experienced a significant side effect of hypotension with systolic blood pressure <90 mm of Hg in the DEX group.

CONCLUSIONS: Delirium assessments were completed on all study subjects every day until the time of discharge/expiration. The study protocol was easily incorporated into patient care. The feasibility of completing the large-scale project was justified through our pilot study. The overall incidence of delirium at 42% is consistent with previous reports¹. Although a trend towards reducing delirium was observed in patients receiving IVA, this finding was insignificant given the small sample size. A multi-center randomized, controlled trial will be the next step in investigating the role of dexmedetomidine and IVA in reducing the incidence of delirium.

REFERENCES: 1. Rudolph JL, et al. Derivation and validation of a preoperative prediction rule for delirium after cardiac surgery. *Circulation* 2009; 119:229-36.

2. Inouye Sk. Delirium in older persons. *NEJM* 2006; 354:1157-65.

3. Saczynski JS, Marcantonio ER, et al. Cognitive trajectories after postoperative delirium. *NEJM* 2012; 367:30-9.

4. Lin Y, et al. Can dexmedetomidine be a safe and efficacious sedative agent in post-cardiac surgery patients: a meta-analysis. *Crit Care* 2012; 16:R169.

5. O'Neal JB. The utility of intravenous acetaminophen in the perioperative period. See comment in PubMed Commons below *Front Public Health*. 2013 Aug 6; 1:25.

S-412.

PREDICTORS OF PERMANENT PACEMAKER FOLLOWING TRANS-CATHETER AORTIC VALVE REPLACEMENT

AUTHORS: M. J. Hoyt¹, M. Beach², J. Hathaway¹

AFFILIATION: ¹Anesthesia, Dartmouth Hitchcock Medical Center, Lebanon, NH, ²Anesthesia, Dartmouth Medical School, Lebanon, NH

BACKGROUND: Transaortic valve replacement (TAVR) is an increasingly common therapy for severe aortic stenosis (AS). A known complication of this procedure is atrioventricular conduction disturbance leading to permanent pacemaker (PPM) placement¹. Previous studies have reviewed ECG characteristics, but procedural and echo predictors have not been explored.

OBJECTIVE: We attempted to characterize predictors of PPM placement following TAVR in a retrospective case series review of our patient population.

METHODS: We performed a retrospective chart review of patients that had TAVR at our institution. Extracted data included, ECG, procedural and echocardiographic data, as well as patient demographics. Multivariate regression was performed to identify associations with need for PPM.

RESULTS: A total of 76 consecutive patients who underwent TAVR using only the SAPIEN XT valve at a single institution were examined. Of these 76, 10 patients were excluded due to perioperative mortality, previous pacemaker, or aborted procedure (change to surgical aortic valve). Of our 66 patients, 13 (19.6%) required PPM, 95% CI (10.9%, 31.3%).

Baseline ECG, STS score, age, and baseline echocardiographic parameters did not predict the risk of PPM. In particular, no effect was seen with RBBB. However, paravalvular leak and multiple deployments were important risk factors. Table 1 describes the outcomes for the 66 patients and Table 2 details selected comparisons. Of 12 patients with mild to moderate leak, none had a PPM (0%, 95% CI 0, 26.4%). 42 % of patients with no leak required a PPM compared with 19% of patients with trace leak (RR 2.2, p=0.11). Valve in valve resulted in a PPM rate of 63% compared with 17% in single deployment patients (RR 3.6, p=0.006). Finally, having both VIV and no leak had a PPM rate of 100% compared with 11% in trace leak and single deployment (RR 8.8, p=0.01). Multivariate models adjusting for baseline characteristics did not alter these results.

CONCLUSIONS: In patients undergoing TAVR with the SAPIEN XT valve, we found a placement rate of approximately 20%. Unlike previous studies, we did not find RBBB to be a risk factor. However, the degree of paravalvular leak and VIV placements were important predictors of pacemaker placement, both alone and in combination. Valve in valve and the presence of a leak may be useful markers for prophylactic transvenous pacemaker placement.

1. Piazza N, Onuma Y, Jesserun E, et al. Early and Persistent Intraventricular Conduction Abnormalities and Requirements for Pacemaking after Percutaneous Replacement of the Aortic Valve. JACC Cardiovascular Interv 2008;1:310-316.

Table 1: Degree of Valvular Leak and Pacemaker Placement

	None	Trace	Mild	Moderate
Pacemaker Placed	12	12	12	12
Patients w/o PPM	70	313	81	21
Patients w/PPM	41	44	00	00
% w/Placement	30 100	12 57	00	00

Table 2: Select Comparisons

		Relative Risk	95% CI	Moderate
Leak				
None	Trace			
5/12 (41.7%)	8/42 (19.0%)	2.2	(0.9, 5.5)	0.11
Deployment				
V/V	Single valve			
5/8 (62.5%)	8/96 (17.4%)	3.6	(1.6, 8.3)	.006
Combined				
No Leak	& VIV	Trace	Leak &	Single valve
1/1 (100%)	4/35 (11.4%)	8.8	(3.5, 22.0)	0.01

Resident Abstracts

Critical Care

S-413.

IMPROVING ADHERENCE TO INTRAOPERATIVE LUNG PROTECTIVE VENTILATION THROUGH EDUCATION AND IMPLEMENTATION OF A DEPARTMENTAL MECHANICAL VENTILATION POLICY

AUTHORS: G. A. Schultz, S. A. Josephs

AFFILIATION: Anesthesiology, University of Cincinnati Medical Center, Cincinnati, OH

INTRODUCTION: Studies have shown that using intraoperative lung-protective ventilation (ILPV) with tidal volumes <8 ml/kg ideal body weight (IBW) can reduce pulmonary complications in patients undergoing abdominal surgery.^{1,2} The use of intraoperative lung-protective ventilation at our institution was evaluated and a quality improvement project (QIP) was initiated to improve adherence to ILPV strategies.

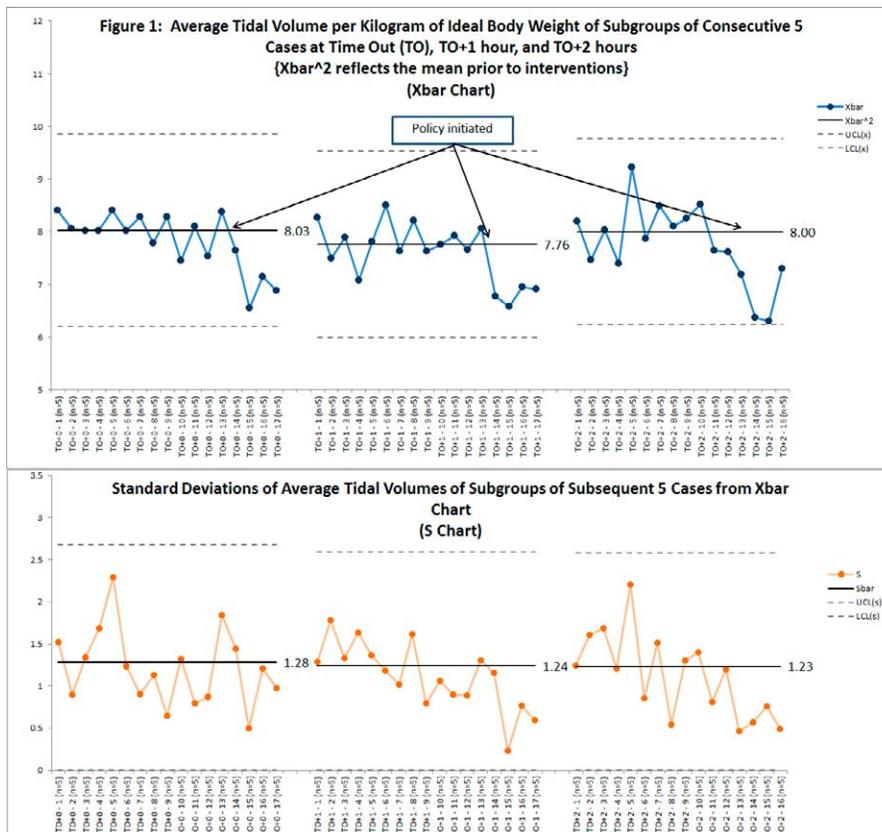
METHODS: A single-center, retrospective observational pre / post evaluation of ILPV was performed June through October 2014 for patients undergoing major abdominal surgery. Intraoperative tidal volume (Vt) was collected at time out (TO), time out plus 1 hour (TO+1), and at time out plus 2 hours (TO+2). Cases were classified as failures of ILPV if Vt > 8 ml/kg IBW. Tidal volumes and ILPV failure rates were placed on statistical process control (SPC) charts. At each intraoperative time point mean Vt and ILPV failure rate were calculated before and after initiation of the QIP. Change interventions included departmental education about ILPV and creation of an ILPV mechanical ventilation policy. Data were analyzed on statistical process control (SPC) charts. Additionally, mean Vt and ILPV failure rates before and after interventions were compared using the Mann-Whitney and Chi-Squared tests, respectively.

RESULTS: Eighty-seven patients were evaluated, 68 before and 19 after the intervention. Pre-intervention Vt data was missing for 1 case at TO+1 and 6 cases at TO+2. One post-intervention Vt was missing for TO+2. Annotated SPC charts showed non-significant trends with decreasing average tidal volumes (Figure 1.) No special cause was seen for ILPV failure rates at TO, TO+1, or TO+2 (Figure 2) but failure rates remained below the mean after the intervention. When ordered by IBW, SPC Charts (Figure 3) show special cause at lower and higher IBW. At TO, TO+1, and TO+2, pre-intervention mean Vt (ml/kg) (standard error of the mean (SEM)) were 8.07 (0.17), 7.83 (0.16), and 8.05 (0.18), post-intervention means of Vt (ml/kg) (SEM) were 6.83 (0.22), 6.76 (0.18), and 6.74 (0.17) (Figure 4.) Mann-Whitney P values for pre / post comparisons at each time point were 0.0004, 0.0007, and 0.0001. At TO, TO+1, and TO+2 pre-intervention ILPV failure rates were 44%, 42%, and 48%, post-intervention ILPV failure rates were 16%, 5%, and 0% (Figure 5.) Chi-Squared P values for pre / post comparisons at each time point were 0.024, 0.0029, and 0.00024.

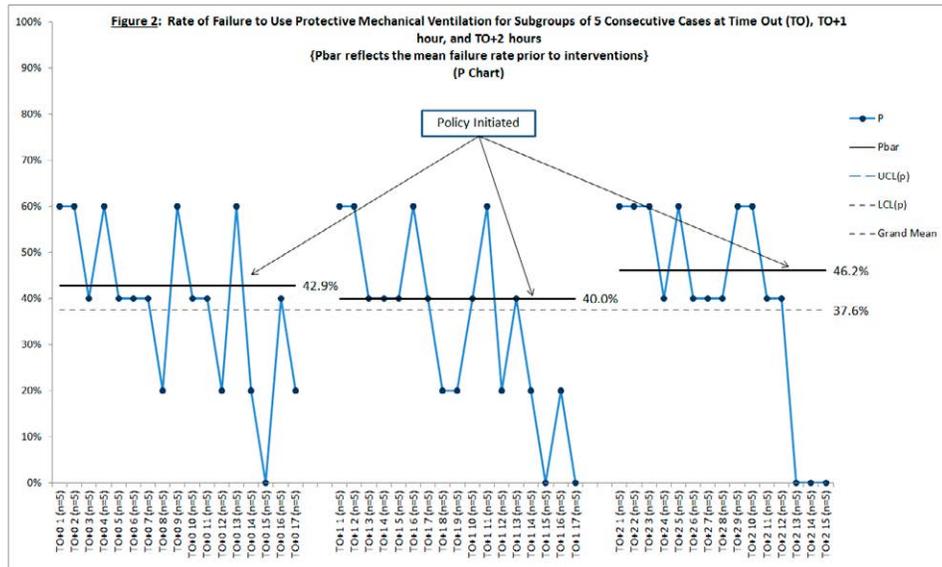
CONCLUSIONS: Providers in this study often failed to use intraoperative lung-protective ventilation and more frequently used appropriate Vt in patients with higher IBW. This agrees with current literature that suggests many patients do not routinely receive LPV under general anesthesia and that this trend may be unintentional.^{3,4} Departmental education and initiation of a lung protective mechanical ventilation policy was associated with decreased average Vt and decreased ILPV failure rates.

REFERENCES:

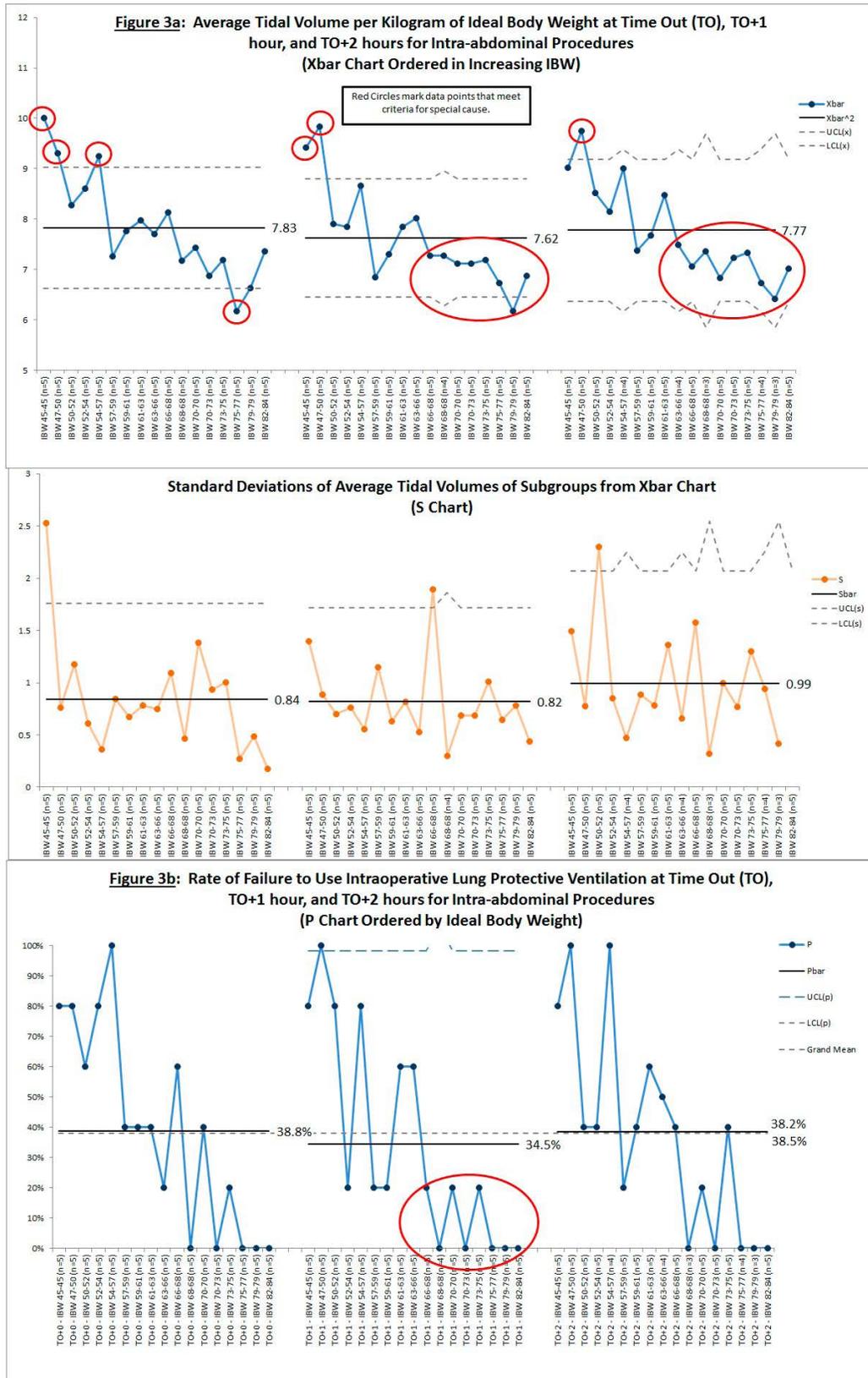
1. Anesthesiology 2013; 118:1307-21.
2. N Engl J Med 2013; 369:428-37.
3. J Crit Care 2013; 28:533-533.
4. Anaesthesia 2012; 67:999-1008.



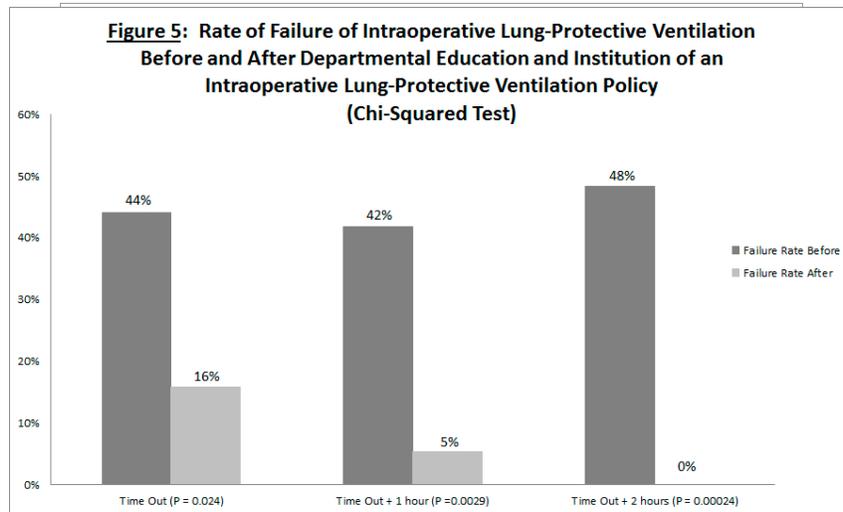
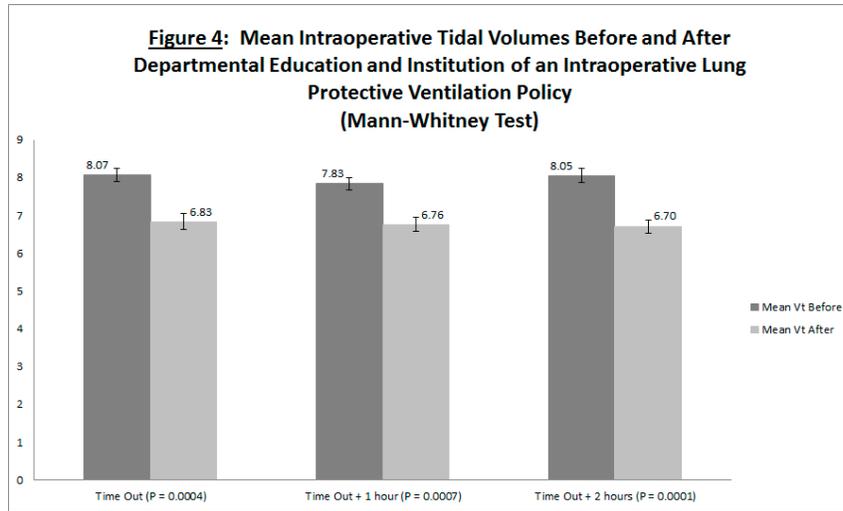
S-413 • continued



S-413 • continued



S-413 • continued



S-414.

THE GERMAN VALIDATION STUDY OF THE SURGICAL INTENSIVE CARE UNIT OPTIMAL MOBILITY SCORE (GEVASOMS-STUDY)

AUTHORS: S. J. Schaller¹, C. Staebler¹, M. Suemasa¹, I. Moreno Duarte², M. Heim¹, M. Eikermann², M. Blobner¹

AFFILIATION: ¹Klinik fuer Anaesthesiologie, Klinikum rechts der Isar der TUM, Munich, Germany, ²Department of Anesthesiology, MGH, Boston, MA

INTRODUCTION: Immobilization, common in the intensive care unit (ICU), leads to muscle weakness which is associated with long-term functional disability¹ and increased costs. Early mobilization of medical ICU patients improves clinical outcomes.²⁻⁴ As a first step towards future investigations, the Surgical ICU Optimal Mobilization Score (SOMS) was created in Boston.⁵ It is a reliable and valid tool to predict mortality, as well as ICU and hospital length of stay.⁵ We validated a German version of the score in the interdisciplinary ICU of the Technische Universität München.

METHODS: After IRB approval nurses, physical therapists and intensivists independently evaluated the patients’ potential mobilization capacity after admission to the ICU by using the German version of the SOMS. The actually achieved mobilization level of the patients was additionally documented at the end of the day. We tested validity of the score in all patients admitted to our ICU over an approximately four month period, thereby distinguishing between neurological/neurosurgical and surgical patients.

RESULTS: Intensivists and physical therapists had a substantial agreement, while nurses had a moderate one regarding predicted and actual SOMS score within their group (table 1).

Multivariate analysis revealed that the German SOMS as assessed by intensivists significantly (p<0.002) predicted ICU length of both patients with neurosurgical/neurological admission diagnosis and surgical patients without neurological problems and the hospital length of stay for neurological/neurosurgical patients (p<0.001). In addition, SOMS taken by physical therapists predicted mortality (p=0.04).

Table 1: Reliability of predicted and actual SOMS score in each group

Medical group	Prediction vs. Actual Score of each group
Nurses	64.84% (k=0.4803)
Physical Therapists	80.70% (k=0.7420)
Intensivists	86.55% (k=0.8045)

Value of kappa (k) - Strength of agreement
 < 0 Less than chance agreement
 0.01-0.20 Slight agreement
 0.21- 0.40 Fair agreement
 0.41-0.60 Moderate agreement
 0.61-0.80 Substantial agreement
 0.81-0.99 Almost perfect agreement

CONCLUSIONS: The German version of the SOMS score is a reliable and valid tool to predict intensive care unit stay. The predictive value of the instrument depends on the assessors’ profession.

REFERENCES:

- Herridge MS, Cheung AM, Tansey CM, et al: One-year outcomes in survivors of the acute respiratory distress syndrome. *N Engl J Med* 2003; 348:683-693
- Peurala SH, Airaksinen O, Huuskonen P, et al: Effects of intensive therapy using gait trainer or floor walking exercises early after stroke. *J Rehabil Med* 2009; 41:166-173
- Siu AL, Penrod JD, Boockvar KS, et al: Early ambulation after hip fracture: effects on function and mortality. *Arch Intern Med* 2006; 166:766-771
- Oldmeadow LB, Edwards ER, Kimmel LA, et al: No rest for the wounded: Early ambulation after hip surgery accelerates recovery. *ANZ J Surg* 2006; 76:607-611
- Kasotakis G, Schmidt U, Perry D, et al. The surgical intensive care unit optimal mobility score predicts mortality and length of stay. *Crit Care Med* 2012;40(4):1122-1128.

S-415.

INCIDENCE AND RISK FACTORS FOR ORGAN INJURY IN PATIENTS UNDERGOING INTRAVENOUS CATHETER DIRECTED THROMBOLYTIC THERAPY FOR ACUTE VASCULAR OCCLUSION - A RETROSPECTIVE STUDY

AUTHORS: S. E. Dodd, A. Subramanian, F. T. Lytle;

AFFILIATION: Anesthesiology, Mayo Clinic, Rochester, MN

INTRODUCTION: Intravenous catheter-directed thrombolytic (CDT) therapy is becoming standard of care for patients with acute arterial occlusion¹. All these patients are managed in the ICU. However, there is limited data on ICU related organ complications in this patient population. In this study, we characterize the incidence of ICU centric complications in patients receiving CDT using a single center cohort.

METHODS: All patients presenting with acute arterial occlusion who received catheter directed thrombolytic therapy between 2007 & 2012 at a single tertiary referral center were retrospectively studied. The primary outcomes of interest were defined as follows: ICU mortality, 30 day mortality, acute kidney injury (AKI) - AKIN definition, acute lung injury (ALI) - European-American consensus definition, requirement for mechanical ventilation, major and minor bleeding (TIMI bleeding score³) and number of units transfused. Baseline demographic and anthropomorphic data, comorbid illness, severity of illness score (ICU admission APACHE 3) and daily SOFA score were extracted from the medical record². The following risk factors for organ injury were also extracted: iodinated radiocontrast exposure (ml), nephrotoxic medications, daily fluid balance and total volume of blood products transfused. The data is presented as medians (25% - 75% interquartile range) or percentages as appropriate.

RESULTS: We identified 94 patients with 104 ICU admissions for CDT therapy. Median (IQR) age was 63.9 (54.4-75.4) years, 63 (68%) were male, 29 (32%) were diabetic, 21 (23%) were smokers and 21 (23%) had chronic kidney disease. Admission APACHE was 30 (IQR 20-40). Therapies received while in the ICU are shown in table 2. All patients were exposed to radiocontrast [median 235 cc (IQR 172-300)] and RBC transfusions [(27 patients (29%) received a median 822.9 cc (IQR 33-1980)]. Complications encountered are also shown in table 1: bleeding (5 (4.8%) major, 19 (18.3%) minor), AKI (12, 11.5%), ICU mortality (16, 15.4%) and 30 day mortality (29, 27.9%).

CONCLUSIONS: Patients receiving CDT have a high severity of illness on presentation, undergo therapies that are potentially injurious to organs, and have a high rate of major morbidity and mortality.

REFERENCES:

1. J Vasc Surg 52:512-5, 2012.
2. Mayo Clin Proc 87(9):817-824, 2012.
3. Circulation 23:2736-47, 2011.

Table 1. Therapies and complications in ICU patients undergoing CDT for acute thrombus

	Median (25%-75% IQR)	n (%)
Iodinated Contrast (cc)	235 (172-300)	103 (99.0%)
RBC (cc)	822 (330-1980)	27 (26.0%)
Bleeding		24 (23.0%)
Minor bleeding		19 (18.3%)
Major bleeding		5 (4.8%)
AKI		12 (11.5%)
Mechanical ventilation		
Invasive		13 (12.5)
Non-invasive		2 (2)
Length of stay (days)		
ICU	2.3 (1.9-3.1)	
Hospital	5.7 (3.5-9.1)	
Mortality		
ICU		16 (15.4%)
30-day		29 (27.9%)

S-416.**THE EFFECTIVENESS OF A REAL-TIME ELECTRONIC ALERT TO DETECT SEVERE SEPSIS IN AN INTENSIVE CARE UNIT****AUTHORS:** J. Chang¹, M. C. Sullivan², E. R. Shea², D. Shimabukuro¹**AFFILIATION:** ¹Anesthesia, University of California, San Francisco, San Francisco, CA, ²Innovations in Population Health, University of California, San Francisco, San Francisco, CA**INTRODUCTION:** Early identification and early implementation of a sepsis resuscitation bundle can reduce mortality¹. However, identification of severe sepsis, especially in Intensive Care Unit (ICU) patients with multiple co-morbidities, can be difficult.

At our institution, a real-time screening electronic alert tool was created to identify potential patients with severe sepsis admitted to an adult mixed medical-surgical ICU. The computer-generated alert uses real-time physiologic and laboratory data found in patients' electronic medical records (EMR). For an alert to be generated, there needed to be at least 2 systemic inflammatory response syndrome (SIRS) criteria [1) white blood cell count > 12 or < 4 x 10⁹/L, 2) heart rate > 100 beats/minute, 3) respiratory rate > 22 breaths/minute, or 4) temperature > 38.3 or < 35.5 C] and end organ damage (defined by the Surviving Sepsis Campaign). The purpose of this study was to determine the positive predictive value, negative predictive value, sensitivity, and specificity of this alert.

METHODS: After receiving approval from the Committee on Human Research, charts for all patients admitted to an adult 16-bed mixed medical-surgical ICU between June 01, 2014 and June 30, 2014 were reviewed for the diagnosis of severe sepsis and to obtain physiological data at time of presentation. This was then compared to a computer-generated list of all severe sepsis alerts. To address variability and accuracy of the diagnosis of severe sepsis, all chart reviews were performed by the same physician; for quality assurance, 10% of the charts were re-reviewed by a senior physician.

RESULTS: During the one-month period, 31 of 91 patients (34.1%) admitted to the ICU had severe sepsis and 41 of 91 patients (45.1%) had an alert. Of the 31 severe sepsis patients, 27 triggered an alert at some time during their ICU admission. Of the remaining 60 patients without a diagnosis of severe sepsis, 14 generated a positive alert. The calculated positive predictive value (PPV) for the alert was 65.9% and the calculated negative predictive value (NPV) was 92.0%. The sensitivity was determined to be 87.1% while the specificity was 76.7%.

CONCLUSIONS: In this mixed medical-surgical population, the PPV and NPV of our EMR-based alert are higher than that of fecal occult blood testing for colon cancer detection (PPV 41.3%, NPV 78.7%)², and the PPV of this alert is similar to mammography for breast cancer detection (PPV 68%, NPV 99.6%)³. This tool was designed specifically for a mixed medical-surgical intensive care unit, therefore it may be useful in other hospitals with ICUs that have similar patient populations, but test characteristics may be different in institutions with separate surgical and medical intensive care units. A major limitation to our study is the sample size. However, at this point, our findings suggest an EMR-based sepsis alert may be useful as a screening tool to automatically identify potential patients with severe sepsis.

REFERENCES:

1. Critical Care Medicine 2014; 42(8):1890-1998.
2. Canadian Medical Association Journal 2011;183(13):1474-1481.
3. British Journal of Cancer 1997; 76(3):377-381.

S-417.

MEASUREMENT OF HEMOSTASIS BY THROMBO-ELASTOGRAPH (TEG) DURING THERAPEUTIC HYPOTHERMIA AFTER CARDIAC ARREST

AUTHORS: C. L. Nelson¹, R. M. Craft², J. R. Langdon¹

AFFILIATION: ¹Anesthesiology, University of Tennessee, Knoxville, TN, ²Anesthesiology, University of TN COM Knoxville, Knoxville, TN

INTRO: Purpose of the study was to measure by thromboelastography (TEG) hemostasis before cooling, during therapeutic hypothermia, and during warm-up to evaluate in real-time the coagulation profile. The effect of anticoagulants were examined prior to starting the hypothermia protocol and its effect on TEG values and mortality.

Hypothermia has been used for neuroprotection after cardiac arrest. A few studies have been done in healthy patients without trauma or surgery. One study (n=16) used samples at 36°C, 34°C, & 32°C. Results showed R time (clot time) was increased with a drop in body temp, but the MA (clot strength) wasn't affected.¹

Other studies have cited the use of anticoagulants as a risk regarding initiation of hypothermia and have caused clinicians concern for coagulopathy.

The effect of dropping temperature to 33°C for 24 hrs after cardiac arrest on hemostasis in the setting of anticoagulants has not been investigated.

METHODS: 56 patients were prospectively considered for inclusion if admitted for therapeutic hypothermia after cardiac arrest. Patients with pre-existing coagulopathy and patients who fell outside of protocol for therapeutic hypothermia during cooling or re-warming were excluded. 16 patients were included in the study. That group was subdivided into 10 patients receiving anticoagulant and 6 who did not. The group of 16 was assessed for mortality: living or dead. Blood samples were drawn at admission prior to cooling, every 4 hrs during cooling, and at 33°C (target temp) and subjected to TEG for effect on the R, alpha angle, & MA at each temperature. TEG samples were also taken during re-warming at 34°C, 35°C, & 36°C. Data sets were analyzed with marginal means & factorial ANOVA

RESULTS: Figs. 1 & 2 show difference among mortality groups over time for angle (p = .005) & R (p<0.001) Figs 3 & 4 show interaction between anticoagulant and no drug groups among patients who were alive over sample time points indicating angle in living patients is not negatively impacted by anticoagulants. No difference was seen in use of anticoagulant & mortality groups (p=.22)

CONCLUSIONS: This study showed patients had poor function of coagulation factors (prolonged R) & low fibrinogen (decreased angle) prior to cooling, but no significant changes during cooling or re-warming despite use of anticoagulants. This suggests therapeutic hypothermia doesn't worsen coagulopathy. Also, anticoagulant therapy prior to admission didn't cause an increase in mortality which may help clinicians make more informed choices when starting therapeutic hypothermia. Platelet function was preserved after cardiac arrest and during therapeutic hypothermia despite use of anticoagulants. The literature often cites this as a potential risk regarding hypothermia. R value & Angle may have associations with survival after cardiac arrest as evidenced by the pattern of change seen in these patients when therapeutic hypothermia is indicated.

Future studies include a multi-center trial which may provide an opportunity to increase cases, thus increasing statistical power, hopefully showing effects in patients for R & Angle.

REFERENCES:

1 Anesth Analg 2003;96:1772-6

Figure 1 Mortality difference across time with for R values

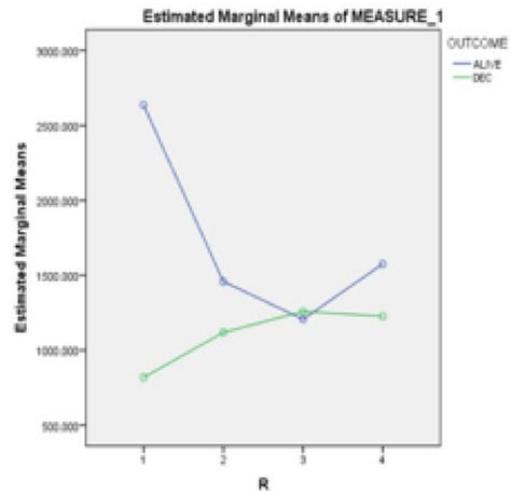
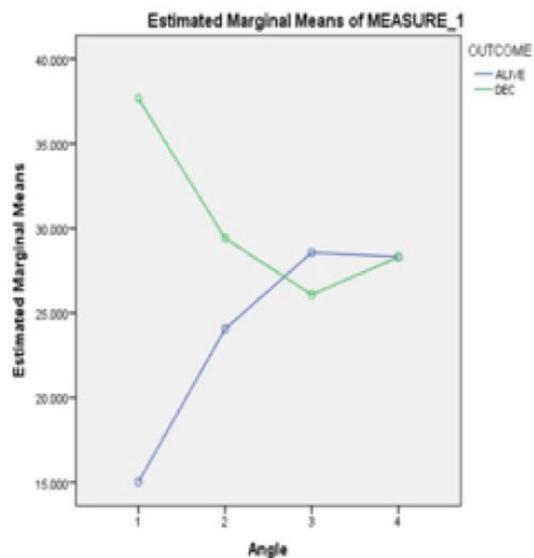


Figure 2 Mortality difference across time for Angle



S-418.**ALEMTUZUMAB AND PULMONARY COMPLICATIONS IN RENAL TRANSPLANT RECIPIENTS: A CASE SERIES****AUTHORS:** K. Gelber¹, H. Aslam¹, G. Wagener², R. Whittington¹**AFFILIATION:** ¹Anesthesiology, Columbia University Medical Center, New York, NY, ²Anesthesiology, Columbia University, New York, NY

INTRODUCTION: Alemtuzumab (Campath®) is a humanized anti-CD52 antibody that is approved for the treatment of refractory chronic lymphocytic leukemia (CLL), and it is also used at our institution for the induction of immunosuppression during kidney transplantation. The overall safety profile of this immunosuppressant is incompletely understood. In CLL patients, the majority of adverse events were infectious in nature; however, studies have shown up to a 28% incidence of dyspnea and 3% incidence of hypoxia in awake patients¹. Intraoperative complications following alemtuzumab, and specifically pulmonary complications, have rarely been reported but include one case of diffuse alveolar hemorrhage² and one case of dependent pulmonary edema³. Here we review three recent renal transplant cases at our institution with pulmonary complications following alemtuzumab administration.

METHODS: We performed a retrospective review of three cases that took place from December 2013 through September 2014. Details of alemtuzumab administration, arterial blood gases, and specific pulmonary complications were reviewed from computerized anesthesia records (CompuRecord®) and electronic medical records.

RESULTS: The standard dose of 30mg of intravenous alemtuzumab was given intraoperatively as an infusion over 4-6 hours. Fig. 1-3 illustrate that both PaO₂ and PaO₂/FiO₂ (P:F) ratio trended down after alemtuzumab infusion was initiated. The percent decline in P:F ratio ranged from 18.8% to 56.2%. This occurred from 148 minutes to 286 minutes after the start of the alemtuzumab infusion, respectively. On average, the P:F nadir occurred after 214 minutes. Case 1 (Fig. 1) was extubated at the end of the case but suffered a respiratory arrest en route to the PACU. Case 2 (Fig. 2) was also extubated but required BiPAP in the PACU. Case 3 (Fig. 3) developed a P:F ratio consistent with ARDS and remained intubated in the PACU for 15 hours post-op.

CONCLUSIONS: Induction immunosuppression with alemtuzumab is potentially associated with acute pulmonary toxicity in renal transplant patients, sometimes resulting in significant morbidity. Therefore, it is important that transplant anesthesiologists be aware of the risk of pulmonary complications with alemtuzumab, especially when making clinical decisions regarding termination of ventilatory support. A larger retrospective review of all patients receiving alemtuzumab intraoperatively is warranted to better understand this phenomenon.

REFERENCES:

1. Keating MJ et al (2002) Therapeutic role of alemtuzumab (campath-1H) in patients who have failed fludarabine: results of a large international study. *Blood* 99:3554-3561.
2. Sachdeva A, Matuschak GM (2008) Diffuse alveolar hemorrhage following alemtuzumab. *Chest* 133:1476-1478.
3. Grable B, Sakai T (2010) Isolated left-sided pulmonary edema caused by alemtuzumab (Campath) during kidney transplantation. *Transplant International* 23:851-854.

S-419.

THE BEST HEAD ANGLE FOR CENTRAL LINE PLACEMENT: A NEW APPROACH

AUTHORS: T. Jan, V. DeAngelis, J. T. Denny, D. Chyu, A. Solina

AFFILIATION: Anesthesiology, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ

INTRODUCTION: The internal jugular vein (IJV) is frequently utilized for both venous access and monitoring purposes in the perioperative period. Ultrasound guided techniques have improved the efficiency and safety of IJV cannulation. The relationship between head rotation and the relative anatomy of the right IJV and the carotid artery (CA), as it pertains to the safety of IJV cannulation, has not been elucidated. The aim of this study is to determine the degree of head rotation that creates the maximal anatomical separation between the right IJV and the CA.

METHODS: After IRB approval, informed consent was obtained from 50 patients in 2013-2014. Subjects included in the study were patients over 21 years of age undergoing cardiac surgery. All patients were placed supine, with Trendelenburg positioning at 15°. An US probe was used to capture an image of the right IJ and CA, and measurements were done using a digital caliper. The distance between the vessel centers, the closest distance between vessel edges, the RIJV diameter, and the CA diameter were measured. In addition, unencumbered vertical and horizontal distance was measured, which were defined as length of vein that did not overlap with the CA in the vertical and horizontal plane, respectively. These values were reported as a percent of the IJ exposed. All of the measurements were performed with the patient's head at -15°, 0°, 15°, 30°, 45°, 60°, 75°, and 90°.

RESULTS: Measurements for all 50 patients were averaged at every head angle and are tabulated in Table 1. With the patient head at 0°, the distance between the centers of the RIJV and the CA was 1.19±0.04 cm. The distance between the edges of the IV and CA at 0° was 0.16 ±0.03 cm. The IJ diameter and CA diameter at 0° were 1.31±0.07 cm and 0.76±0.02 cm respectively. All of the above were not statistically different among different head angles. At 0°, 87.2%±2.9 of the IJ was unencumbered laterally and 37.2%±3.9 of the IJ was unencumbered vertically. There was no statistical difference between the different head angles laterally, but there was a difference between the groups vertically (p<0.01). Unencumbered vertical distance was different between 75° vs. 0°, and 75° vs. 15°. At 75°, 60.3%±5.3 of the IJ was unencumbered vertically. It is important to note that only 72% of the patients were able to position their head at 75° and 54% of the subjects were able to position their head at 90°.

CONCLUSION: We did not find a difference between the head angles with regard to IJ to CA distance, IJ diameter, CA diameter, or lateral unencumbered distance. However, we did find that the IJ was more vertically unencumbered at 75° versus 0° and 15°, indicating that the IJ may become more separated from the CA at more extreme head angles. However, we found that patients were less likely able to position their head at these extreme angles. Our study is notable because it describes a new method of assessing access to the IJ by ultrasound: describing the unencumbered distance of the IJ, both horizontally and vertically.

REFERENCES:

1. Crit Care. 2006; 10(6): R162
2. Anesthesiology. 1996;85:43-8
3. J Emerg Med. 2006 Oct;31(3):283-6
4. Anesth Analg. 2005;100(2):514

Table 1: Tabulated measurements of all subjects at all head angles

	Degrees								p-value
	-15	0	15	30	45	60	75	90	
Distance from center of artery to vein (cm) (SD)	1.10 (0.04)	1.19 (0.04)	1.18 (0.04)	1.14 (0.05)	1.15 (0.04)	1.12 (0.05)	1.09 (0.04)	1.06 (0.04)	0.455
Distance from edge of artery to vein (cm) (SD)	0.15 (0.02)	0.16 (0.03)	0.15 (0.03)	0.14 (0.02)	0.16 (0.03)	0.11 (0.02)	0.13 (0.02)	0.12 (0.03)	0.849
Carotid Artery diameter (cm) (SD)	0.74 (0.02)	0.76 (0.02)	0.76 (0.03)	0.77 (0.02)	0.72 (0.03)	0.71 (0.03)	0.73 (0.03)	0.71 (0.03)	0.937
Internal Jugular Vein diameter (cm) (SD)	1.28 (0.08)	1.31 (0.07)	1.35 (0.06)	1.36 (0.07)	1.39 (0.07)	1.34 (0.07)	1.26 (0.06)	1.32 (0.09)	0.465
Percent Unencumbered Lateral Distance (%) (SD)	83.1 (3.1)	87.2 (2.9)	86.4 (2.7)	81.7 (3.2)	81.9 (3.4)	81.6 (3.7)	75.3 (4.4)	76.8 (4.1)	0.213
Percent Unencumbered Vertical Distance (%) (SD)	41.5 (4.5)	37.2 (3.9)	40.3 (3.8)	44.4 (3.9)	46.5 (4.3)	45.4 (4.9)	60.3 (5.3)	54.7 (5.2)	0.01

S-420.

WITHDRAWN.

S-421.**DAILY LOWEST HEMOGLOBIN PREDICTS RESPIRATORY DYSFUNCTION IN CRITICALLY ILL PATIENTS**

AUTHORS: S. Hemauer¹, A. Kingeter¹, X. Han², M. S. Shotwell², P. Pandharipande¹, L. M. Weavind¹

AFFILIATION: ¹Anesthesiology, Vanderbilt University Medical Center, Nashville, TN, ²Biostatistics, Vanderbilt University, Nashville, TN

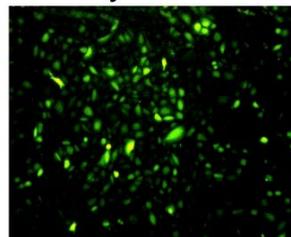
INTRODUCTION: Anemia is common in the ICU population, however transfusion of packed red blood cell (PRBC) is associated with worse clinical outcomes. Restrictive transfusion strategies have been adopted, with a resultant decrease in PRBC use and acceptance of anemia. What remains unclear is the impact of this anemia on the daily risk of individual organ dysfunctions in medical and surgical ICU patients

METHODS: We performed a post-hoc analysis of prospectively collected data from the BRAIN-ICU observational cohort study of medical and surgical ICU patients admitted with respiratory failure or shock. Baseline demographic data as well as detailed in-ICU and hospital data, including daily hemoglobin levels, were collected in the study up to hospital day 30. Patients were evaluated daily for brain dysfunction (delirium) using the CAM-ICU, for renal dysfunction using the renal SOFA score (based on creatinine and urinary output) and for respiratory dysfunction using the respiratory SOFA score (based on the PaO₂/FiO₂ ratio) or need for mechanical ventilation. We also collected data on in-hospital mortality and calculated time to death. The adjusted associations between the current day hemoglobin level and organ dysfunction the following day were assessed using multinomial, ordinal (proportional odds) and binary logistic regression. Cox proportional hazards regression with time-varying covariates was used to assess the adjusted association between current day hemoglobin and time to death. In each analysis, we adjusted for covariates including age, the APACHE II score, Charlson comorbidity index, Framingham stroke risk profile, ICU day, ICU type (medical vs. surgical), current sepsis, current organ dysfunction, and current lowest hemoglobin level. Statistical significance was indicated for p-values less than 0.05, or for 95% confidence intervals that fail to include the relevant null value.

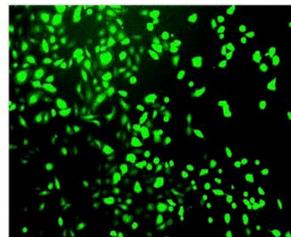
RESULTS: In 821 medical and surgical ICU patients with a median (interquartile, IQR) age of 61 (51, 71), APACHE II score of 21 (15, 26), there was no evidence of an association between current hemoglobin level and brain dysfunction, renal dysfunction, or the odds of mechanical ventilation the following day, or time to death. Daily lowest hemoglobin was significantly associated with worsened respiratory SOFA score the following day, with odd ratio of 0.72 ((0.56-0.95), p <0.019). Each increasing hemoglobin unit (g/dL) decreased the odds of more severe respiratory SOFA score the following day by 28%. This protective effect was significantly reduced in patients with greater current respiratory SOFA score (worse respiratory status) (interaction p=0.05).

CONCLUSION: In this study population, lower hemoglobin levels were associated with more severe respiratory dysfunction the following day, especially in patients who previously had a lower respiratory SOFA score implying less pulmonary dysfunction. No association was found between hemoglobin and next day delirium, renal dysfunction, mechanical ventilation, or death. Of the organ systems investigated in this study, the lung appears to be the most associated with daily anemia.

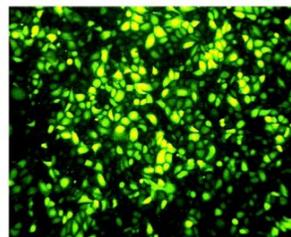
Isoflurane induced ROS generation Carboxy-H2DCFDA Fluorescence



Carrier Gas
16 hrs



Isoflurane
2.5% 6 hrs



Isoflurane
2.5% 16 hrs

S-422.**TETRAHYDROBIOPTERIN IMPROVES CAPILLARY PERFUSION AND DECREASES LEUKOCYTE ADHESION WITHIN THE INTESTINAL MICROCIRCULATION IN EXPERIMENTAL SEPTIC SHOCK IN THE RAT**

AUTHORS: T. C. Dumbarton¹, N. Farah², A. Maxan², J. Zhou², J. Nantais³, N. Shawari³, C. Lehmann¹

AFFILIATION: ¹Anesthesiology, Perioperative Medicine and Pain Management, Dalhousie University, Halifax, NS, Canada, ²Pharmacology, Dalhousie University, Halifax, NS, Canada, ³General Surgery, Dalhousie University, Halifax, NS, Canada.

INTRODUCTION AND GENERAL PURPOSE: Microvascular changes represent a key pathophysiologic mechanism in septic shock, resulting in inadequate blood flow, up-regulated leukocyte-endothelial cell interaction and breakdown of endothelial barrier function^{1,2}. Clinically, these mechanisms lead to hypotension and inflammation and eventually to organ dysfunction. Tetrahydrobiopterin (BH4) is an endogenous nucleic acid derivative that acts as an important cofactor for several enzymes, including nitric oxide synthase^{3,4}. Recently, BH4 has been used as an experimental treatment for septic shock⁵, however, little is known about the effect of tetrahydrobiopterin on the microcirculation of key vascular beds, such as the intestine. The aim of the study was to examine the effect of intravenous BH4 on intestinal microcirculation in a model of septic shock in rats. Our hypothesis was that BH4 would improve microvascular flow and decrease inflammation within small blood vessels of the intestine.

METHODS: We conducted a randomized, controlled trial using an endotoxemia model of septic shock in Lewis rats. Experimental design was approved by the local Animal Care and Use Committee. Rats were anesthetized with sodium pentobarbital and assigned into one of 5 experimental groups (n=5 each): 1) Control: received saline only; 2) LPS: received endotoxin (20mg/kg lipopolysaccharide from *E. coli*), no BH4, no norepinephrine (NE); 3) LPS + NE: Endotoxin, titrated NE, no BH4; 4) BH4: No endotoxin, and BH4 bolus (20mg/kg); 5) LPS + NE + BH4: Endotoxin, titrated NE and BH4 bolus.

At the two-hour time point, a segment of terminal ileum was externalized and examined by intravital microscopy. Specifically, we created video recordings of multiple visual fields within the intestinal wall to study leukocyte adhesion within submucosal venules and capillary blood flow within the mucosa and muscle layers. Video recordings were analyzed to quantify leukocyte adhesion and functional capillary density.

RESULTS AND MAJOR FINDINGS: Compared with standard treatment of intravenous fluids and norepinephrine infusion, the addition of BH4 improves functional capillary density in capillary beds within the intestine (141.3 vs. 106.7 mm/cm², p<0.05, Figure 1). BH4 also decreases leukocyte adhesion in submucosal postcapillary (=V3) venules to a greater degree than norepinephrine treatment alone (1230 vs. 679 adherent leukocytes per mm², p<0.05; Figure 2). Hemodynamics were no different between standard treatment and BH4.

CONCLUSIONS: BH4 presents a novel therapeutic approach in septic shock. This study demonstrates, in a rat model, that BH4 improves standard indices of microvascular function in endotoxemic shock more effectively than NE treatment alone, despite similar hemodynamic parameters between groups. BH4 may therefore represent an important adjunct in the treatment of septic shock in clinical practice and further dose-finding studies and clinical trials are warranted.

REFERENCES:

1. Crit Care Med. 2004; 32:1825-31
2. Crit Care. 2004; 8:462
3. Trends Cardiovasc Med 2004; 14:323-327
4. Crit Care Med. 2012; 40:2833-40
5. Vasc Pharm. 2013; 58:219-23

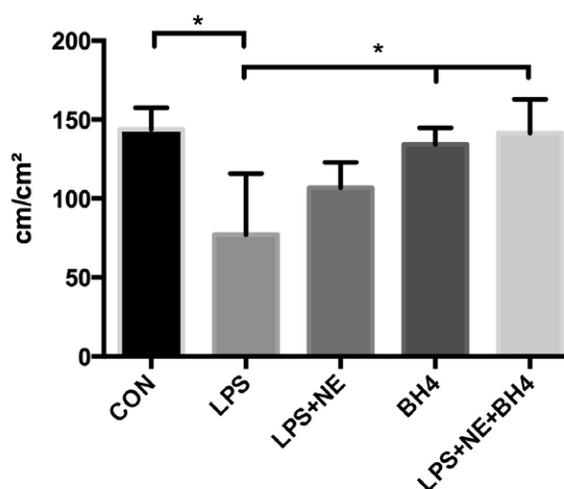


Figure 1. Functional capillary density of the circular muscle layer of rat intestine. * p<0.05, One way ANOVA.

Con: Control; LPS: lipopolysaccharide; NE: norepinephrine; BH4: tetrahydrobiopterin.

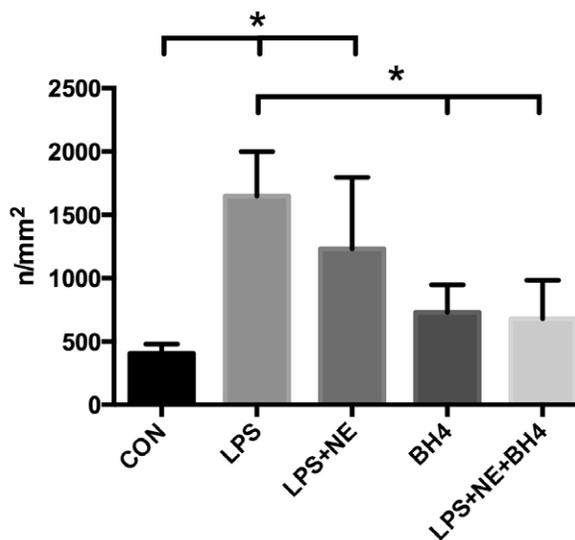


Figure 2. Leukocyte adherence in V3 venules in the rat intestine. * p<0.05, One way ANOVA.

Resident Abstracts

Economics, Education & Policy

S-402.**YOUTUBE AS A PLEBEIAN SOURCE OF
KNOWLEDGE FOR LABOR EPIDURAL ANALGESIA:
MISCONCEPTIONS UNRAVELED**

AUTHORS: M. Tickoo¹, A. Bardia², J. Jainandunsing², B. Jachna²

AFFILIATION: ¹MEDICINE, BMC, Boston, MA, ²Anesthesia, Critical Care and Pain Medicine, BIDMC, Boston, MA

INTRODUCTION: Despite the use of labor epidural analgesia since many decades, there still exist prevalent misconceptions related to its usage in the general population. YouTube, a widely used source of audio-visuals; is a first point of contact for many individuals even for health information. However, there is no quality check to assess the authenticity of the information provided by YouTube videos on healthcare related topics including epidural analgesia.

OBJECTIVE: The primary aim of our study was to evaluate the quality and the accuracy of information in the existing YouTube videos on the subject.

METHODS: The website (www.youtube.com) was searched for keywords: lumbar anesthesia, epidural, labor analgesia, labor pain control. Videos containing non-labor epidural placements, in languages other than English and personal experiences were excluded.

RESULTS: A total of 26 videos addressing the topic were found. Only a third (34.61%) of the videos were uploaded by anesthesiologists. A substantial number of videos (15.38%) had misinformation about labor epidural. Some of the common misconceptions seen were present in the videos such as an epidural is harmful for the fetus, epidural increases the rate of cesarean section etc. Most of the videos did not discuss the possibility of an epidural failure (80.76%) or common complications (61.53%).

CONCLUSION: There is a paucity of accurate information on YouTube regarding epidural analgesia, with a high percentage of videos uploaded by non-experts conveying a significant amount of misinformation. Expert committees from IARS/ASA/SOAP should consider uploading official videos to deliver accurate information to the community.

S-423.**WITHDRAWN.**

S-424.**EDUCATION CAN REDUCE OPERATING ROOM WASTE COSTS****AUTHORS:** A. Odefey¹, M. Tsai¹, D. M. Mathews¹, Z. Harambasic²**AFFILIATION:** ¹Dept. of Anesthesiology, University of Vermont Medical Center/University of Vermont College of Medicine, Burlington, VT, ²Dept. of Perioperative Services, University of Vermont Medical Center, Burlington, VT**INTRODUCTION:** Four billion pounds of waste are produced annually by American health care facilities, with operating room and labor-delivery suites generating approximately 70% of this hospital waste.¹ Regulated medical waste (i.e. sharps, red-bag) represent high-cost waste streams in both economic and ecologic terms.² At our institution, visual inspection of OR sharps bins' contents revealed a high proportion of empty glass medication containers, which do not need to be processed as regulated medical waste. Instead, these vials can be disposed of in trash bins at a vastly reduced environmental and economic cost.² We theorized that simple educational interventions regarding OSHA and institutional guidelines on disposal of empty glass medication vials would reduce the amount of sharps waste produced in our institution's ORs.**METHODS:** The institution's IRB did not require review. First, we recorded the weight (in kg) of both pharmaceutical and sharp bins' contents at anesthesia work stations in four operating rooms over an eleven day period. Then, we delivered an educational presentation at Grand Rounds for the Department of Anesthesiology, distributed the information via email and placed posters near anesthesia work stations.

Following the educational interventions, pharmaceutical and sharps waste bins' contents in the same operating rooms were weighed over similar eleven day periods, five times over the next ten months. Case volumes were compared between the study periods and found to be similar. Data from pre-intervention to post-intervention was compared by t-test. An ANOVA was performed to ascertain differences among the time periods.

RESULTS: Prior to the educational interventions, the average amount (mean \pm SD) of sharps waste from the four operating rooms over the eleven day study period was 3.2 ± 1.0 kg. Following the intervention the average amount of sharps waste from the four operating rooms was 1.35 ± 0.5 kg ($p < 0.001$). The pre-intervention data was significantly different from each post-intervention measurement, while the post-intervention data were not significantly different from each other. The mean total amount of pharmaceutical waste was reduced, but not significantly so, indicating that waste was not simply diverted from sharps to pharmaceutical bins.**CONCLUSIONS:** This 57% reduction represents significant cost savings in both economic and ecologic terms. If maintained throughout a year and extended to all of our ORs, savings could amount to more than \$15,000 annually. If all sharps waste in our hospital could be reduced by the same proportion, our hospital could save almost \$75,000 annually. The ecological savings realized through this reduction in sharps waste, though not quantified in this study, offer additional benefit. This project illustrates the impact anesthesiologists can have in improving a hospital's financial and environmental functioning. It also provides an example of the benefit that anesthesiologists could deliver by embracing the Perioperative Surgical Home concept.**REFERENCES:**

1. Arch Surg. 2011; 146(2):131-136
2. Hospital Safety Officer. Personal Communication.

S-425.

AN EVALUATION OF THE PREFERRED LEARNING STYLES OF INCOMING FACULTY AND HOUSESTAFF: A MULTIDISCIPLINARY AND MULTIGENERATIONAL APPROACH

AUTHORS: T. Northern, L. Daste, P. G. Boysen

AFFILIATION: Anesthesiology, Ochsner Clinic Foundation, New Orleans, LA

INTRODUCTION AND GENERAL PURPOSE OF THE STUDY: Due to limits of resident’s workhours, it is necessary to improve the quality of resident education. We investigate the learning styles of incoming housestaff and faculty as a start in answering an important question as to whether training can be improved by evaluation of learning styles. Kolb described four learning styles: Converging, Accommodating, Diverging and Assimilating. Convergers are detail-oriented, preferring to practically trial new ideas. Accommodators are able to pull out important details of complex situations and prefer learning actively. Divergers ask “why” when learning and prefer to work in groups. Assimilators aim for vast knowledge, preferring passive learning.

METHODS: We used a learning style inventory adapted from Kolb and McCarthy to determine the learning style of incoming housestaff (n=95), consisting of Medicine (37), fellows (20), Surgery (19) and Anesthesiology (19); as well as incoming faculty, including Medicine (27), Surgery (8), Anesthesiology (8)and Pediatrics (7) .

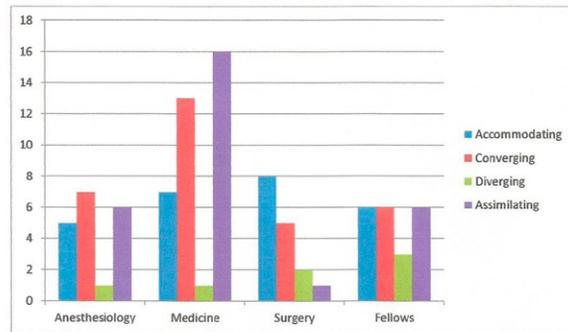
RESULTS AND MAJOR FINDINGS: The learning styles amongst housestaff showed a variety of all types with a fairly even spread of Converging, Assimilating and Accommodating. The results for incoming faculty were drastically different than the incoming housestaff. Internal Medicine and Pediatrics faculty demonstrated the greatest distribution, with the majority being either Diverging or Accommodating. Surgery and Anesthesiology faculty showed a preponderance of Divergers.

CONCLUSIONS: Our findings demonstrate diversity in learning styles amongst incoming housestaff, contrasted to faculty that was primarily Divergers and Accommodators. Most doctors do not have formal training in education, yet are charged with providing critical teaching to the next generation. As residency training transitions from a primarily apprenticeship to a problem-based learning didactic with limited workhours, it is necessary to self-evaluate the quality of resident training. It may prove helpful for residents to understand their own preferred learning style.

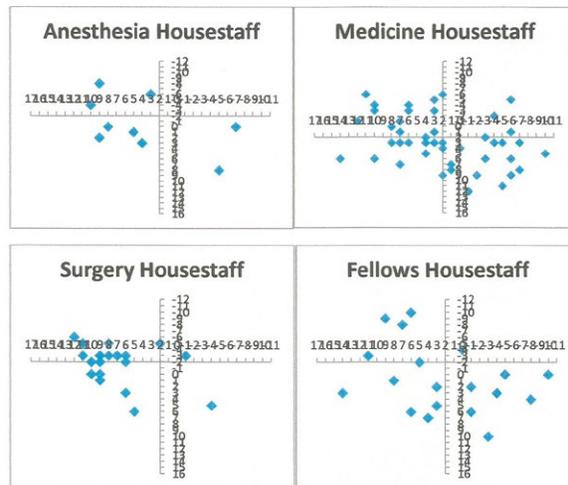
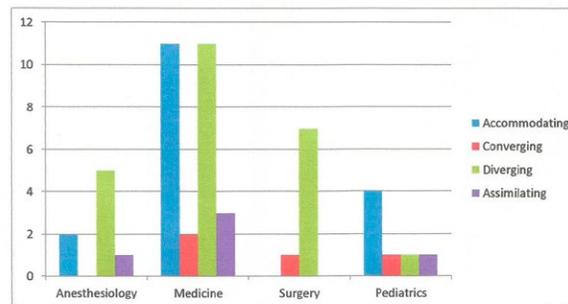
REFERENCES:

1. Contessa J, Ciardiello KA, Perlman S. Surgery Resident Learning Styles and Academic Achievement. *Current Surgery*. 2005; 62: 344-347.
2. Jack MC, Kenkare SB, Saville BR, Beidler SK, Saba SC, West AN, Hanemann MS, van Aalst JA. Improving Education under Work-Hour Restrictions: Comparing Learning and Teaching Preferences of Faculty, Residents, and Students. *Journal of Surgical Education*. 2010; 67: 290-296.
3. Smits PBA, Verbeek JHAM, Nauta MCE, Ten Cate THJ, Metz JCM, Van Dijk FJH. Factors predictive of successful learning in postgraduate medical education. *Medical Education*. 2004; 38: 758-766.
4. Adesunloye BA, Aladesanmi O, Henriques-Forsythe M, Ivonye C. The Preferred Learning Style among Residents and Faculty Members of an Internal Medicine Residency Program. *Journal of the National Medical Association*. 2008; 100: 172-5.

Housestaff Learning Styles



Faculty Learning Styles



S-426.

WITHDRAWN.

S-427.

EXPERIENTIAL LEARNING: APPLYING THE KOLB LEARNING STYLE INVENTORY IN ANESTHESIOLOGY EDUCATION

AUTHORS: L. Daste, T. Northern, P. G. Boysen;

AFFILIATION: Anesthesiology, Ochsner Clinic Foundation, New Orleans, LA

INTRODUCTION AND GENERAL PURPOSE OF STUDY:

The need for experiential learning is a reality and the *raison d'être* in postgraduate medical training. Didactic learning does not translate into a knowledgeable and effective practitioner. We sought to assess and improve learning in anesthesia by utilizing a concept and methodology formulated by David Kolb¹. He described four distinct learning styles associated with preferred styles of learning: Converging (solving technical problems and experimenting with new ideas), Accommodating (hands-on, relying on others for information, acting on instinct), Diverging (watching/gathering information and working in groups) and Assimilating (interested in ideas and abstract concepts).

Kolb further theorized that career choices are based on preferred learning styles; as such, physicians and scientists would fall in the converging domain. Our initial hypothesis sought to refute this assertion, at least for anesthesiologists, as a starting point toward improved teaching and learning.

METHODS: We administered the Learning Style Inventory (LSI) to faculty and resident volunteers. We enrolled 16 residents and 25 faculty who completed the LSI, then graphically located their position on the LSI chart, thereby identifying their learning style based on which of the four quadrants into which they were placed. These data points are presented in Figure 1.

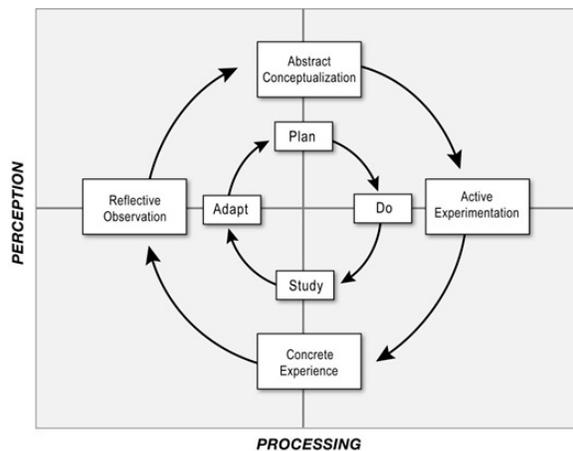
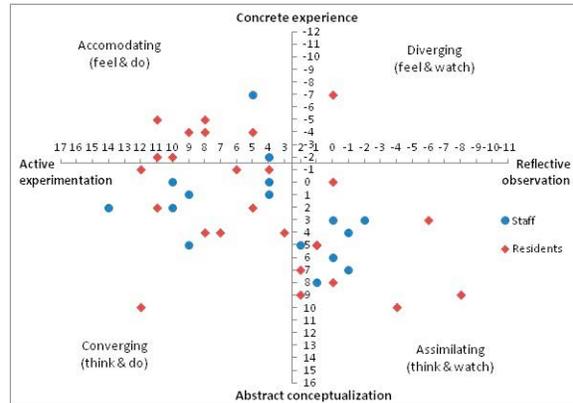
RESULTS:

1. Our data does not show a preferred learning style for resident or staff anesthesiologists.
2. The diverging learning style is almost an empty cell but for one individual.
3. Only 24% of participants fell above the x-axis, i.e. most people were either convergers or assimilators.

CONCLUSIONS: It has been said that experience is the hardest teacher; the test comes first, then the lesson. In anesthesiology experiential learning predominates in the operating room and intensive care unit, yet experience teaches us nothing without reflection and analysis. For effective organizational learning, Kolb proposed that cycling through all four domains is necessary (2), and our data indicates that the same is true for individual learning. Further, quality improvement utilizes the PDSA cycle (Plan -> Do -> Study -> Adapt), and developing run charts is based on the same concept (Figure 2). Experiential learning in the clinical setting predominates in anesthesiology. Supplemental learning using simulation and problem-based learning supports and enhances the clinical experience but cannot effectively replace it.

RESOURCES:

1. Assessing Experiential Learning Styles: A Methodological Reconstruction and Validation of the Kolb Learning Style Inventory. *Learning and Individual Differences*, v23 p44-52 Feb 2013.
2. *Experiential Learning: experience as the source of learning and development.* Prentice-Hall, Englewood Cliffs N.J. 1984.
3. Plan, Do, Study, Act (PDSA). http://www.institute.nhs.uk/quality_and_service_improvement_tools/quality_and_service_improvement_tools/plan_do_study_act.html



S-428.

READABILITY AND CONTENT ASSESSMENT OF WEB-BASED PATIENT EDUCATION MATERIALS ADDRESSING NEURAXIAL LABOR ANALGESIA

AUTHORS: H. C. Goucher¹, S. K. Patel¹, C. A. Wong², P. Toledo¹

AFFILIATION: ¹Department of Anesthesiology, Northwestern University, Chicago, IL, ²Department of Obstetric Anesthesiology, Northwestern University, Chicago, IL

INTRODUCTION: The Internet is increasingly utilized as a source of health care information. Web-based patient education materials (PEMs) should be written at a reading level appropriate for the average patient, which is at or below the 6th grade level per the US Department of Health and Human Services. The aim of this study was to evaluate the content, readability, and quality of English- and Spanish-language PEMs addressing neuraxial labor analgesia.

METHODS: The websites of 122 U.S. academic medical centers with obstetric anesthesia divisions were searched for English-language PEMs. A search for web-based PEMs was conducted using the names of these institutions along with search terms such as: obstetric anesthesia, labor analgesia, labor epidural, spinal anesthesia, and health information. Links to external websites were excluded. The readability of English-language PEMs was assessed with three validated indices: Flesch-Kincaid Grade Level (FKGL), Simple Measure of Gobbledygook (SMOG), and

Gunning Frequency of Gobbledygook (Gunning FOG). Scores reflect the grade level required to comprehend the material. A one-sample t-test was used to evaluate mean readability level against the recommended 6th grade reading level. A scoring matrix was developed to evaluate the content of PEMs. P < 0.05 was considered significant. Website quality was assessed for understandability and actionability using the previously validated Patient Education Materials Assessment Tool for Print (PEMAT-P).

RESULTS: Seventy-two English-language PEMs were identified. The mean readability levels of all PEMs were higher than the recommended 6th grade reading level using all indices (Table). All PEMs discussed the benefits of neuraxial analgesia, but only 14% discussed contraindications. Post-dural puncture headache and hypotension were the most commonly addressed complications (92%). All other complications were addressed by less than 50% of PEMs. PEMAT-P scores were consistent with poor understandability (mean (SD) 69.9% (14.3)) and poor actionability (27.5% (13.2)).

CONCLUSIONS: The mean readability of Web-based PEMs addressing neuraxial labor analgesia was above the recommended 6th grade reading level. Furthermore, while most PEMs explained the benefits of neuraxial analgesia, information about contraindications and complications was not consistently presented. Previous work has shown that patients have significant misunderstandings regarding labor analgesia, therefore the content, readability, and quality of PEMs should be improved to help patients make more informed decisions during labor and delivery.

Table Readability Scores of Web-based PEMs		
Readability Indices	Mean Score ± Standard Deviation	Comparison to 6 th Grade Reading Level (P-value)
FKGL	9.3 ± 2.0	< 0.001
Gunning FOG	11.9 ± 2.2	< 0.001
SMOG	8.8 ± 1.5	< 0.001

S-429.

TRANSITION OF CARE PROCESS BY GRADUATING MEDICAL STUDENTS IN A SIMULATED CRISIS SITUATION USING A COGNITIVE AID

AUTHORS: B. Ginter¹, A. Rebel², A. DiLorenzo², M. F. Lukens², J. S. Dority², Z. Hassan³

AFFILIATION: ¹Department of Anesthesiology, University of Kentucky, Lexington, KY, ²Anesthesiology, University of Kentucky, Lexington, KY, ³Anesthesiology, University of Kentucky, Lexington, KY

INTRODUCTION: Correct, complete, and effective communication during transition of care (ToC) is essential since loss of important information can compromise patient care, especially in crisis situations.¹ In a patient simulation (PS) scenario assessing the quality of the ToC process, significant loss of information and poor report quality was noted.² To address this issue, the authors developed a cognitive aid. The aim of this project was to assess: (1) 4th year medical students' ability to retrieve and report essential patient information under pressure, and (2) whether the use of a cognitive aid improves the quality of the ToC process.

METHODS: A PS crisis scenario was developed by the authors. 4th year medical students were enrolled after IRB approval, divided into groups of 3, and assigned roles (team leader, respiratory therapist, nurse). Participants viewed a video demonstrating a correctly performed ToC. After randomization, half of the teams were given a cognitive aid (History and Physical outline) to use during the scenario. The teams then participated in a scenario where they assumed care of an unstable patient. After a bedside nurse provided essential patient information, the patient deteriorated, allowing the team to run an ACLS code. After the participants stabilized the patient, they provided a verbal ToC report to the ICU provider. A video of the ToC scenario was reviewed by 3 expert faculty blinded to the randomization. Each faculty assessed the completeness of the ToC process using a checklist and rated the overall quality of the ToC process using a Likert scale (1=unsatisfactory, 5=outstanding). Completeness score is expressed as a percentage of maximum score.

RESULTS: A total of 112 medical students participated. 19 groups completed the PS using the cognitive aid (wCA n=19) and 19 groups did not use the cognitive aid (nCA). Two teams were excluded secondary to incomplete data collection (nCA n=17). ToC information improved significantly when a cognitive aid was used. The overall ToC quality was rated higher in the group with the cognitive aid. (Table 1).

CONCLUSIONS: The use of a cognitive aid improved the completeness and quality of ToC process as assessed by expert faculty. Further studies and refinement of the cognitive aid format are needed to optimize the positive impact on ToC during crisis situations.

REFERENCES:

1. Blum RH et. al. A Method for Measuring the Effectiveness of Simulation-Based Team Training for Improving Communication Skills. *Anesth Analg* 2005;100:1375-80.
2. Rebel A et. al. Loss of Information During Transfer of Care: Preliminary Results of a Simulation Project. Post Graduate Assembly, New York, NY 2013.
3. Ginter B et al. Assessment of the transition of Care Process in crisis situation using simulation. Does a cognitive Aid help? Post Graduate Assembly, New York, NY 2014.

Table 1

	Group nCA	Group wCA
	N=17	N=19
Completeness score	0.52 ± 0.07	0.80 ± 0.06*
Overall ToC quality score	1.92 ± 0.56	3.16 ± 0.65*

Data are shown as mean ± SD. *p-value (t-test, Mann-Whitney U-test) < 0.01

S-430.

THE SHIFT IN ANESTHESIOLOGIST PRACTICE PATTERNS DURING A DRUG SHORTAGE

AUTHORS: T. W. Engar, A. Slee, R. Hsiung

AFFILIATION: Anesthesiology, Virginia Mason Medical Center, Seattle, WA

INTRODUCTION: Drug shortages frequently challenge anesthesiologists. Propofol shortages and the clinical consequences of using substitute medications are not entirely new. In the critical care literature, midazolam was used as a propofol substitute and did not increase the duration of mechanical ventilation.¹ However, alternate medications can have adverse effects as shown in a study where the substitution of propofol with etomidate during a shortage led to increased incidence of phlebitis.² We examined how a moratorium on propofol use for sedation during a severe drug shortage affected anesthesiologists' choice of anesthetic for lower extremity total joint replacement surgery. Our theories were that providers would choose an alternative agent for sedation during a propofol shortage and that the rate of general anesthetics would increase. Dexmedetomidine was used as an alternative sedation agent, and we hypothesized its use would increase the incidence of nausea and bradycardia leading to a prolonged PACU course.

METHODS: This study included all patients scheduled for elective hip and knee joint replacement surgery from December 1st, 2012, to February 15th, 2013. Retrospective review of the EMR was used to analyze the perioperative data to determine the primary anesthetic modality and the use of rescue drugs for bradycardia and nausea in the propofol and dexmedetomidine groups. Total time in the PACU was analyzed to determine time to readiness for discharge.

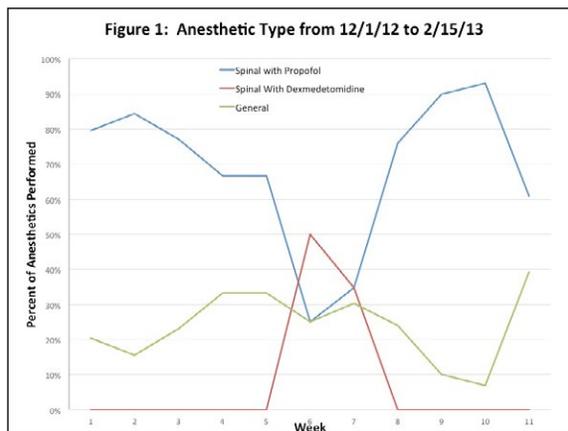
RESULTS: 286 total patients were identified according to anesthetic modality at the time of incision: 199 in the spinal with propofol sedation group, 24 in the spinal with dexmedetomidine sedation group, and 63 in the general anesthesia group. The propofol shortage occurred from January 7th, 2013, through January 16th, 2013. During this time some providers continued to use propofol for sedation despite repeated requests to stop use, others elected to use dexmedetomidine for sedation, while others utilized general anesthesia (figure 1). The rate of general anesthetic

use remained stable during and after the shortage. The propofol and dexmedetomidine comparison showed no difference between the two groups in the need for rescue anti-emetics, however, the dexmedetomidine group was more likely to require rescue medication for bradycardia. Total time to discharge readiness from the PACU was prolonged by 51 minutes in the dexmedetomidine group (Table 1).

CONCLUSION: Anesthesiologists utilized dexmedetomidine for sedation under spinal anesthesia during a propofol shortage. Despite the critically low supply, other providers elected to continue propofol use. General anesthesia utilization remained unchanged. The use of dexmedetomidine did not continue after the shortage, possibly due to bradycardia, longer PACU stays, and less familiarity with the drug. While dexmedetomidine is a sedation alternative for total joint replacement surgery under spinal anesthesia, it is unlikely to be widely used in the future compared to propofol, except in times of drug shortage.

REFERENCES:

1. Crit Care Med. 40:406-411. 2012
2. Ochsner J. 11:143-6. 2011



		Propofol (n = 199)	Dexmedetomidine (n = 24)	Total (n = 223)	p value:
NAUSEA	Any Intraop Antiemetic	Yes 67 (33.7%) No 132 (66.3%)	18 (75.0%) 6 (25.0%)	85 (38.1%) 138 (61.9%)	<.001*
	Number of Intraop Antiemetics	0 132 (66.3%) 1 25 (12.6%) 2 28 (14.1%) 3 14 (7.0%)	6 (25.0%) 5 (20.8%) 8 (33.3%) 5 (20.8%)	138 (61.9%) 30 (13.5%) 36 (16.1%) 19 (8.5%)	<.001*
	Any PACU Nausea Treatment	Yes 31 (15.6%) No 168 (84.4%)	4 (16.7%) 20 (83.3%)	35 (15.7%) 188 (84.3%)	1.0
	Lowest HR (bpm)	N 199 Mean ± SD 81.67 ± 12.32	24 52.67 ± 9.95	223 80.70 ± 12.39	<.001*
	Lowest HR <= 45 bpm	Yes 16 (8.0%) No 183 (92.0%)	6 (25.0%) 18 (75.0%)	22 (9.9%) 201 (90.1%)	0.019*
	Any Bradycardia	Yes 91 (45.7%) No 108 (54.3%)	18 (75.0%) 6 (25.0%)	109 (48.9%) 114 (51.1%)	0.009*
BRADYCARDIA	Duration of Bradycardia (min)	N 91 Mean ± SD 46.46 ± 33.82	18 87.22 ± 63.34	109 53.19 ± 42.61	<.001*
	HR at PACU discharge	N 199 Mean ± SD 67.47 ± 12.70	24 61.58 ± 9.76	223 66.84 ± 12.53	0.029*
	Any Rescue Med (atropine, glycopyrrolate, ephedrine)	Yes 9 (4.5%) No 190 (95.5%)	4 (16.7%) 20 (83.3%)	13 (5.8%) 210 (94.2%)	0.038*
	Total Time in PACU (minutes)	N 199 Mean ± SD 77.63 ± 35.17	24 128.6 ± 88.43	223 83.12 ± 46.52	<.001*

Table 1: Outcome data comparing propofol and dexmedetomidine groups need for rescue medications for nausea and bradycardia and time to discharge readiness in PACU.

Resident Abstracts

Geriatric Anesthesia

S-432.**THE EFFECTS OF THE AGE ON FENTANYL-INDUCED BISPECTRAL INDEX VALUE AND SPECTRAL EDGE FREQUENCY 95% CHANGES UNDER GENERAL ANESTHESIA**

AUTHORS: Y. Horikoshi¹, H. Nakayama¹, H. Nagasaka¹, T. Imamura², S. Hagihira³

AFFILIATION: ¹Department of Anesthesiology, Saitama Medical University Hospital, Irumagun, Japan, ²Division of Anesthesiology, Meikai University Hospital, Sakado, Japan, ³Department of Anesthesiology, Osaka University Graduate School of Medicine, Suita, Japan

INTRODUCTION AND GENERAL PURPOSE OF THE STUDY: We have reported that fentanyl increases bispectral index (BIS) values with nitrous oxide under sevoflurane anesthesia in young patients. However, it is appreciated that the effects of opioids, as an analgesics, differ with the age of the patients. Therefore, we have examined the effects of age on fentanyl-induced BIS value and spectral edge frequency 95% (SEF95) changes under nitrous oxide-sevoflurane anesthesia.

METHODS: The study was approved by the ethics committee of our institution, and written informed consent was obtained from all patients. The study was designed and performed as a prospective, randomized, double-blinded, controlled clinical trial. ASA I patients, scheduled for elective oral surgery were enrolled in the trials. Patients were randomly assigned to one of 2 groups: fentanyl 2 μ g/kg group (n = 48) or saline group (n = 18). Anesthesia was induced with thiopental and vecuronium bromide and maintained with nitrous oxide (64-67%)-sevoflurane (1%). Patients were assigned to receive either a bolus of fentanyl or saline 15 min after the intubation. Fifteen min after the intubation, mean arterial blood pressure (MAP), heart rate (HR), SEF95, and BIS values were recorded as baseline values. MAP, HR, SEF95, and BIS values were measured every 5 min after the intubation up to 30 min. All data were expressed as the mean \pm SD. Pearson's correlation coefficient test were used to assess associations between age and fentanyl-induced BIS and SEF95 changes. These relationships were further assessed by analysis of the variance of regression coefficients. In all comparisons, values of p<0.01 and of r<-0.6 were considered statistically significant.

RESULTS AND MAJOR FINDINGS: Δ BIS and Δ SEF95 are subtracted baseline values from those after either fentanyl IV or saline IV. Data were obtained from 9-89 years (average:50.0 \pm 25.0 years) patients in fentanyl group and from 18-73 years (average:33.7 \pm 16.9 years) patients in saline group. Correlation coefficients between age and Δ BIS 5, 10, and 15 minutes after fentanyl administration were -0.55(p<0.0001), -0.67(p<0.0001), and -0.66 (p<0.0001), respectively. Δ BIS had a significant linear relationship with age at 5, 10 and 15 min after fentanyl administration (Δ BIS=-0.18xage+15.9, Δ BIS=-0.26xage+20.5, and Δ BIS=-0.27xage+21.6, respectively). However, in saline group, correlation coefficients between age and Δ BIS 5, 10, and 15 minutes after saline administration were 0.36(p=0.1), -0.01(p=0.3), and 0.24(p=0.7), respectively. Correlation coefficients between age and Δ SEF95 5, 10, and 15 minutes after fentanyl administration were -0.50(p<0.001), -0.73(p<0.0001), and -0.77(p<0.0001), respectively. Δ SEF95 also had a significant linear relationship with age at 5, 10 and 15 min after fentanyl administration. However, in saline group, there were no significant correlations between age and Δ SEF95.

CONCLUSIONS: The clinician should be aware of the age-related decreased effects of fentanyl-induced BIS and SEF95 changes in older patients under nitrous oxide-sevoflurane anesthesia.

Resident Abstracts

Liver

S-433.**BLOODLESS LIVER TRANSPLANTATION IN JEHOVAH WITNESS PATIENTS: THE EXPERIENCE OF A SINGLE UNIVERSITY TRANSPLANTATION CENTER****AUTHORS:** C. Garbee¹, B. Podd², I. A. Hilmi³**AFFILIATION:** ¹Anesthesiology, UPMC, Pittsburgh, PA, ²Pediatric Critical Care Medicine, Children's Hospital of Pittsburgh, Pittsburgh, PA, ³Anesthesiology, University of Pittsburgh, Pittsburgh, PA

INTRODUCTION: Liver transplantation (LT) commonly results in considerable surgical blood loss and subsequent need for perioperative blood product replacement. Prior studies have demonstrated the association of allogeneic blood product transfusions following LT with a higher morbidity and mortality¹. A limited number of studies have described outcomes in patients undergoing LT without allogeneic blood transfusion, including a prior report from our institution that demonstrates that orthotopic LT was possible using strict preoperative selection criteria, cell-saver (CS) autotransfusion, albumin and plateletpheresis^{2,3}. Here we report our updated experience over twenty years with a case series of nine Jehovah's Witnesses (JW) who underwent LT without transfusion of allogeneic blood. **Methods:** Retrospective medical record review of JW patients who underwent LT for 20-years period (IRB#13070351). **Results:** Nine JW patients who underwent LT between 1994 and 2013 were included in the study. There were two males and seven females with a median age of 42.38 years (range 35-56) who received an average of 340 mL of albumin and CS blood intraoperatively. Acute blood loss anemia reached a nadir at one week post-LT, but resolved to baseline after three weeks. Adverse outcomes at three months post-LT include biopsy-proven acute rejection episodes in five patients, systemic sepsis in three patient, and postoperative AKI in two patients. Two patients died within one year of transplantation. **Conclusions:** With a multidisciplinary protocol and better surgical techniques, it is possible to perform LT without the use of blood products with favorable postoperative outcomes.

REFERENCES:

1. J AM Coll Surg 216(5):902-7. 2013 May.
2. Arch Surg 129: 528-33. 1994 May.
3. Arq Gastroenterol 50(2):138-40. 2013 June.

S-434.**EVALUATION OF POSTOPERATIVE COAGULATION PROFILE IN LIVING LIVER DONORS****AUTHORS:** E. Abuelkasem¹, I. A. Hilmi²**AFFILIATION:** ¹Anesthesiology, UPMC, Pittsburgh, PA, ²Anesthesiology, University of Pittsburgh, Pittsburgh, PA.

INTRODUCTION: Living donor (LD) liver transplantation has become a common practice to increase the donor organ pool. However, removal of the whole right hepatic lobe may expose donors to multiple complications including hypercoagulability¹. The objective of this study is to investigate changes in the postoperative coagulation profile of LDs that may put them at risk of thromboembolic or bleeding complications.

METHODS: Prospective observational study. After IRB approval, 20 LDs undergoing right lobe hepatectomy were included. Coagulation tests including platelet count, prothrombin time(PT), international normalized ratio (INR), partial thromboplastin time (PTT), thrombin generation product(TGP), thrombin-antithrombin complex (TAT),antithrombin III(AT-III), protein C, sP-selectin and thromboelastography(TEG) were done simultaneously at the following time points: baseline(after induction of general anesthesia),postoperative day (POD)1,3,5,7,15 and 30. Changes of coagulation tests were described as percent change from the corresponding baseline value of each test. McNemar's test was used to compare the percent change differences on POD 1,3,5,7,15 and 30 from baseline with p-value of <0.05 as deemed to be statistically significant.

RESULTS: A total of 20 patients were included, 12 females (60%),mean age 37.003±9.194. No patient received blood product transfusion or pharmacologic DVT prophylaxis. TEG parameters (MA, R, α -angle) showed no significant changes throughout the study period. INR significantly increased at the end of the surgery and continued to be high on POD 1, 3, 5 (p=0.004,<0.001, <0.001, 0.004 respectively). Platelet count significantly decreased at the end of the surgery and remained low on POD 1,3 but returned to the baseline on POD5 (p=0.031, 0.004, 0.001, 0.063 respectively), while PTT remained unchanged. sP-selectin significantly increased on POD 1, 3,5 (p=0.001,0.002, 0.016 respectively), while protein C significantly decreased on POD1,3,5(p<0.001).ATIII significantly decreased from the baseline on POD 1, 3,5 (p=0.002, 0.002 and 0.016 respectively). TAT complex significantly increased from the baseline on POD 1, 3, 5 (P=0.004, 0.004, 0.016 respectively). The area under the curve (AUC) for the TGP showed significant decrease on POD 1 (p=0.022) but remained within the normal ranges for POD 3 and 5, while the peak height of TGP did not show significant changes.

CONCLUSIONS: There were trends toward decrease in the natural anticoagulant activities and stimulation of clotting activities during the first postoperative week in LDs. However, there were parallel changes in INR and platelet count pointing toward hypocoagulation which theoretically might have established a balance between the risk of clotting and bleeding. Hepatic coagulation/anticoagulation functions were normalized on POD15 and 30 without any interventions. Further studies are needed to confirm these findings.

REFERENCES:

1. Hypercoagulability after partial liver resection. Bezraud A, et al.Thromb Haemostasis 2007; 98:1252-1256

Resident Abstracts

Medically Challenging
Case Report

S-435.**DESATURATION CICV AFTER GENERAL ANESTHESIA INDUCTION WITH POST OPERATION OF INTRAORAL RESTRUCTURING**

AUTHORS: A. Tomita, N. Katsumi, K. Fujimoto

AFFILIATION: Anesthesiology, Hokkaido Medical Hospital, Sapporo, Japan

INTRODUCTION: We report desaturation caused by CICV after general anesthesia induction. In case of predicted anatomical change, we failed nasal awake tracheal intubation. We canceled case, and tried invasive airway access in accordance with ASA difficult airway algorithm.¹ But, patient fell into transient desaturation until invasive air way access was established.

CASE REPORT: A 62y/o man had a previous operation of reconstruction of the oral cavity using pectoralis major muscle flap following resection of malignant tumor of the oral floor and the mandible. Radiation therapy and chemotherapy was performed, but airway obstruction by tumor recurrence proceeded. During follow-up period, emergency operation was performed for perforative peritonitis. He felt dyspnea on supine position and was sitting position. We choosed awake nasal fiberoptic intubation. Light sedation was needed for patient agitation. We administered 1mg midazolam, and 50 microgram fentanyl. We failed obtain fiberoptic view of vocal cord, because of a tumor progression and of limitation in range of motion of the mouth and the mandible. Secondary, we tried oral intubation with Airwayscope® and failed. Gradually, face mask ventilation became difficult because of oral discharge and bleeding. We quickly administered flumazenil and naloxone as reversal agent. We call otolaryngologist for help emergency invasive airway access. Transient desaturation under 50% was observed, but quickly recovered after administration of reversal agent. After tracheotomy, abdominal surgery was performed.

CONCLUSION: We failed awake nasal intubation under light sedation. Light sedation can occur airway obstruction in severe difficult airway patient. Supraglottic airway device is difficult for oral cancer. Reversible drug and preparation of emergency invasive airway access is important for difficult airway management.

REFERENCES

1. Apfelbaum JL et al. Practice guidelines for management of the difficult airway. Anesthesiology. 2013 Feb; 118(2):251-70.

S-436.**SUCCESSFUL TREATMENT OF
SPONTANEOUS CEREBROSPINAL LEAK
HEADACHE WITH EPIDURAL BLOOD PATCH**AUTHORS: C. Schwab¹, K. Macaluso²AFFILIATION: ¹Anesthesiology, The Ohio State University Wexner Medical Center, Columbus, OH, ²Anesthesiology, Ohio State University, Dublin, OH.

INTRODUCTION: Spontaneous cerebrospinal fluid (CSF) leak is a rare clinical finding that can result in disabling headaches. Leakage of CSF through dural defects causes traction on the meninges and associated symptoms. Treatment of such cases can be difficult when multiple defects are present however; epidural blood patches may provide significant relief.¹ We present a case of successful treatment of spontaneous CSF leakage with a non-directed epidural blood patch (EBP).

CASE REPORT: A 70 year old female with a history of bilateral occipital strokes and leukemia presented with acute on chronic bifrontal headaches and visual hallucinations. She endorsed nausea, photophobia and hyperacusis and was admitted for conservative treatment with hydration, caffeine and symptomatic management. Spinal MRI findings demonstrated CSF leakage with extra-arachnoid fluid circumferentially surrounding the thecal sac from the level of C1 to L2-L3. Conceivable lesions for the site of leakage included T11-12, T8-9 and S1-2. Due to the technical difficulties and risks of placing an EBP at the exact location of the patient's dural tears, a patch was performed at L3-4 with 25 ml of autologous blood, resulting in 90% symptomatic relief almost immediately. The patient has since remained asymptomatic.

CONCLUSIONS: Initial symptoms of chronic CSF leakage resemble that of a post-dural puncture with worsening headache in the upright position. Symptoms may evolve into a non-positional chronic diffuse headache. MRI is used to confirm the diagnosis of a dural leak. Randomized trials and treatment guidelines on this topic are lacking however, mainstay treatment is focused on symptom management. Studies show that when conservative treatments fails, up to three lumbar blood patches each 5 days apart can be attempted. Larger autologous blood volumes should be considered to facilitate spread along the dura. Studies have shown that a series of three EBP's show 33-50% initial improvement rate with an additional 20-33% and up to 50% improvement respectively.² If symptoms remain, CT or MRI with myelography should be used to better localize the defect, followed by directed blood patches. Fibrin sealant or neurosurgery should also be considered. A large volume thoracic EBP was avoided in this case due to concern for cord compression. We believe that placing a large enough blood volume into this patient's epidural space enabled travel to the locations of the dural defects. Headaches secondary to spontaneous CSF leaks are a source of severe pain for patients. It is important that management is first focused on the safest, most minimally invasive treatments. If conservative management fails, EBP's should be considered.

REFERENCES:

1. Amoozegar F, Et al. Spontaneous intracranial hypotension: recommendations for management. The Canadian Journal Of Neurological Sciences. March 2013;40(2):144-157.
2. Hayek S, Et al. Successful treatment of spontaneous cerebrospinal fluid leak headache with fluoroscopically guided epidural blood patch: a report of four cases. Pain Medicine. Dec 2003;4(4):373-378.



S-437.**LOCAL ADMINISTRATION OF METHYLERGONOVINE
CAUSED SKIN ISCHEMIC REACTION DURING A
CESAREAN SECTION-THREE CASES REPORT****AUTHORS:** S. Hoang¹, H. Li¹, R. B. Vadhera²**AFFILIATION:** ¹Anesthesiology, The Univ of Texas Med Branch, Galveston, TX, ²Anesthesia, University of Texas Medical Branch, Galveston, TX

CASE REPORT: A 25 year-old female underwent an emergency cesarean section for fetal decelerations. Upon arrival to the OR the fetus was noted to have a normal heart rate and a subarachnoid block was quickly performed. After delivery of the fetus the patient was noted to have severe uterine atony. IV and direct uterine injection of oxytocin were administered without optimal result. She subsequently received 0.2 mg of methylergonovine IM by TB syringe in the left proximal thigh and 0.25 mg of carboprost IM in the distal left thigh. Persistent uterine atony ultimately required bilateral uterine artery ligation. Upon arrival to the PACU she was noted to have a localized, slightly raised, 7x10cm area of purple discoloration surrounded by erythema in the left proximal thigh at the site of methylergonovine injection. The area was noted to be cool in temperature, non-indurated, and no other ischemic signs and symptoms were noted distal to the site. She did not report pain given her persistent spinal anesthesia. Patient was immediately treated with warm blanket and warm pad to her left thigh, and progression of area of ischemia was documented upto 24 hours. Subsequent physical examinations were performed throughout her hospitalization. The reaction had resolved within 24 hours of her procedure.

The similar reactions happened to other two patients during and after cesarean section

CONCLUSION: Methylergonovine causes constriction of vascular smooth muscle via partial agonist/antagonist action at serotonergic, dopaminergic and adrenergic receptors. Coronary vasospasm, pulmonary vasoconstriction and exacerbation of hypertension in preeclamptic patients are well-documented side effects of methylergonovine administration. There are, however, no case reports of local skin reactions due to IM methylergonovine. Our patient appeared to have a localized, intense vasoconstriction with no permanent sequelae. As literature search found no similar case, it is impossible to speculate the possible incident rate. The potential cause of the localized skin ischemia is considered, instead of IM injection, methylergonovine is possibly accidentally injected into Veso-Poor subcutaneous tissues. Comparing to skeletal muscle, subcutaneous tissues are much more prone to vasoconstrictive agents induced ischemia. We also suggest that it would be reasonable to use longer needle when IM injection is carried out.

S-438.

MANAGEMENT OF MASSIVE AIR EMBOLISM WITH THERAPEUTIC HYPOTHERMIA

AUTHORS: V. Kumar, T. L. Evans, S. Dwarakanath, M. R. Castresana

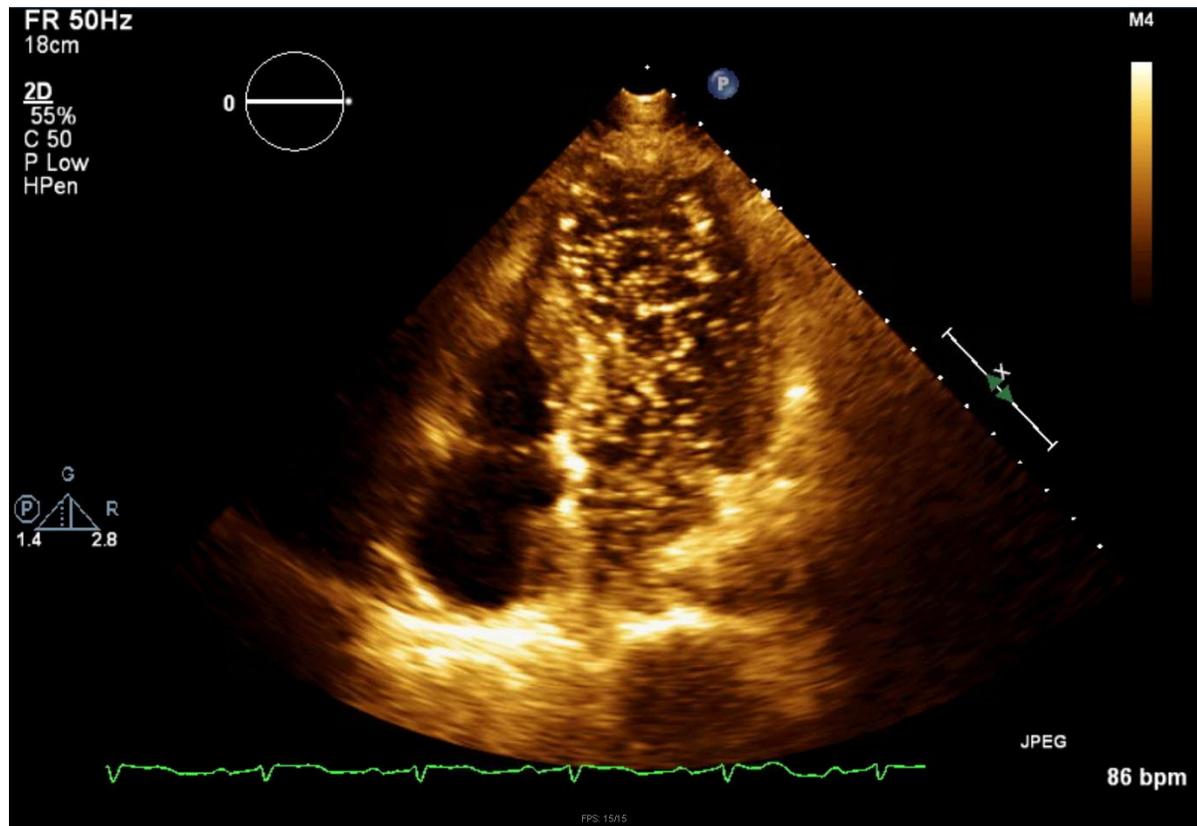
AFFILIATION: Anesthesiology, Georgia Regents University, Augusta, GA

INTRODUCTION: Air embolism is a phenomenon which is rarely encountered but can have disastrous consequences. Due to difficulty with detection and likely subclinical presentation, the true incidence of air embolism is not known. Traditionally this complication has been associated with seated neurosurgical procedures, but air embolism has been documented in a variety of conditions. Presentation is variable but can involve cardiovascular, pulmonary and neurologic sequelae, dependent mostly on rate and volume of air entrainment. While management with 100% oxygen, aspiration of air, hyperbaric oxygenation, and cardiopulmonary support have become standard, therapeutic hypothermia is not well described.

CASE PRESENTATION: A 58 year-old male undergoing treatment for gastric cancer underwent a semi-emergent coronary artery bypass grafting. Initial post-operative course was complicated by atrial fibrillation and right-sided pleural effusion. On post-operative day 4, in anticipation of transfer from the ICU, the patient's left internal jugular vein Cordis catheter was

inadvertently removed while sitting. Within minutes of removal of catheter, patient developed significant respiratory distress, agitation, and precordial pain. He was placed immediately in bed on 100% FIO₂ and massive air was visualized in the left atrium and ventricle by physician directed bedside transthoracic echo (TTE) prompting slight left Trendelenburg positioning. The patient showed initial improvement but within 4 hours complained of difficulty breathing, became confused, and required endotracheal intubation. Therapeutic hypothermia protocol to 35 degrees Celsius was initiated to prevent neurological and cardiac insult from ischemia. Other interventions included: maintenance of mean arterial pressure greater than 85 mmHg, sedation, paralysis, and trending of blood troponin levels. Follow-up TTE within hours showed severely depressed left ventricular function with an ejection fraction of 24% concurrent with troponin elevation. After 24-hours of hypothermia, rewarming, and extubation no neurologic dysfunction was evident and normalization of cardiac function occurred reflected by an ejection fraction of greater than 40% and normalization of troponin levels.

DISCUSSION: The potentially catastrophic effects of massive air embolism highlights the importance of prevention, including proper positioning, rapid recognition, and management. Therapeutic hypothermia has been shown to have neurologic and cardiac benefits in association with ischemic cardiac arrest. Similarly, therapeutic hypothermia may add value to minimize the effects of ischemia associated with massive air embolism.



S-439.**CORONARY ARTERY THROMBOSIS IMMEDIATELY AFTER CORONARY BYPASS GRAFT SURGERY IN A PATIENT WITH UNDIAGNOSED FACTOR V LEIDEN****AUTHORS:** V. Gaffney, V. Kumar, T. L. Evans, S. Dwarakanath;**AFFILIATION:** Anesthesiology, Georgia Regents University, Augusta, GA

INTRODUCTION: Hypercoaguability in patients undergoing cardiac surgery can cause serious postoperative thrombotic complications. One of the most common reasons for perioperative thrombophilia is Factor V Leiden. It is estimated that approximately 30% of patients who develop deep venous thrombosis have this specific gene mutation. Cardiac surgery has its own inherent morbidity and mortality but the addition of an undiagnosed hypercoaguable state in a cardiac patient compiles the perioperative risk.

CASE PRESENTATION: A 49 year old female with a past medical history significant for hypertension, coronary artery disease (CAD), chronic renal insufficiency, type II diabetes mellitus, hypothyroidism, gastroesophageal reflux disease and atrial fibrillation presented with a chief complaint of angina. Patient underwent cardiac catheterization, which showed multi-vessel CAD and hence scheduled for coronary artery bypass grafting. Preoperative anesthesiology evaluation was unremarkable for any new medical findings; preoperative EF was 45% and electrocardiogram showed sinus rhythm. The patient tolerated the procedure well. The patient underwent CABG x 2 (LIMA to LAD and SVG without any intraoperative complications. The procedure lasted less than 4 hours and the patient was brought to surgical intensive care unit postoperatively. Within two hours, the patient became hypotensive, unresponsive with subsequent ST elevations in the inferior leads II, III and aVF. Emergent cardiac catheterization revealed an acute thrombosis of both surgical grafts. Bare metal stents were placed in each surgical graft and an intra-aortic balloon pump was placed secondary to cardiogenic shock. The patient had an extended intensive care postoperative course inclusive of hemodynamic instability requiring vasopressors, prolonged mechanical ventilation, sepsis requiring IV antibiotics, shock liver with transaminitis, right common femoral deep venous thrombosis and acute kidney injury. Due to the patient's emergent need for continued anticoagulation, she was tested for hypercoaguability. She was found to be heterozygous for the Factor V Leiden gene mutation. Hematology/oncology was consulted and she was managed with a Heparin infusion protocol, transitioned to oral Warfarin prior to discharge.

DISCUSSION: Factor V Leiden is a genetic disorder characterized by a poor anticoagulant response to activated Protein C and an increased risk for venous thromboembolism. Deep venous thrombosis and pulmonary embolism are the most common manifestations. The diagnosis and management of Factor V Leiden in cardiac surgery patients is continued anticoagulation, monitored with frequent coagulation checks for an INR goal of 2.5-3.5. In cardiac surgery, there is a delicate balance between overanticoagulation, leading to postoperative bleeding and hypercoaguability, leading to thrombosis. This review of the literature and patient case discussion is an attempt to increase the cannon of knowledge of the patient in a hypercoaguable state who undergo cardiac surgery.

S-440.**POSTOPERATIVE RHABDOMYOLYSIS: EASY DIAGNOSIS, UNCLEAR ETIOLOGY****AUTHORS:** A. R. Vera, H. Murad, R. Yang, M. Cobas**AFFILIATION:** Department of Anesthesiology, University of Miami, Jackson Memorial Hospital, Miami, FL

INTRODUCTION: Rhabdomyolysis is a serious condition resulting from destruction of skeletal muscle. Presentation of rhabdomyolysis can range from asymptomatic elevation of creatine phosphokinase (CPK) to life threatening elevation of CPK. Manifestations include kidney injury, acute renal failure, electrolyte disturbances, cardiac arrhythmias and DIC¹. It is multifactorial and can be seen postoperatively following bariatric², spinal³ and laparoscopic surgeries. Some risk factors include obesity, positioning, and duration of surgery.

CASE REPORT: A 46-year-old male underwent rapid sequence induction for dental restoration surgery with succinylcholine and maintained with inhaled anesthetics for approximately 6 hours. History was significant for a BMI of 44, hypertension, obstructive sleep apnea (OSA), depression, and serotonin syndrome. Surgery was uneventful. Admission to the ICU was recommended for postoperative airway observation due to his history of OSA. Upon arrival, he complained of upper extremity pain. Examination revealed bilateral upper extremity weakness, hyperalgesia, increased tone, limited range of motion, diminished reflexes, and intact pulses. Vitals were within normal limits except for mild hyperthermia. A CPK level was sent, which resulted in >25,000 U/L.

The differential diagnosis included malignant hyperthermia (MH), neuroleptic malignant syndrome (NMS), and idiopathic rhabdomyolysis. Immediate management included aggressive intravenous fluid administration, a sodium bicarbonate infusion, active cooling measures, adequate analgesia, and consultation with psychiatry and the MH hotline, which excluded the diagnoses of NMS and MH respectively. The diagnosis of exclusion was idiopathic rhabdomyolysis, possibly from succinylcholine administration. Serial lab work monitored serum creatinine and CPK levels. Over the following 3 days, his symptoms improved and serum creatinine returned to preoperative levels and CPK to 2249 U/L. Follow up 4 weeks later showed resolution of his symptoms, normal serum creatinine and CPK levels.

DISCUSSION: Presentation of post surgical rhabdomyolysis in the ICU warrants consideration of a variety of differential diagnoses including but not limited to neuroleptic malignant syndrome, malignant hyperthermia, and succinylcholine induced rhabdomyolysis. Additionally, surgical risk factors predisposing patients to rhabdomyolysis include obesity, intraoperative positioning, and the duration of surgery. Although the management of rhabdomyolysis is mainly supportive, its rapid diagnosis is key to improved morbidity and mortality⁴.

REFERENCES:

1. Zutt, R., et al. Rhabdomyolysis: Review of literature. *Neuromuscular disorders* 2014. 24; 651-659
2. Chakravarty, S., et al. Rhabdomyolysis in Bariatric surgery, a systematic review. *Obes surg* 2013. 23;1333-1340
3. Dakwar, E., et al. Rhabdomyolysis and acute renal failure following minimally invasive spine surgery. *J Neurosurg spine* 2011. 14:785-788
4. Holt SG, et al. Pathogenesis and treatment of renal dysfunction in rhabdomyolysis. *Intensive Care Med* 2001. 27(5): 803-11

S-441.**ECMO IN THE ICU AS A THERAPY FOR TRALI****AUTHORS:** H. Murad¹, A. R. Vera², M. Cobas³**AFFILIATION:** ¹Critical Care, University of Miami, Miami, FL, ²Anesthesia, University of Miami / Jackson Memorial Hospital, Miami Beach, FL, ³Critical Care/Anesthesia, University of Miami / Jackson Memorial Hospital, Miami, FL

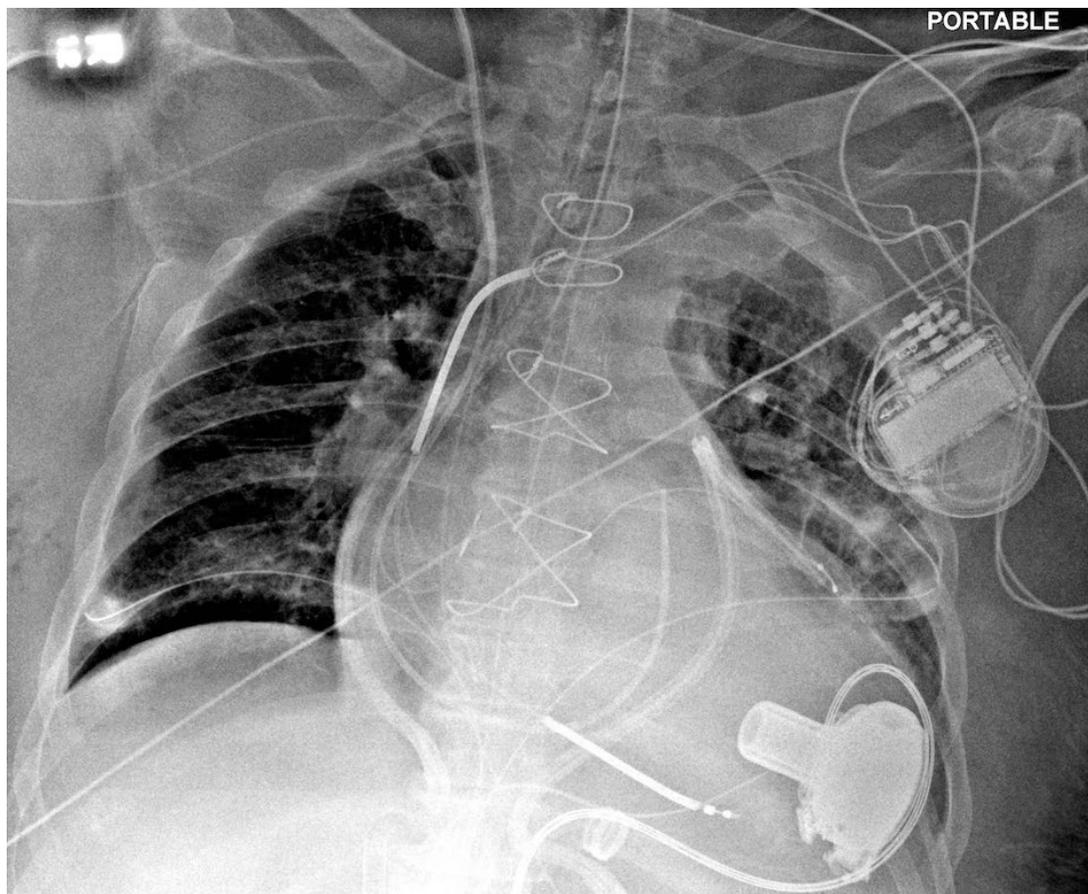
Transfusion related acute lung injury is the leading cause of transfusion-related mortality in the United States². Management is usually supportive, including supplemental oxygen, intravenous fluids, and mechanical ventilation. Most cases recover within 72 hours¹. Case: Patient is a 56 year old male with history of NICMP, EF of 10%, s/p AICD placement, s/p stem cell transendocardial injection, HTN, CVA, who was admitted for management of heart failure, after episode of ventricular tachycardia and pulmonary edema. Patient deteriorated requiring inotropic support and eventual placement of Impella CP. Patient was ultimately taken to the operating room for placement of LVAD (Heart Ware) device as mechanical cardiac support for bridge to transplant. Intraoperatively while receiving PRBC the patient decompensated, becoming hypotensive and hypoxemic, developing elevated PAP + PIP, and pink frothy fluid was evident from the endotracheal tube. The RV demonstrated significant dysfunction. Supportive therapy was initiated with inotropic agents, vasopressors, nitric oxide and recruitment maneuvers. Due to the patients limited response, continued hypoxemia as well as diminished LVAD flows the decision was made to initiate ECMO. ECMO cannulas were placed in the PA and right atrium. After initiation of ECMO there was an increase in pulse oximetry, stabilizing hemodynamics, lower PA pressures, and evidence of improving RV function. In the ICU the

patients course was complicated by coagulopathy requiring multiple transfusions, ARF requiring continuous hemodialysis, as well as continued hemodynamic instability requiring inotropic/vasopressor infusions. Lung protective strategies were able to be implemented allowing lung recovery due to ECMO use. The patient was able to weened from ECMO and decannulated in the OR, where he also underwent placement of right sided tandem heart (CardiaAssist).

DISCUSSION: TRALI can be caused by plasma-containing blood products, including PRBC's¹. Lab diagnosis in TRALI is unreliable. A high degree of suspicion is necessary to make the early clinical diagnosis. Over 70% of patients with TRALI require mechanical ventilation. Optimal method of ventilation is not established, the use of lung protective strategies is advised. In this case ECMO was initiated to manage the life-threatening hypoxemia. TRALI is usually a self-limiting process, ECMO may be well suited to the management of the most severe cases by providing oxygenation while allowing the lungs to recover. Early use of ECMO enabled reduction of FIO₂ and PIP and can prevent ventilator-induced lung injury(3,4).

REFERENCES:

1. Popovsky MA, et al. The National Heart, Lung and Blood Institute Working Group on TRALI Crit Care Med 2005;33:721-6.
2. Looney MR, et al. Transfusion-related acute lung injury: a review. Chest 2004;126:249-58.
3. Nouraei SM, et al. Management of transfusion-related acute lung injury with extracorporeal cardiopulmonary support in a four-year-old child. Br J Anaesth 2003;91:292-4.
4. Lee A, Martinez-Ruiz R. Severe transfusion-related acute lung injury managed with extracorporeal membrane oxygenation.



S-442.

A ROLE FOR INTRAVENOUS ACETAMINOPHEN ADMINISTRATION IN PATIENTS UNDERGOING CRANIOTOMY FOR TUMOR RESECTION – A CASE SERIES

AUTHORS: M. J. Lopez, A. L. Hoefnagel, D. I. Smith

AFFILIATION: Anesthesiology, University of Rochester School of Medicine, Rochester, NY

INTRODUCTION: Patients undergoing craniotomy for tumor resection have often experienced moderate to severe postoperative pain and management of which has been continually evolving.^{1,2} Opioids remain the mainstay of analgesia but have several well-established side effects, which include depression in mental status, hypoventilation, and hypercarbia. The adverse effects of opioids can result in an increase in cerebral blood flow and concomitant rise in intracranial pressure that can lead to undesirable outcomes.^{3,4} Opioids may also induce post-operative nausea and vomiting which is already common in intracranial surgery.^{5,6} Additional needs for anti-emetics can further depress mental status, thus perpetuating a negative cycle. The objective of this case series is to describe the observed benefits of including IV Acetaminophen (Ofirmev®) as an adjunct in general anesthesia to decrease postoperative opioid requirements and incidence of nausea in patients undergoing craniotomy for tumor resection.

METHODS: A retrospective analysis was completed of patients undergoing elective craniotomy for intracranial tumor removal. All patients had anesthesia provided by a single anesthesia provider using the same anesthetic protocol with the addition of IV Acetaminophen during dural closure. Patient pain scores were recorded in PACU and total amounts of opioid and anti-emetic medications administered in PACU and within 24 hours were noted.

RESULTS: 5 patients with a median age of 62, underwent craniotomy for tumor resection. One female had an anesthetic history significant for PONV. Each patient was anesthetized with a standard anesthetic protocol, which includes maintenance with 0.5 MAC of inhalational agent as well as Propofol, Dexmetomidine, and Remifentanyl infusions titrated to effect. There were no significant intra-operative or post-operative events. The mean high pain score in PACU was 5.6 with a mean overall PACU and 24 hour pain score of 2.3. In PACU, 2 of the 5 patients had additional opioid requirements, and 1 patient required additional anti-emetics.

CONCLUSIONS: Patients in this series receiving IV acetaminophen in addition to our standard craniotomy protocol had relatively low pain scores. Further analysis as a follow-up study is required to conclude if this intervention could reduce post-operative opioid and anti-emetic requirements.

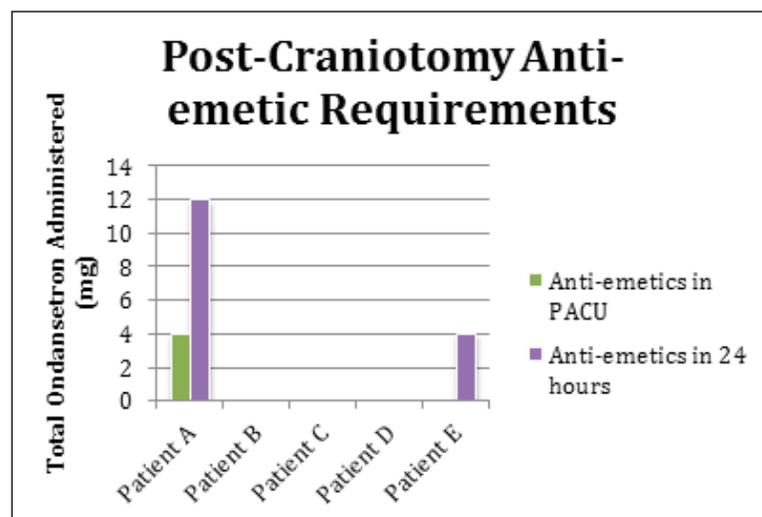
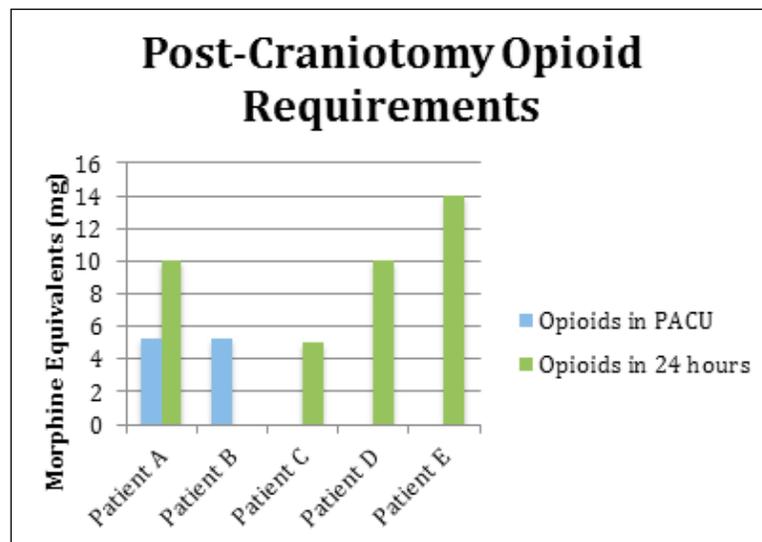
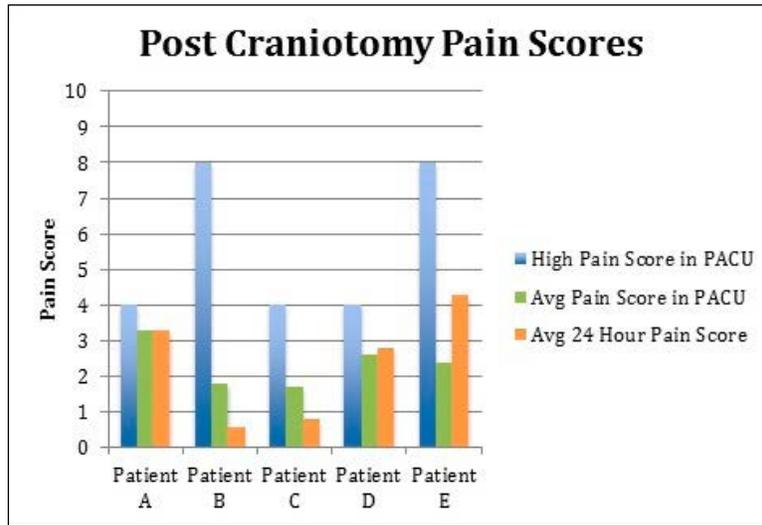
REFERENCES:

1. Trying to do better. 2009;109(5):1379-81
2. Post-craniotomy analgesia: current practices in British neurosurgical centres – a survey of post-craniotomy analgesic practices. Eur J Anaesthesiol 2005;22:328-32
3. Even small doses of morphine might provoke “luxury perfusion” in the postoperative period after craniotomy. Neurosurgery 1993;32:327
4. Fentanyl and Sufentanil increase Intracranial pressure in head trauma patients. Anesthesiology 1992;77(3):416-20
5. Postoperative nausea and vomiting: Its etiology, treatment, and prevention. Anesthesiology 1992;77:162-184
6. Postoperative nausea and vomiting. A retrospective analysis of patients undergoing elective craniotomy. J Neurosurg Anesthesiol. 1997; 9(4):308-312

Table 1 - Morphine Equivalents and Ondansetron Administered

Patient	Age	Gender	High Pain Score in PACU	Average Pain Score in PACU	Average Pain Score in 24 hours	Opioids administered in PACU	Anti-emetics administered in PACU	Additional opioids in 24 hours	Additional anti-emetics in 24 hours
A	67	M	4	3.2	3.3	5.3 mg	0 mg	10 mg	12 mg
B	41	M	8	1.8	0.6	5.3 mg	4 mg	0 mg	0 mg
C	62	F	4	1.7	0.8	0 mg	0 mg	5 mg	0 mg
D (PONV)	53	F	4	2.6	2.8	0 mg	0 mg	10 mg	0 mg
E	54	M	8	2.4	4.3	0 mg	0 mg	14 mg	4 mg

S-442 • continued



S-443.**ULTRASOUND GUIDED LONG AXIS NERVE SCAN TECHNIQUE TO GUIDE PLACEMENT OF POPLITEAL SCIATIC CONTINUOUS PERIPHERAL NERVE CATHETER****AUTHORS:** J. Van Straten, J. Alexander, G. P. Joshi**AFFILIATION:** Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX

INTRODUCTION: Continuous peripheral nerve blocks (CPNB's) provide regional analgesia for a longer duration than single injection nerve blocks, and allow for a faster return of functionality following surgery^{1,2}. Traditionally, most catheters for CPNB catheters are placed with help of an ultrasound (US) short axis view (SAX)³ and/or with the use of a stimulating catheter. The use of the US long axis view (LAX) to guide CPNB placement has the advantage of continuous visualization of the catheter during advancement along the peri-neural space to its final position⁴. While previous case reports have used the LAX view in conjunction with a stimulating catheter for a sciatic CPNB^{4,5}, we describe the use of a LAX view to successfully place a popliteal sciatic CPNB catheter.

CASE REPORT: A previously healthy 28-yo male with a RLE injury after an ATV accident (s/p multiple orthopedic procedures) with severe tibial/common peroneal nerve neuralgia (average VAS score was 7.3/10 with average hydromorphone PCA use of 15mg/day) underwent a series of operations for RLE wound complications. An US guided popliteal sciatic CPNB catheter was placed prior to these procedures for perioperative pain control. With the patient in the prone position, a SAX view of the sciatic nerve proximal to the popliteal fossa was obtained. Then the probe was rotated 90 degrees to obtain a LAX view without loss of visualization. An 18g Touhy needle was inserted in plane using sterile technique 6cm tangentially to the nerve with good visualization of spread of 3mL of 0.25% ropivacaine about the needle tip. A non-stimulating epidural catheter was advanced to 12cm (5-6cm in peri-neural position) and tunneled under direct visualization. 17mL 0.25% ropivacaine was injected through the catheter incrementally with good spread in both the long axis and short axis views. Ropivacaine 0.2% (~12mL/h) was infused to achieve adequate pain relief. The catheter remained in place for 21 days as the patient underwent three additional operations. The patient reported excellent pain relief after the catheter was placed (average VAS score dropped to 4.2/10 with a hydromorphone PCA use of 6.4mg/day).

CONCLUSION: Our success of catheter placement with US alone seems to be in agreement with a recent study that found no clear benefit of adding a stimulating catheter to the SAX technique for sciatic CPNB⁶. However this study did not look at the LAX technique. With time and study the use of the LAX view alone may prove to shorten block times while ensuring improved block success versus a SAX technique.

REFERENCES:

1. Reg Anes Pain Med 2012; 37: 583-594!
2. Anesthesiology 2005; 103:1035-1045!
3. Anesth Analg 2006;103:1436-1443!
4. Reg Anes Pain Med 2008; 33:477-482!
5. Agri. 2010 Oct;22(4):175-7!
6. Middle East J Anesthesiol. 2013 22(2):179-83

S-444.**MANAGEMENT OF A CRITICALLY ILL PATIENT FOR PERCUTANEOUS CORONARY INTERVENTION (PCI)****AUTHORS:** T. Safi, S. Goldstein**AFFILIATION:** Anesthesiology, Montefiore Medical Center, Bronx, NY**INTRODUCTION:** We report care of a critically ill patient for Percutaneous Coronary Intervention (PCI)

CASE REPORT: 53 yr old 170 kg male presented for PCI with history of HTN, AODM, ESRD on HD, morbid obesity (BMI =61), OSA on CPAP, MI 4-months prior and V-fib arrest. Echo report: "technically difficult, RV and LV global hypokinesis". Cath: 95% occlusion proximal & distal LAD & LCx arteries. The patient was unable to lie still for cath, so general anesthesia was used during rotational atherectomy and insertion of a Drug Eluting Stent (DES) in proximal and distal LAD. He returned for PCI of LCx. BP = 80/50; 2nd BP = 69/37. NSR@71, RR 16, SpO2 94% on RA, 100% on 2L NC O2. The patient was alert, oriented X 3 and comfortable lying flat. He was dialyzed the day prior. Physical exam: MP III, large neck circumference. Heart RRR, no M; lungs clear to auscultation. He had no peripheral veins. With 1% lidocaine local, sterile technique and US, an 8.5 Fr Cordis and triple lumen slick were inserted in Rt IJV. Lt radial arterial line was inserted. Labs of note ABG 2L NC O2 7.39/36/79/26/BE 1.1; K+ 5.3; Hct 33%. Phenylephrine (NEO) (0.1mcg/kg/min) was begun. When SBPs rose to 100s, patient induced with etomidate 14mg, fentanyl 200mcg, rocuronium 50mg and midazolam 1mg. Elective glidescope intubation performed. Over 5 mins SBP decreased to 60s and HR rose to 140s (ST). NEO was increased to 0.3mcg/kg/min; dobutamine (DBX) 2.5 mcg/kg/min and esmolol 10 mcg/kg/min were begun. TEE revealed LVEF = 35%, 2-3+ MR, 2+TR, fibro-calcific AV no stenosis, and mitral annular calcification. RV was moderately enlarged and moderately hypokinetic. NEO, DBX and esmolol were titrated to maintain SBPs 110s-120s and NSR in the 80s, with ET sevoflurane 1.0 % throughout procedure. K+ at end of case = 6.3. Regular insulin 5U and 1 ampule NaHCO3 were administered and RR increased from 12 to 14 breaths/min. DES into ostial LCx artery and balloon angioplasty of re-stenosed distal LAD yielded excellent reperfusion. Dexmedetomidine 0.5mcg/kg/hr was infused for transport to CCU. The next morning he was extubated, BP = 80/50, on NEO 0.1 mcg/kg/min and felt well.

DISCUSSION: Despite low BP, other VS a normal lung exam and labs, and his ABG, indicated no "optimization" would improve his status, especially as past records indicated he often had low BPs. Due to his baseline hypotension and co-morbidities it was apparent vasopressors and/or inotropes would be required to provide general anesthesia for this patient. As the population ages, all anesthesiologists will need to provide anesthesia for critically ill patients. Consultation with colleagues who care for such patients regularly may be advisable.

S-445.**A SIMPLE NASAL CPAP ASSEMBLY MAINTAINED SPONTANEOUS RESPIRATION AND IMPROVED OXYGENATION IN A NON-OSA PATIENT WITH NGT WITH AIRWAY OBSTRUCTION DURING EGD UNDER DEEP SEDATION****AUTHORS:** W. Wang, J. T. Denny, S. Morgan, J. Tse**AFFILIATION:** Anesthesiology, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ.

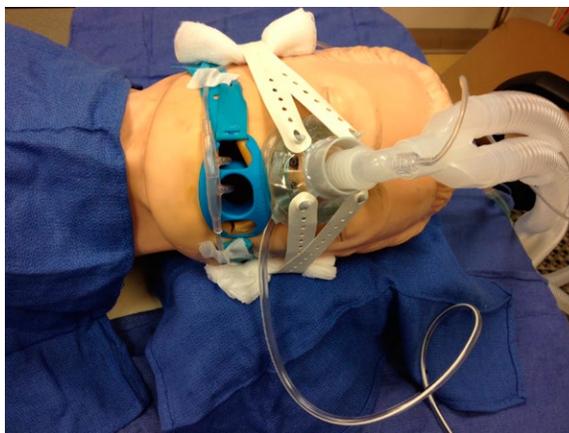
INTRODUCTION: Patients who undergo monitored anesthesia care routinely receive IV sedation and O₂ via nasal cannula (NC). Oxygen desaturation may develop if over-sedation and/or airway obstruction occurs, especially in patients with obstructive sleep apnea (OSA). These OSA patients may require frequent jaw thrust, chin lift, or nasal trumpet during sedation to maintain a patent airway. The updated ASA Guidelines recommend continuous positive airway pressure (CPAP) for OSA patients under intraoperative sedation.¹ A simple nasal CPAP assembly has been shown to improve oxygenation in sedated OSA patients using existing anesthesia equipment.²⁻⁵ We used this simple technique to provide CPAP in a non-OSA patient with a nasogastric tube (NGT) with airway obstruction during upper GI endoscopy (EGD).

CASE REPORT: A 51 y/o male (BMI 31 kg/m²) with asthma, diverticulitis, GERD, and GI bleed presented for an EGD after gastric decompression with an NGT. The patient denied OSA and only had 2 of 8 criteria (age and male gender) in the STOP-BANG questionnaire for OSA risk. He was found to have bilateral moderate wheezing and a room air O₂ saturation (Sat) of 92%. The wheezing improved with albuterol nebulizer treatment, however mild wheezes still remained. The anesthetic plan was to look briefly with the endoscope under sedation, with general anesthesia ready and available on standby. The patient's O₂ Sat improved to 99% with NC O₂ (5 L/min) and a simple face tent (TSE "Mask")² (Photo 1). He received 100 mg of lidocaine followed by a slow bolus of 100 mg of propofol and propofol infusion (125 mcg/kg/min). After a few minutes on propofol infusion, the patient's airway became obstructed as indicated by a loss of ETCO₂ wave form on capnography and desaturation to 95%. Spontaneous respiration resumed after bilateral jaw thrust was applied. An infant face mask (size #2) with fully inflated air cushion (10 cc air added) was secured over his nose using head straps and connected to an adult breathing circuit and anesthesia machine (Photo 2). The air cushion provided a good seal around the patient's NGT. The APL valve was adjusted to provide CPAP (3 cm H₂O) with O₂ flow (4 L/min) and air (1 L/min). The NGT provided a guide for the endoscope and was removed after endoscope insertion into the stomach. With the nasal CPAP, the patient maintained spontaneous respiration and O₂ Sat at 99% throughout the procedure. No active GI bleeding was found, and the patient tolerated the procedure well and recovered from sedation without any complication.

CONCLUSIONS: The fully-inflated air cushion of the infant face mask provided a good seal around the NGT in order to provide CPAP to a patient with airway obstruction under sedation. With this simple nasal mask assembly, we were able to maintain spontaneous respiration and oxygenation. It only takes a few minutes to assemble using existing anesthesia equipment and may improve patient safety at a low cost.

REFERENCES:

1. Anesth 120(2): 268-286, 2014
2. www.TSEMask.com
3. SAMBA 28th AM, 2013
4. NYSSA 67th PGA (MCC-7189), 2013
5. IARS AM (MCC-668), 2014



S-446.**ANGIOEDEMA WITH FACTOR V LEIDEN AFTER FRESH FROZEN PLASMA TRANSFUSION****AUTHORS:** C. Adams, S. Yazdani;**AFFILIATION:** Department of Anesthesiology, Texas Tech University Health Sciences Center, Lubbock, TX

INTRODUCTION: Angioedema is a well described complication associated with the use of angiotensin-converting enzyme (ACE) inhibitors. Here, a gentleman who takes an ACE-I for hypertension develops angioedema several following a MAC case. This patient has known Factor V Leiden which could put him an increased risk, yet during the procedure he received fresh frozen plasma which is gaining a role as angioedema treatment.

CASE REPORT: A 76 year old male with a history of Factor V Leiden and hypertension treated with daily ramipril presented to our institution for abdominal pain. He was found to have elevated liver function tests and total bilirubin. Imaging showed gallstone pancreatitis. He was scheduled for ERCP to remove ductal stones. During the procedure he was transfused one unit of fresh frozen plasma. He returned to his room on the surgical floor without issue. Four hours following the procedure a surgical resident was making rounds and appreciated that he appeared to have some facial edema. The anesthesia airway service was notified and in the patient's room within 5 minutes, where the edema had drastically increased. The patient was immediately transferred to the surgical ICU. Upon arrival to the SICU, the edema at was present on the patient's tongue, mouth, and lips, with breathing becoming difficult and oxygen saturation falling to 85. With surgeons in the room on standby and after pre-oxygenation, intubation was attempt with a CMAC. Edema to the airway obscured any meaningful view, and no landmarks were indentified. An ETT was placed blindly, but showed no color change and no breath sounds. This ETT was removed, and mask ventilation was employed while the surgical team attempted a bedside tracheostomy. The patient's trachea was only present below his sternum, so a cricothyrotomy was performed, and a small ETT tube was inserted into the trachea. The OR had been notified and had a room ready, so the patient was taken immediately for surgical tracheostomy. Upon arrival to the OR, the CMAC was used again to attempt to pass an endotracheal tube with the airway now being well controlled. This attempt to identify landmarks was also unsuccessful, and the percutaneous tracheostomy with 8F Portex percutaneous trach was performed. The patient was treated with diphenhydramine and steroids. His edema had completely resolved in 48 hours, his trach was downsized and eventually removed prior to discharge. The patient had no long term complications.

DISCUSSION: Angioedema is a well described complication associated with the use of angiotensin-converting enzyme (ACE) inhibitors, with an incidence of 0.1% to 0.6 % (Byrd, miller). It presents most commonly in the first few weeks after starting the medication, and may be the cause of up to 25% of reported cases of angioedema (vleeming). ACE inhibitors impact the renin-angiotensin-aldosterone pathway (RAA) and decrease the degradation of bradykinin. This leads to chronically elevated levels of bradykinin, which is a potent vasodilator and increases vascular permeability.

This patient has several known and potential risk factors for angioedema including age older than 65, smoking and seasonal allergies. Case reports in the past have described angioedema being triggered following oral surgery, anterior cervical surgery and even biting of the lip (Simmons, Og, Krnacik). Other potential causes could include his known factor V mutation, leading to activated protein C resistance and reduced effective C1 inhibitor levels. This has been described in a patient with hereditary angioedema (Celikel). Other types of vascular permeability problems related to factor V mutations have been described (Széplaki).

Another noteworthy element of this case was the administration of FFP prior to the onset of angioedema. Recently, FFP has gained favor as a treatment for angioedema resistant to standard treatment methodologies and even as prophylaxis for patients with hereditary angioedema (Buyantseva). The rationale for the using FFP is that it provides kininase II which is identical to ACE, and it causes the degradation of accumulated bradykinin (Hassen).

CONCLUSIONS: Any patient who has takes an ACEI is at risk to develop angioedema. This patient also had known risk factors, and is possibly at an increased risk due to underlying factor V mutation. The angioedema was quick in onset and was moving toward airway failure. Good communication between the surgical team, the anesthesia airway team and the operating room were the keys to assuring a good outcome for this patient. Indeed, this type communication is beneficial to all airway emergencies, regardless of cause.

REFERENCES:

1. Byrd JB, Adam A, Brown NJ. Angiotensin-converting enzyme inhibitor-associated angioedema. *Immunol Allergy Clin N Am* 2006; 26: 725-37.
2. Vleeming W, van Amsterdam JGC, Stricker BHC, deWildt DJ. ACE inhibitor-induced angioedema. *Drug Saf* 1998; 18: 171-88.
3. Miller DR, Oliveria SA, Berlowitz DR, Fincke BG, Stang P, Lillienfeld DE. Angioedema incidence in US veterans initiating angiotensin-converting enzyme inhibitors. *Hypertension*. 2008 Jun;51(6):1624-30. Epub 2008 Apr 14
4. Simmons B, Folsom MA, Bryden LA, Studdiford,JS. Angioedema After Local Trauma in a Patient on Angiotensin-Converting Enzyme Inhibitor Therapy. *J Am Board Fam Med* November-December 2008 vol. 21 no. 6 577-579
5. Ogbureke KUE, Cruz C, Johnson JV, Helfrick JF. Perioperative angioedema in a patient on long-term angiotensin-converting enzyme (ACE) inhibitor therapy. *J Oral Maxillofac Surg* 1996; 54: 917-20.
6. Krnacik M, Heggeness MH. Severe angioedema causing airway obstruction after anterior cervical surgery. *Spine* 1997; 22: 2188-90
7. Celikel S, Buyukasik Y, Karakaya G, Kalyoncu A.F. Hereditary Angioedema Associated with Heterozygous Factor V Leiden Mutation in a Patient with Purpura Fulminans. *Int Arch Allergy Immunol* 2007;142:175-178
8. Széplaki G1, Varga L, Osváth L, Karádi I, Füst G, Farkas H. Deep venous thrombosis associated with acquired angioedema type II in a patient heterozygous for the mutation of factor V Leiden: effective treatment and follow-up for four years. *Thromb Haemost*. 2006 May;95(5):898-9.
9. Hassen GW, Kalantari H, Parraga M, Chirurgi R, Meletiche C, Chan C, Ciarlo J, Gazi F, Lobaito C, Tadayon S, Yemane S, Velez C. Fresh frozen plasma for progressive and refractory angiotensin-converting enzyme inhibitor-induced angioedema. *J Emerg Med*. 2013 Apr;44(4):764-72. doi: 10.1016/j.jemermed.2012.07.055. Epub 2012 Oct 28. Review.
10. Buyantseva LV, Sardana N, Craig TJ. Update on treatment of hereditary angioedema. *Asian Pac J Allergy Immunol*. 2012 Jun;30(2):89-98. Review.

S-447.**INTERSCALENE NERVE BLOCK IN A PATIENT WITH BRACHIAL PLEXUS PALSY****AUTHORS:** K. E. Knapp, A. Gorlin**AFFILIATION:** Anesthesiology, Mayo Clinic, Phoenix, AZ

INTRODUCTION: Interscalene nerve block directed at the roots/trunks of the brachial plexus has been utilized as a form of perioperative analgesia for patients undergoing shoulder surgery since it was initially described in the 1970s. This type of nerve block is most often performed under direct ultrasound guidance with well defined risks including: bleeding or infection at the site of needle insertion, local anesthetic toxicity resulting from inadvertent intravascular injection, and direct injury to the peripheral nerves in question. A review of published data by Brull et al estimates that the rate of neuropathy after peripheral nerve blockade is <3:100, or 3% with permanent injury being a rare complication.

Peripheral nerve damage may be a result of mechanical injury, ischemia secondary to disruption of the vascular supply, or direct local anesthetic nerve toxicity. In patients with pre-existing peripheral nerve injury, there is a theoretical increased risk of nerve damage with regional anesthesia. The reason for this is unclear however studies have hypothesized that sick nerves are simply more susceptible to injury. In this case report, we use the example of an adult patient with brachial plexus birth palsy to discuss the steps that should be taken prior to performing an interscalene nerve block in this specific patient population.

CASE REPORT: A 39 year old female with past medical history significant for left upper and lower trunk brachial plexus birth palsy secondary to shoulder dystocia presented for elective glenohumeral arthrodesis for relief from progressive pain and paresthesias of this arm. Since birth she has suffered from chronic dislocation of the left humeral head with significantly limited movement of the left upper extremity. Prior to surgical intervention a complete neurological evaluation was performed, as well as MRI (Image 2 shows coronal view of patients cervical spine with small pseudomeningocele present), and EMG studies confirming the diagnosis of brachial plexus injury. On the morning of surgery, the anesthetic plan was discussed in detail with the patient, given that she had significantly limited left upper extremity function, in combination with her significant concern for adequate post operative pain control, she consented to brachial plexus block. The nerve block was completed without incident using 30 mL of 0.375% bupivacaine under direct ultrasound guidance (Image 1 shows ultrasound guided image of patients brachial plexus nerve roots). Surgical intervention went as planned and she was discharged home on post operative day 2. No new neurological deficits were identified in the immediate post operative period or with subsequent outpatient follow up.

CONCLUSIONS: Peripheral nerve blockade is not without complications, even in patients with brachial plexus anatomy that is presumed to be normal. In a patient with a preexisting nerve injury, there is a theoretical increased risk of injury with regional anesthesia. Due to this increased risk, the question must be asked, what would a worsened nerve injury mean to the patient? The answer to this question may be ascertained by evaluating the patient's pre-operative functional status, presence of chronic pain, and their expectations for post operative pain control. In discussion with the patient, we realized that because of her current pain and level of disability, post operative pain control was more important than a theoretical risk of additional nerve injury.

Once it has been determined that the benefit of performing the block outweighs the risk of potentially worsened neurological deficit, a detailed history and physical exam should be completed to quantify the extent of pre-existing injury. In addition, a review of relevant studies should be performed. In this case, Bilateral brachial plexus MRI and EMG studies were useful to document the patient's baseline function.

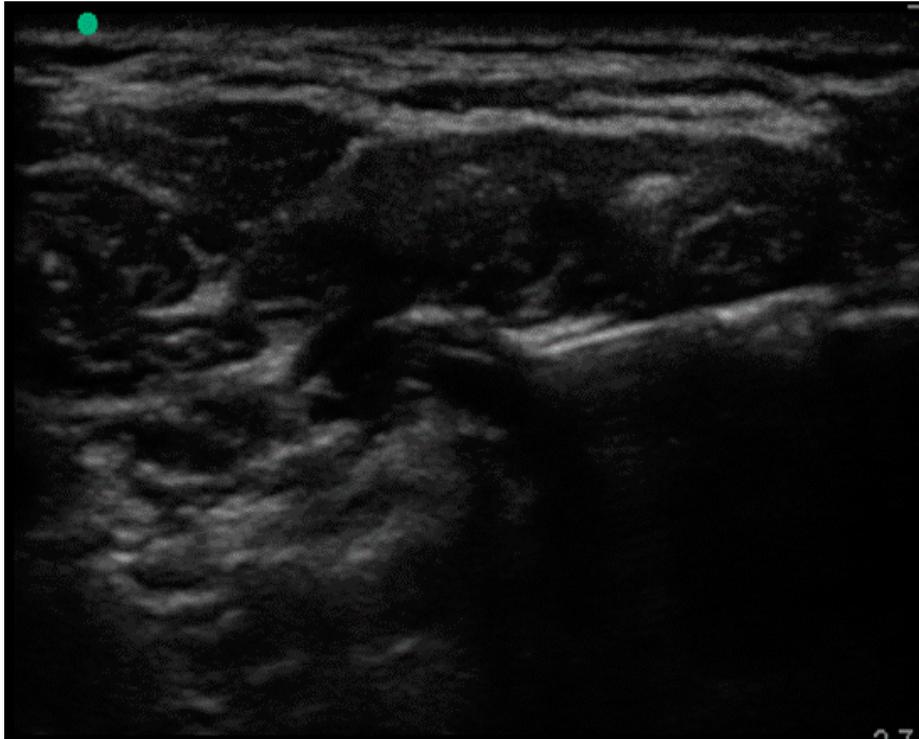
These studies may not be cost effective in all situations and therefore a thorough neurological examination may be adequate.

Every effort should be made to minimize risk when performing the nerve block. This could include measures such as decreasing local anesthetic concentration and volume as studies have shown that local anesthetic-induced toxicity is concentration dependent, with high concentrations leading to necrosis and cell death. Attempting to limit nerve injury secondary to needle trauma is also important and may be done by utilizing ultrasound guidance to minimize the number of passes made, as well as the use of nerve stimulator to prevent intraneural injection. Lastly, we suggest omitting local vaso-constrictors, such as epinephrine to decrease the degree of regional ischemia.

REFERENCES:

1. Neurological complications after regional Neurological complications after regional anesthesia contemporary estimates of risk. International anesthesia research society. 2007;104(4):965-974
2. Local anesthetic 'in-situ' toxicity during peripheral nerve blocks: update on mechanisms and prevention. *Cr Opin Anesthesiol.* 2012;25:589-595
3. Pathophysiology of peripheral nerve injury during regional anesthesia. *Regional anesthesia and pain medicine.* 2008;33:435-441
4. Neurological injuries associate with regional anesthesia. *Regional anesthesia and pain medicine.* 2008;33:442-448
5. Acute and nonacute complications associated with interscalene block and shoulder surgery. *Anesthesiology.* 2001;95:875-880
6. Regional anesthesia procedures for shoulder and upper arm surgery upper extremity update-2005-present. *International anesthesiology clinics.* 2012;50(1):26-46
7. Complications associated with peripheral nerve blocks: Lessons from the ASA closed claims project. *International anesthesiology clinics.* 2011;49(3):56-67

S-447 • continued

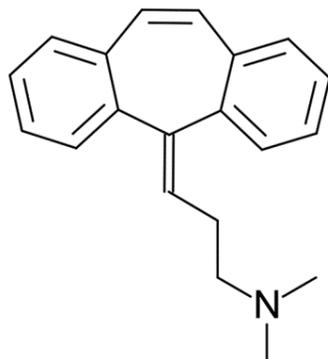
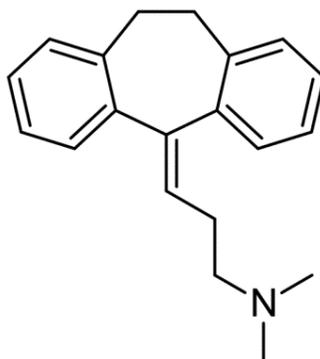
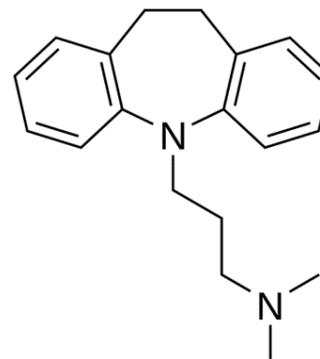


S-448.**PAINFUL EJACULATION WITH CYCLOBENZAPRINE: A CASE REPORT AND LITERATURE REVIEW****AUTHORS:** M. Kraus¹, D. Rosenfeld², A. Gorlin³, C. Wie¹**AFFILIATION:** ¹Anesthesia, Mayo Clinic Hospital, Phoenix, AZ, ²Anesthesiology, Mayo Clinic, Phoenix, AZ, ³Anesthesiology, Mayo Clinic, Phoenix, AZ**INTRODUCTION:** Sexual dysfunction is a well-known side effect of antidepressants. TCAs have the potential to cause dysfunction in all sexual response phases: interest, arousal and orgasm.¹ Painful ejaculation is a rare side effect that has been reported with the use of TCA, SSRI, SNRI as well as antipsychotic drugs.^{2,3,4,5,6,7,8}Cyclobenzaprine is a muscle relaxant that is structurally similar to tricyclic antidepressants. It was developed as an antidepressant but had more adverse side effects and less antidepressant effects than other drugs. Cyclobenzaprine is the most commonly prescribed muscle relaxant in the United States and accounts for 18% of all prescriptions written for chronic back pain.⁹

We present a case of painful ejaculation secondary to cyclobenzaprine use, provide proposed mechanisms, and offer a literature review of this side effect with other related drugs.

CASE REPORT: A 55 year-old male was referred to our pain medicine clinic for pain with ejaculation. He described the pain as a sharp, stabbing pain located in the groin area, slightly worse on the right. The pain would maintain that intensity for a several minutes before slowly improving and ultimately resolving after 10 minutes. This significantly affected his quality of life and resulted in reduced sexual activity. After evaluation in our clinic, it was noted that he was prescribed cyclobenzaprine for unrelated muscle tension. He was advised to discontinue cyclobenzaprine due to reports in the medical literature of painful ejaculation with the use of TCAs drawing on knowledge of their structural similarities with cyclobenzaprine. He returned for re-evaluation 6 weeks later to report complete resolution of his pain. He stated that he saw notable improvement 2 weeks after stopping cyclobenzaprine. Subsequently he started methocarbamol for muscle spasms in his back and hip without any significant side effects.**CONCLUSION:** Painful ejaculation is an underreported side effect of tricyclic antidepressants and perhaps cyclobenzaprine.¹⁰ This side effect is likely more prevalent than the literature suggests because patients cannot be relied upon to report sexual dysfunction.^{4,8} Awareness of these effects may lead to anticipatory reassurance. Providers who prescribe cyclobenzaprine should consider screening for sexual dysfunction and painful ejaculation. Fortunately, painful ejaculation due to a medication is reversible. In our case, as with others reported in the literature, discontinuation of the causative medication led to resolution of symptoms.**REFERENCES:**

1. Harvey KV, Balon R. Clinical implications of antidepressant drug effects on sexual function. *Ann Clin Psychiatry* 1995;7(4):189-201.
2. Aizenberg D, Zemishlany Z, Hermesh H, Karp L, Weizman A. Painful ejaculation associated with antidepressants in four patients. *J Clin Psychiatry* 1991;52(11):461-3.
3. Kulik FA, Wilbur R. Case report of painful ejaculation as a side effect of amoxapine. *Am J Psychiatry* 1982;139(2):234-5.
4. Simpson GM, Blair JH, Amuso D. Effects of anti-depressants on genito-urinary function. *Dis Nerv Syst* 1965;26(12):787-9.
5. Hsu JH, Shen WW. Male sexual side effects associated with antidepressants: a descriptive clinical study of 32 patients. *Int J Psychiatry Med* 1995;25(2):191-201.
6. Demyttenaere K, Huygens R. Painful ejaculation and urinary hesitancy in association with antidepressant therapy: relief with tamsulosin. *Eur Neuropsychopharmacol* 2002;12(4):337-41.
7. Michael A. Venlafaxine-induced painful ejaculation. *Br J Psychiatry* 2000;177:282. Epub 2000/10/21.
8. Kotin J, Wilbert DE, Verburg D, Soldinger SM. Thioridazine and sexual dysfunction. *Am J Psychiatry* 1976;133(1):82-5.
9. Luo X, Pietrobon R, Curtis LH, Hey LA. Prescription of nonsteroidal anti-inflammatory drugs and muscle relaxants for back pain in the United States. *Spine* 2004;29(23)
10. Monteiro WO, Noshirvani HF, Marks IM, Lelliott PT. Anorgasmia from clomipramine in obsessive-compulsive disorder. A controlled trial. *The British Journal of Psychiatry* 1987;151(1):107-12.

Cyclobenzaprine**Amitriptyline****Imipramine**

S-449.**ANESTHETIC CONSIDERATIONS FOR A LARGE, LONG-STANDING, SYMPTOMATIC TRAUMATIC DIAPHRAGMATIC HERNIA REPAIR****AUTHORS:** E. Penick¹, E. MACKAY¹, T. KENNEDY²**AFFILIATION:** ¹Anesthesiology, Thomas Jefferson University Hospital, Philadelphia, PA, ²Anesthesiology, Sidney Kimmel Medical College, Philadelphia, PA

INTRODUCTION: Blunt trauma causing diaphragmatic herniation can be difficult to diagnose due to its nonspecific symptoms. There are only a handful of case reports in the past 30 years in the anesthesia literature that address anesthetic considerations, potential complications, and management of surgical repair of this injury^{1,2}. Anesthetic considerations include the risk of difficult intubation from tracheal deviation, aspiration, hypoxia, cardiovascular collapse upon induction of anesthesia and positive pressure ventilation, massive hemorrhage, and possible loss of domain and compartment syndrome. Relevant radiology images will be reviewed.

CASE REPORT: A 68 year old female status post motor vehicle crash in 1980 was incidentally found to have a large diaphragmatic hernia in 1992. She was asymptomatic for 30 years until she began to experience worsening shortness of breath, regurgitation, hoarseness, and sought surgical management. CT scan revealed a large right diaphragmatic hernia containing colon, liver, and gallbladder. A thoracoscopy, thoracotomy, and mesh repair of the diaphragmatic hernia was planned.

Given the chronicity of the herniation, the hernia may have been adhered in the thorax. The intrathoracic viscera included a large portion of the liver and had potential to cause massive hemorrhage upon dissection of the adhesions. Large bore IV access was obtained preoperatively with blood products immediately available.

The surgeon was at the bedside during induction, as we were concerned for cardiovascular collapse from intrathoracic contents compressing the heart and great vessels. A rigid bronchoscope was available in the event of loss of the airway from tracheal compression after paralysis.

There was hypotension in lateral decubitus position, probably from an intrathoracic compressive effect from the herniated organs in the right pleural cavity. This improved with volume and pressors.

Despite aggressive attempts at recruitment maneuvers, we were unable to reinflate a portion of the right middle and lower lobes. These regions were likely chronically atelectatic from decades of compression from the hernia. They were deemed nonviable and resected. The patient tolerated the procedure well and was extubated in the operating room.

CONCLUSIONS: Despite multiple potentially life-threatening anesthetic complications, our patient safely underwent the repair of her diaphragmatic hernia due in large part to our careful anesthetic preparation. We describe the unique anesthetic considerations and management for repair of an unusual presentation of a traumatic diaphragmatic hernia.

REFERENCES:

1. Katz R, Belenker S, Poppers P. Intraoperative Management of a Patient with a Chronic, Previously Undiagnosed Traumatic Diaphragmatic Hernia. *J Clin Anes* 1998;10:506-509.
2. Power M, McCoy D, Cunningham AJ. Laparoscopic Assisted Repair of Traumatic Ruptured Diaphragm. *Anesth Analg* 1994;78:1187-1189.

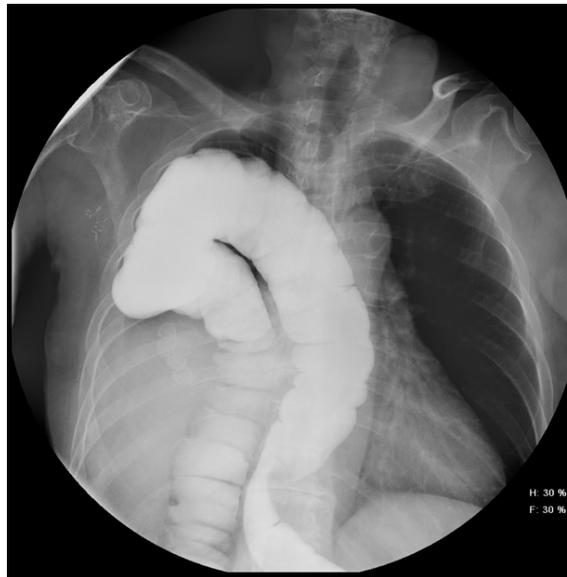


Figure 1. Barium enema. Colon herniates into the right pleural cavity through a defect in the diaphragm.



Figure 2. Herniated liver, colon, omentum, and gallstone-containing gallbladder in the right thorax.

S-450.**SEIZURE-LIKE ACTIVITY (SLA) DURING GENERAL ANESTHESIA FOR ROBOTIC PROSTATECTOMY: A CASE REPORT****AUTHORS:** C. Whiting, H. Li**AFFILIATION:** Anesthesiology, The Univ of Texas Med Branch, Galveston, TX**INTRODUCTION:** A 45 year old male with prostate cancer presented for a robotic prostatectomy. The patient was an otherwise healthy African American male, 6'0", 75 kg with no history of seizures.**CASE REPORT:** Patient was medicated with midazolam 2 mg. General anesthesia was induced with fentanyl 100 mcg, lidocaine 100 mg, propofol 200 mg, and succinylcholine 60 mg. Following intubation the patient was given vecuronium 3 mg IV and anesthesia was maintained with isoflurane. Thirty minutes after induction he began to undergo generalized tonic myoclonic SLA lasting approximately 1 minute. Propofol 50 mg and midazolam 2 mg were given and the SLA ceased. At the time it was unclear if the myoclonic activity was seizure, SLA, or reacting to the stimulus of surgical prepping and it was decided to proceed with the surgery.

During emergence from anesthesia the patient once again had SLA that interfered with his respirations. The patient was unable to be awakened and extubated due to the SLA and altered breathing pattern which was treated with boluses of propofol and midazolam. He was therefore transferred to the MICU intubated and on a propofol infusion.

After admission to the MICU the patient continued to have SLA that was treated with IV lorazepam. A CT of the head was negative for intracranial pathology. An EEG was performed the next day while the patient was sedated with propofol and fentanyl and did not show any epileptiform activity at that time. He was weaned off sedation and extubated on POD 2.

CONCLUSION: Propofol in particular seems to be associated with SLA. A systematic review by Bernhard et al¹ analyzed 70 cases of patients without epilepsy who experienced SLA after receiving propofol. SLA occurred on induction in 24 (34%), during maintenance in 2 (3%), and during emergence in 28 (40%). In 16 cases (23%) patients experienced SLA after emergence. Our patient had SLA shortly after induction with propofol while anesthesia was being maintained with isoflurane, and then on emergence from anesthesia. Propofol is similar to benzodiazepines and barbiturates in that it potentiates GABA-mediated pre- and post-synaptic inhibition by decreasing the release of excitatory neurotransmitters. Borgeat has demonstrated that propofol is an agonist-antagonist of glycine, the major inhibitory neurotransmitter in the subcortical centers and spinal cord². The antagonist effect appears to predominate at lower doses whereas the agonist effect dominates at higher doses of propofol³.Propofol is administered as a routine induction agent for general anesthesia. The overall incidence of propofol-induced SLA is estimated at 1 in 47,000⁴. It appears reasonable to suggest that propofol is a safe and effective induction agent of general anesthesia, however, patients who experience SLA should not be given propofol again. It is important to be aware of the possibility of the SLA observed with propofol administration.**REFERENCE:**

1. Neurology 2002;58:1327-32.
2. Anesthesiology, 74 (1991), pp. 24-27
3. J Soc Med, 85 (1992), pp. 288-291. 4. Acta Anaesthesiol Scand, 42 (1998), pp. 739-741

S-451.**ANESTHETIC MANAGEMENT OF A PATIENT WITH HERMANSKY-PUDLAK SYNDROME: A CASE REPORT****AUTHORS:** S. Thomas, O. Gusakov;**AFFILIATION:** Anesthesiology, Boston Medical Center, Boston, MA**INTRODUCTION:** Hermansky-Pudlak syndrome (HPS) is a rare autosomal recessive disorder with a broad range of systemic manifestations including oculocutaneous albinism, bleeding diathesis due to a lack of platelet dense bodies (qualitative disorder), and pulmonary fibrosis secondary to ceroid lipofuscin deposition.^{1,2} We have described the anesthetic plan for a patient with HPS undergoing wisdom teeth extraction under general anesthesia to familiarize the anesthesia community with management of patients with HPS and to emphasize the importance of a multidisciplinary team approach to patient care.**CASE REPORT:** A 30-year-old female with HPS underwent bilateral wisdom teeth extraction under general anesthesia due to concerns for potential intraoperative hemorrhage secondary to platelet dysfunction. The patient had a history of hemorrhage during a tooth extraction as a child and her first vaginal delivery. Subsequent vaginal deliveries were uneventful after pre-treatment with DDAVP (desmopressin acetate). The patient is of Puerto Rican descent, legally blind, portrayed features of albinism, and denied pulmonary symptoms (except for a history of "fluids in lungs" after pregnancy of unknown etiology due to the inability to access medical records). After multidisciplinary consultation, we administered DDAVP (desmopressin acetate) and aminocaproic acid in the pre-operative area with the goal of preventing intraoperative hemorrhage. After discussion with the surgeon, we planned to perform an endotracheal intubation instead of the typical nasotracheal method due to the patient's increased tendency for epistaxis. General anesthesia was induced with fentanyl, propofol, and succinylcholine. The patient was carefully intubated and maintenance was achieved using sevoflurane. The goal FiO₂ of 30-40% was achieved throughout the procedure due to concerns of oxygen free radical production exacerbating any potentially undiagnosed and/or developing pulmonary fibrosis. The patient was extubated without any complications, and discharged as planned.**CONCLUSIONS:** Anesthetic management should be modified to decrease potential perioperative complications associated with HPS. The patient's increased risk of hemorrhage and pulmonary fibrosis may create anesthetic challenges. Hence, a multidisciplinary approach including surgery, anesthesiology, hematology, and pulmonology teams is vital in preventing perioperative complications. Pre-treatment with DDAVP and aminocaproic acid as well as altering airway management proved to be successful in preventing hemorrhage for this patient. General anesthesia helped facilitate stable intraoperative respiratory dynamics especially regarding concerns of pulmonary fibrosis.**REFERENCES:**

1. Anikster Y, Huizing M, White J, et al. Mutation of a new gene causes a unique form of Hermansky-Pudlak syndrome in a genetic isolate of central Puerto Rico. Nat. Genet. 2001;28(4):376-380. doi:10.1038/ng576.
2. Poddar RK. Hermansky-Pudlak syndrome in a pregnant patient. Br. J. Anaesth. 2004;93(5):740-742. doi:10.1093/bja/ae256.

S-452.**MANAGEMENT OF A PATIENT WITH HEREDITARY COPROPORPHYRIA****AUTHORS:** P. Mishra¹, S. Goldstein²**AFFILIATION:** ¹Anesthesiology, Albert Einstein College of Medicine & Montefiore Medical Center, Bronx, NY, ²Anesthesiology, Albert Einstein College of Medicine & Montefiore Medical Center, Bronx, NY**INTRODUCTION:** Hereditary coproporphria (HCP), a rare autosomal dominant porphyria due to coproporphyrinogen oxidase deficiency, has an incidence of 2/1,000,000. We describe care of a patient with HCP.**CASE REPORT:** 26 year old male with HCP presented for abdominal wall reconstruction and anterolateral thigh flap. He had an acute porphyria attack and fulminant hepatic failure 2 years prior due to oral hydroxycut, complicated by bowel perforation, peritonitis requiring multiple laparotomies, abdominal wall hematoma evacuations, pancreatic debridement, diverting ileostomy and subsequent reversal. He recovered, but had complete loss of the abdominal wall. Comorbidities included mild asthma and morbid obesity (BMI =41). Echo EF = 75 %, PASP = 50mmHg; normal valves. Labs were normal. Total bili = 0.6; direct bili = 0.2. Standard ASA monitors were placed. The patient was anesthetized with propofol and fentanyl, vecuronium for muscle relaxation; 7.5 ETT. Sufentanil (0.2mcg/kg/hr) and vecuronium (0.5mcg/kg/min) were begun and titrated to effect. 2 Large bore IV lines and arterial line were inserted. Patient was hemodynamically stable and warm, with clear urine, throughout the 16 hour surgery. Due to large incision, surgeon desired overnight intubation. Hematology was consulted POD2 to assess Hb decrease from 11 to 7 gm/dl, without bleeding. Hematologist noted HTN, tachycardia, increased total (6.6) and direct (3.7) bili, increased WBC, mildly decreased platelets, all of which may be explained by acute porphyria. He noted hydralazine was administered in the ICU. Glucose was administered, but hemin withheld, as he was not convinced this was acute porphyria. POD6 patient developed a rash (erythema with bullous areas) on upper extremities, rust colored urine, total bili = 13.6 and direct bili = 10.3. IV Hemin was begun. Patient remained intubated for 5 days. 1 Day before discharge total bili = 3.8 and direct bili = 2.2. Urine porphyrins not performed, due to improper collection. POD16 urine porphobilinogen = 451.6 mg/dl (0.0 - 0.2 mg/dl).**DISCUSSION:** Porphyrias are rare, and staff may not know medications that may trigger an acute attack. Despite indicating history of HCP in report to ICU, hydralazine, a known triggering agent, was administered. Although some conflicting info exists (ex. porphyria-europe.org suggests IV lidocaine be avoided, but porphyriafoundation.com indicates lidocaine is likely safe), we suggest when report is provided to another service on a patient with a porphyria the need to check all drugs for safety should be emphasized.

1. Bissell, D.M., et al., Hereditary Coproporphria, in GeneReviews®, R.A. Pagon, et al., Editors. 1993: Seattle (WA)

S-453.

ACUTE INTRACRANIAL HEMORRHAGE & PREGNANCY: THE CASE OF AN OTHERWISE HEALTHY PARTURIENT WITH AN UNKNOWN AVM CREATING HAVOC IN THE 2ND TRIMESTER

AUTHORS: S. C. Couch, E. M. Pages, L. Germond

AFFILIATION: Anesthesiology, Ochsner Medical Center, New Orleans, LA

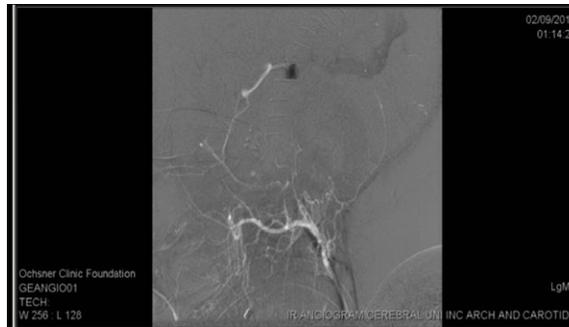
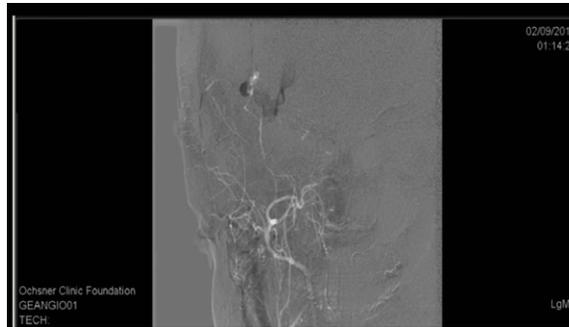
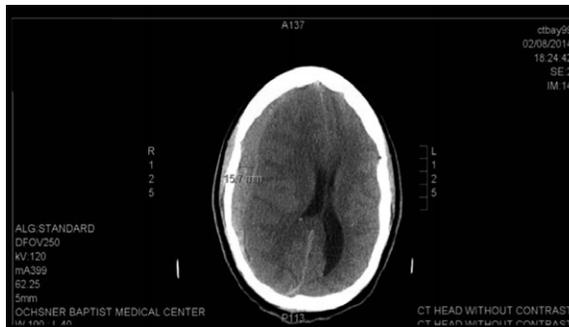
INTRODUCTION: ICH due to AVM rupture during pregnancy is a rare but dangerous event with the potential for neurologic catastrophe. The effect of pregnancy on the progression of AVMs is poorly understood, but the increasing number of reported cases has initiated discussion of the multidisciplinary management necessary for these patients. Studies show prompt surgical intervention has better outcomes and decreased rates of rebleeding.³ However, AVMs with larger bleeds causing mass effect, had increased M&M.

CASE REPORT: A healthy 21 y/o G1 at 27 wga sustained a syncopal episode after complaining of a headache. EMS witnessed a seizure, after which she became unresponsive. In the ED, she was intubated and transported to radiology. Head CT revealed a right subdural hematoma (SDH) with mass effect causing herniation. She became hemodynamically (HD) unstable requiring initiation of vasopressors. On exam, brainstem reflexes were absent with fixed, nonreactive pupils, negative corneal, oculocephalic, and gag reflexes. Uterine US showed FHR of 150. The patient was brought to the OR for craniectomy with hematoma evacuation, resection of right temporal vascular malformation, and cesarean section. A 1 kg baby was delivered (APGARS of 1, 3 & 4 at 1, 5, & 10 min) and taken to the NICU in stable condition. Surgery was complicated by major EBL requiring transfusion of 15 units PRBC, 2 packs of platelets, 12 units FFP, and 1 unit of cryo. Decision was made to leave the dura open and take patient to the IR suite for cerebral angiogram. She underwent embolization of an extravasating right middle meningeal artery. The patient was taken back to the OR, for right frontoparietal exploration and re-evacuation of SDH. On POD 2, patient was HD stable, but remained comatose. On POD 6, gag and cough reflexes returned. Her neurologic status improved with equal and reactive pupils, as well as, positive withdrawal to pain on POD 10. Peg tube and tracheostomy were performed on POD 11.

DISCUSSION: ICH due to AVM rupture during pregnancy is a medical emergency. Although management of these patients has no set guidelines, investigators conclude conservative versus surgical intervention depends on several factors. Grade of AVM, presence of mass effect, maternal HD stability, and neurological symptoms help direct a treatment plan. Reported studies have conflicting evidence in regard to increased risk of AVM rupture during pregnancy. Some studies conclude that pregnancy poses no increased risk for AVM rupture.¹ However, a recent study concluded that 2nd and 3rd trimester gestation were risk factors for increased incidence of AVM rupture.² This suggests that physiological and HD changes of late gestational age are contributing factors to AVM rupture. In our case, emergent surgical intervention was necessary for maternal survival. Due to the patient's HD instability, urgent delivery of the fetus was indicated. In the setting of impending death due to ICH causing herniation, multidisciplinary cooperation is essential for survival of mother and fetus.

REFERENCES:

1. Rev Bras Anesthesiol 2013; 63(2): 223-226
2. Neurology 2014; 82: 1798-1803
3. Neurol Med Chir 2013; 53: 565-570



S-454.

WITHDRAWN.

S-455.**A CASE OF LATE ONSET HORNER SYNDROME FOLLOWING ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK FOR POSTOPERATIVE PAIN MANAGEMENT AFTER INTERNAL FIXATION OF A LEFT HUMERUS FRACTURE****AUTHORS:** M. R. Aerni¹, I. Gasanova², G. P. Joshi²**AFFILIATION:** ¹Anesthesiology and Pain Management, Parkland Health and Hospital System, Dallas, TX, ²Anesthesiology and Pain Management, University of Texas Southwestern Medical Center, Dallas, TX**INTRODUCTION:** Supraclavicular brachial plexus block has been used to provide perioperative analgesia for procedures involving the upper extremity. The advent of ultrasound-guided (UG) regional anesthesia has brought more precision to this technique by allowing a greater degree of sensory and motor blockade. However, Horner syndrome can occur, although rare after supraclavicular approach¹. We describe a case of late onset Horner syndrome after supraclavicular brachial plexus block that resulted in unnecessary testing and emphasize the need for improved communication between the acute pain service (APS) and the primary surgical team.**CASE REPORT:** A 22-year old extremely anxious female with no significant past medical or surgical history (ASA I) underwent an open reduction and internal fixation of humeral shaft fracture under GA. In the PACU the patient complained of severe pain despite intravenous opioid and non-opioid analgesics. Therefore, an UG supraclavicular brachial plexus block was performed to optimize pain control. Block was achieved with ropivacaine 0.5%, 20 mL, with no immediate complications. Good visualization and spread of the anesthetic surrounding the brachial plexus were observed. Patient had complete relief of pain within five minutes. Six hours later the patient began experiencing left sided numbness and flushing to the face and upper chest along with left ptosis and miosis. The primary surgical service consulted a neurologist who ordered head/neck angiography and brain MRI. The findings of the workup were normal. Of note, the APS was not notified initially. Upon involvement of the APS, it was determined that the patient had late onset Horner syndrome. The patient had spontaneous resolution of symptoms within 12 hours and was discharged to home with no consequences.**CONCLUSION:** The Horner syndrome associated with brachial plexus blocks may result from proximal local anesthetic spread and blockage of sympathetic afferents. Although this syndrome occurs in almost 100% of cases after an interscalene approach², the incidence is only about 1% after supraclavicular approach using UG technique¹ and about 20-65% without UG^{3,4}. In our case, the patient experienced late onset of Horner's syndrome, which is rare. The lack of awareness of this side effect resulted in unnecessary testing and increased anxiety for the patient. Therefore, it is necessary that the primary surgical team is educated about this complication and patients are reassured that it will resolve on its own.**REFERENCES:**

1. Med Ultrason 2013; 15: 224-9.
2. J Shoulder Elbow Surgery 2007;16:379-87.
3. Reg Anesth Pain Med 2009;34:366-71.
4. Reg Anesth Pain Med 2009;34:134-70.

S-456.**ROLE OF PERIOPERATIVE ECHOCARDIOGRAPHY PERFORMED BY ANESTHESIOLOGIST IN DIAGNOSIS OF HEMODYNAMIC COLLAPSE DUE TO AIR EMBOLISM.****AUTHORS:** J. Benitez Lopez¹, R. Dudaryk², D. B. Covington³**AFFILIATION:** ¹Anesthesiology, Perioperative Medicine and Pain Ma, University of Miami, Miami, FL, ²Department of Anesthesiology, Perioperative Medicine and Pain Management, University of Miami, Miami, FL, ³Anesthesiology, Perioperative Medicine and Pain Ma, Jackson Memorial Hospital, Miami, FL**INTRODUCTION:** Venous air embolism (VAE) continues to be under-diagnosed, and remains as a complication associated with high morbidity. Air is entrained through open veins when a gradient that results in negative pressure, compared to atmosphere is established. Symptoms vary from respiratory distress to cardiopulmonary collapse. VAE, is usually associated with neurosurgical procedures in the sitting position, with an incidence as high as 76%. VAE has also been related with a wide variety of surgical procedures, intravascular catheters and trauma.**CASE REPORT:** A 25 yo Male presented after a collision with a full speed train. At the scene the patient had a GCS of 5. On arrival his vital signs were HR 130, blood pressure 84/45 SPO2 95%. Airway was secured, and ATLS protocol followed. On survey the patient had a scalp laceration with bleeding, chest and abdominal contusions, and bilateral open tibia and fibula fractures. Focused abdominal ultrasound exam was negative, and focused assessed transthoracic echo (FATE) showed an empty left ventricle. Central access was established, and blood products transfused with suitable hemodynamic response.

Upon return from radiology, the patient developed a junctional rhythm, hypotension and diffuse S-T segment elevations. FATE exam showed a dilated right ventricle (RV) with global hypokinesis. He was transported to the OR for irrigation and reduction of the lower extremity fractures. A transesophageal echocardiogram (TEE) was placed. Exam showed a severely dilated RV with global hypokinesis, severe tricuspid regurgitation, and large patent foramen ovale with right to left shunting. Left ventricular function was intact. Patient was started on an epinephrine infusion, with improved hemodynamics and RV function.

On reduction of the lower extremities, the patient went into ventricular fibrillation, ACLS began. TEE this time showed a large amount of echogenic bubbles suspicious for air embolus. Immediate investigation of other sources of air was done. Patient went into repeated episodes of ventricular fibrillation resistant to cardioversion. Progression of RV failure with resultant left ventricular failure and global dilatation was observed.

CONCLUSIONS: The patient was diagnosed with a large burden of venous air resulting in RV failure. Air likely entrained from the extremities as they were raised on reduction. Other sources of air could include: vascular access, scalp laceration, chest trauma, and positive pressure ventilation. Fat with other debris from the lower extremities could also be a potential source of emboli. The high echogenicity of the emboli in our case favors the presence of air. The use of echocardiography has been described as a sensitive indicator of entrained air. A single bubble of air can be detected with modern TEEs. Detection can lead to a change in management and ideally positive patient outcomes, however in our case the large embolic insults proved difficult to overcome for the patient.**REFERENCES:**

1. Basic TEE: Consensus Statement. A&A.
2. Gas embolism. NEJM.
3. The differences between VAE and Fat embolism. J Trauma-Infection and Critical Care.

S-457.**HOW VITAL IS A PREINDUCTION MACHINE CHECK?
LESSONS LEARNED AFTER FAILURE TO VENTILATE****AUTHORS:** N. Gharibjanians, V. Tateosian;**AFFILIATION:** Anesthesiology, Saint Barnabas Medical Center, Livingston, NJ

INTRODUCTION: The anesthesia apparatus checkout recommended by the Food and Drug Administration is a vital component of any anesthesiologist's morning schedule¹. This checkout process includes procedures to evaluate the high and low pressure systems of the anesthesia machine and serves as a safety system to avoid the inability to ventilate a patient subsequent to induction of anesthesia. Although many advances have been made with newer machines with self-checkout functions, there are many older machines still in use that require manual pressure and system checks. In addition to internal components, each machine contains a CO₂ absorber and circuit that can potentially cause failure.

CASE REPORT: A 42 year old male smoker with history of asthma was admitted for an elective lumbar decompression laminectomy. Upon arrival to the operating room, the patient was kept supine on his transport bed and standard monitors were applied. The anesthesia machine had been inspected before the prior case according to the ASA / Food and Drug Administration (FDA) guidelines¹. Oxygen was administered with a standard face mask attached to the circuit of a Datex-Ohmeda Aestiva 5 machine (Ohmeda, Madison, WI) and end tidal CO₂ was detected. Anesthesia was induced with fentanyl and propofol and the patient was intubated without complication. The endotracheal tube was attached to the circuit at which point there was difficulty ventilating the patient. Small tidal volumes of approximately 65ml were obtained with vigorous ventilation. A "concrete bag" was observed with increasing peak pressures greater than 50 cm Hg. Upon immediate auscultation distant breath sounds were heard and a wide differential including bronchospasm, chest wall rigidity, pneumothorax, mucous plug, and kinking of circuit were considered; appropriate treatments were not curative. To rule out machine failure the patient was disconnected from the circuit and a backup self-filling manual ventilation bag was used successfully. The case was canceled and the patient was extubated with complete recovery.

CONCLUSIONS: We report an anesthesia machine failure similar to a case described by Ianchulev and Comunale². However, in our case it was a wrapped CO₂ absorbent canister which had been replaced between cases without our knowledge. We were unable to ventilate the patient during induction and subsequently went through a wide differential of potential causes. Similar to the case described by Ianchulev and Comunale², it was the presence of a backup self-filling manual ventilation bag which prevented an inevitable emergency.

REFERENCES:

1. Food and Drug Administration. Anesthesia apparatus checkout recommendations, 1993. Rockville, MD: Food and Drug Administration, 1993.
2. Ianchulev SA, Comunale ME. To do or not to do a preinduction check-up of the anesthesia machine. *Anesth Analg* 2005;101:774-6.

S-458.**MULTI-SEDATIVE THERAPY FOR AN OBESE PATIENT
WITH SEVERE PULMONARY HYPERTENSION
UNDERGOING PERCUTANEOUS CORONARY
INTERVENTION****AUTHORS:** N. Abitbol, S. Goldstein;**AFFILIATION:** Anesthesiology, Montefiore Medical Center, Bronx, NY.

INTRODUCTION: Patients undergoing Percutaneous Coronary Intervention (PCI) are often sedated by a nurse. We report a case for which cardiology requested sedation by an anesthesiologist for a patient, with multiple co-morbidities, undergoing PCI.

CASE REPORT: A 57 year old obese male (6'0", 313 lbs; BMI 36 kg/m²), with dyspnea with minimal exertion and at rest, presented for PCI. PMHx included HTN, uncontrolled DM, hyperlipidemia, CAD, CHF with EF 30%, pulmonary HTN, CKD_stage I, 20 pack year smoking, and suspected OSA (5/8 STOP-BANG score). Right and left heart cath, one week prior, revealed: mid-LAD diffuse disease, D1 90%, mid-RCA 95%, RPDA 70%, RLV1 95%, RLV2 90%, OM1 60%, OM2 99%. PA pressures = 88/38. Due to severe pulmonary hypertension and multiple comorbidities the cardiologist delayed PCI and requested sedation by an anesthesiologist. Physical exam suggested a difficult airway, due to a large fat pad that limited neck extension, and neck circumference = 48.3 cm. BP was 175/117; patient had not taken his daily losartan, carvedilol or amlodipine. Labetolol 5 mg and hydralazine 5 mg were administered. After midazolam 2 mg IV, dexmedetomidine (DEX) 0.5 mg/kg was administered over 10 mins, followed by DEX infusion at 0.6 mg/kg/hr. Propofol infusion 20 mcg/kg/min was added. 15 Mins later BP was unchanged, and an additional 5 mg of hydralazine was administered. 10 Mins later as the procedure began, BP = 170/100. 10 Mins later BP = 140/90, and remained close to 135/80, NSR=75, for remainder of the case. O₂ sat was 94-100% on NC 4L/min throughout. Xience stents were placed at sites of circumflex and marginal stenoses; with staged PCI of RCA planned.

CONCLUSIONS: Cardiologists often limit sedation to midazolam and fentanyl; sometimes morphine. Though this case went well, it should be appreciated that avoidance of narcotics, and use of three sedatives, each for specific properties (midazolam- sedation and amnesia; Dex- sedation with maintenance of respiratory drive; propofol- sedation and antiemetic effect), may have resulted in optimal conditions. In contrast, had narcotics been administered, hypercarbia may have increased pulmonary artery pressure, and might have led to hypoxemia and/or hypotension. Furthermore, management of HTN by the anesthesiologists may have improved the safety margin further. Sedation for PCI is often performed by cardiology staff. However, for patients with complicated comorbidities, sedation by an anesthesiologist may be vital to optimize patient safety. This is especially so if conversion to general anesthesia is required mid- procedure.

REFERENCES:

Interventional Cardiology, Miller's Anesthesia, 7th Edition, pp. 2471-2476

S-459.**UNANTICIPATED EMERGENCY CRICOTHYROTOMY IN A HEALTHY PARTURIENT**

AUTHORS: G. Paek¹, S. McConville¹, K. Kennington², B. S. Chortkoff¹

AFFILIATION: ¹Anesthesiology, University of Utah, Salt Lake City, UT, ²Anesthesiology, University of Utah, Bountiful, UT

INTRODUCTION: The difficult airway in obstetrics is frequent; 1 in 300 parturients that undergo general anesthesia may have a difficult intubation with laryngoscopy. The steps outlined in the ASA difficult airway algorithm all lead to the emergent invasive airway. It is the definitive airway; however, likely under utilized.

CASE REPORT: A healthy 19-year-old primigravida patient presented to Labor and Delivery at 37.5 weeks gestation. She had frequent contractions and profound fetal bradycardia, and went emergently to the OR for cesarean delivery. Neuraxial anesthesia was inappropriate due to the emergent nature of the case. On exam, she had a normal body habitus for gestational age, and airway exam normal with a Mallampati score of 2. Rapid-sequence intubation with cricoid pressure and a video laryngoscope 3 blade revealed a Cormack-Lehane Grade 1 view of the vocal cords without anatomic abnormality. A 6.5 mm endotracheal tube (ETT) was advanced but would not pass the cords despite manipulation. Anesthesia help was called. The patient desaturated and mask ventilated. A second attempt with video laryngoscopy and a 6.0 mm ETT met the same resistance just past the cords. The cuff was inflated with attempted hypopharyngeal ventilation but CO₂ was not evident on capnography. The ETT was removed and mask ventilation progressively became difficult with blood suctioned out of the oropharynx. A LMA Classic™ and LMA Fastrack™ were placed but end tidal CO₂ was intermittent. The patient continued to desaturate and became bradycardic. The obstetric team and anesthesia team moved forward with delivery. The anesthesia team simultaneously performed a cricothyrotomy. Oxygenation and ventilation quickly improved. The patient was transported to the OR where ENT secured an oral 7.0 mm ETT after trying a 7.5 mm ETT. The patient's cricothyrotomy site was closed and she transferred to the ICU. She extubated 36 hours later and joined her newborn in L & D, both in good condition.

DISCUSSION: This case outlines the anesthesiologist's "can't intubate can't ventilate" dilemma in an unexpected difficult airway where progression to the surgical airway proved life-saving. After several unsuccessful attempts, another attempt may have been successful with a 5.0 mm ETT, but an additional attempt may have been catastrophic. According to the ASA closed claims project database, severe outcomes were common in the unanticipated difficult airway when clinicians persisted at oral intubation. Furthermore, newborn death or hypoxic brain damage remains a leading cause of obstetric anesthesia malpractice claims. Anesthesiologists are the experts in the difficult airway, and the surgical airway is not excluded.

REFERENCES:

1. Management of the Difficult Airway in Closed Malpractice Claims. *Anesthesiology*, 99: A1252, 2003.
2. The unanticipated difficult airway in obstetrics. *Anesth Analg*; 2011;112:648-652.
3. ASA Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the ASA Task Force on Management of the Difficult Airway. *Anesthesiology*. 2003;98(5):1269-1277.

S-460.**PERSISTENT LEFT SUPERIOR VENA CAVA AND ITS SIGNIFICANCE TO AN ANESTHESIOLOGIST**

AUTHORS: M. T. Albert¹, S. Lee¹, S. R. Musuku²

AFFILIATION: ¹Anesthesiology, Albany Medical Center, Albany, NY, ²Anesthesiology, Albany Medical Center, WaterVliet, NY

INTRODUCTION: Persistent left superior vena cava (PLSVC) is the most frequent (0.3-0.5%) congenital malformation of the thoracic venous drainage system. This condition is usually asymptomatic and is detected when cardiovascular examination is performed for unrelated reasons. We present a cardiac surgical patient who was newly diagnosed with PLSVC utilizing intraoperative transesophageal echocardiography (TEE).

CASE REPORT: 63-year-old female with history of HTN and CVA presents with severe aortic stenosis (valve area of 0.9 cm²) secondary to a bicuspid aortic valve (AV). She was scheduled for elective minimally invasive AV replacement with insertion of Heartport™ lines to administer retrograde cardioplegia. A standard cardiac anesthetic with invasive lines was planned and executed. Post induction, an 11 Fr introducer for coronary sinus catheter (CSC) and a 10 Fr triple lumen Endovent™ for pulmonary artery drainage were inserted via the right internal jugular vein.

TEE examination established AS, but surprisingly revealed a dilated coronary sinus measuring 1.63 cm. Coronary sinus catheter placement was done under fluoroscopy and TEE. To verify PLSVC, agitated saline contrast was injected via the left upper extremity peripheral IV line. TEE revealed saline contrast arising from the coronary sinus confirming the diagnosis of PLSVC. Following discussion with the surgeon, plan was to proceed with surgery by using selective antegrade cardioplegia via coronary ostia. The patient had an uncomplicated surgery and recovered well.

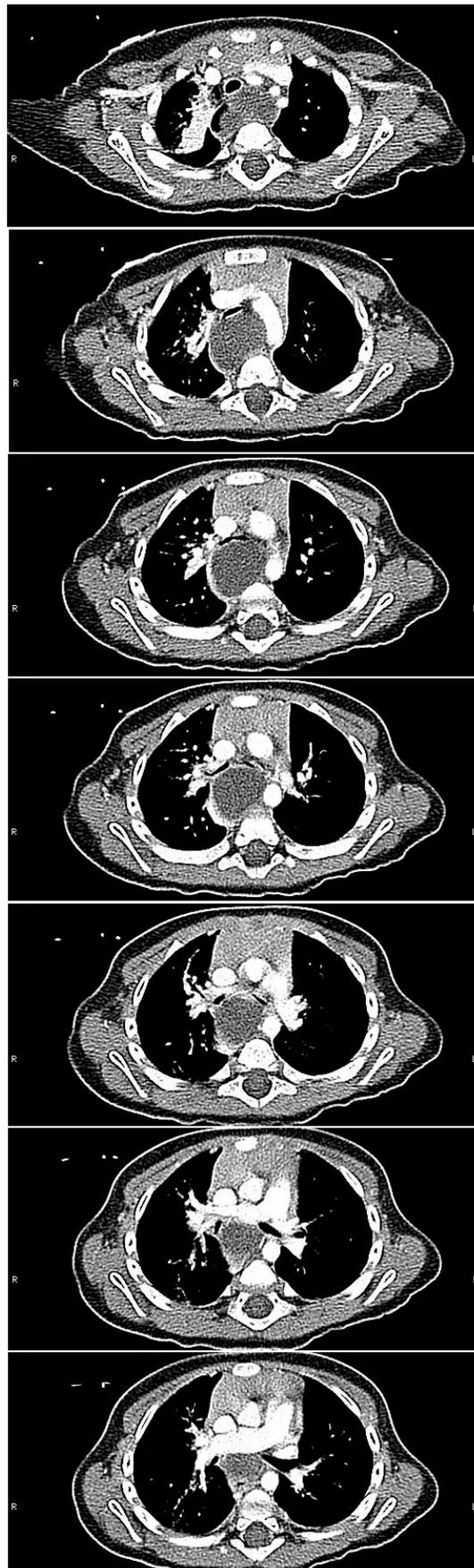
CONCLUSIONS: Diagnosing intraoperative persistent left superior vena cava (PLSVC) in a cardiac surgical patient is of great clinical significance. Almost 40% of patients with PLSVC can have a variety of associated cardiac anomalies such as atrial septal defect, bicuspid aortic valve, or coarctation of aorta. In cardiac surgery an undiagnosed PLSVC renders the administered retrograde cardioplegia ineffective. In addition it may lead to cardiopulmonary bypass weaning issues and myocardial damage. For cardiologists, PLSVC may pose challenges for pacemaker implantation due to the tortuous course of the inserted electrode. For non-cardiac anaesthesiologists, a PLSVC may present technical difficulties with right heart access via the left subclavian, but does not preclude insertion of catheters. The additional associated risks should be discussed with the patient if the diagnosis of PLSVC is already established, and alternative access sites should be considered. In conclusion, PLSVC is a rare, but clinically significant consideration for successful perioperative management.

REFERENCES:

1. Birnie D, et al. Permanent pacing from a left ventricular vein in a patient with persistent left and absent right superior vena cava. *Pacing Clin Electrophysiol*. 2000; 23:2135-37.
2. Lentini S, et al. Recognition of persistent left superior vena cava in non-congenital patients undergoing cardiac surgery. *Perfusion*. 2011 Jul;26(4):347-50.
3. Sarodia B, et al. Persistent left superior vena cava: case report and literature review. *Respir Care* 2000, 45(4):411-416.

S-461.**EMERGENT AIRWAY MANAGEMENT OF AN INFANT WITH A LARGE COMPRESSIVE POSTERIOR MEDIASTINAL MASS****AUTHORS:** C. Liu¹, B. Tinch², S. Soriano²**AFFILIATION:** ¹Anesthesiology Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA, ²Anesthesiology, Perioperative and Pain Medicine, Children's Hospital of Boston, Boston, MA**INTRODUCTION:** Anterior mediastinal masses can be associated with severe airway obstruction and circulatory collapse; however, airway implications of posterior mediastinal masses (PMMs) are not well-described. We present a case of a 10 month old patient with a large PMM causing acute airway obstruction requiring emergent intubation and subsequent urgent thoracotomy for mass decompression.**CASE REPORT:** A 10 month old male with a history of biphasic stridor since birth and CT revealing a large PMM with airway compression (Figure) was admitted to the ICU for worsening stridor. The patient was found by RN to be prone and in respiratory distress with O₂ saturation of 60%. We were called emergently and provided mask ventilation to restore oxygenation. We transferred him to the operating room (OR) for emergent intubation while ensuring otolaryngology and ECMO teams were present. We placed the patient supine while keeping the head of the bed elevated and performed inhalational induction with sevoflurane maintaining spontaneous ventilation. 1 mg/kg of propofol was given to facilitate direct laryngoscopy revealing grade 1 view of the larynx. The right mainstem bronchus was intubated with a 4.0 uncuffed endotracheal tube (ETT) and immediate bronchoscopy revealed copious pink frothy secretions and partial compression of right mainstem bronchus distal to the ETT. End tidal CO₂ was noted to be in the 90s range at this time and rose to as high as 100s while we were best able to achieve tidal volumes of 40 mls with manual ventilation. The ETT was changed to a 4.5 cuffed ETT placed just above the carina. Repeat bronchoscopy demonstrated partial compression of bilateral bronchi. We also noticed that manual ventilation improved when patient effort was minimal and decided to provide muscle paralysis with rocuronium. The patient's ventilatory parameters subsequently improved. We also provided PEEP of 10 cmH₂O to facilitate oxygenation. Once we stabilized the patient, thoracotomy and resection of the mass was performed. 20 ml of clear fluid was aspirated from the cyst with further improvements in ventilation. Given concern for post-obstructive pulmonary edema, he remained intubated post-operatively. He was brought back to the OR post-operative day 1 for reevaluation of the airway and was extubated uneventfully. Histologic evaluation of the mass revealed an enteric duplication cyst. The patient was discharged from the hospital post-operative day 10.**CONCLUSIONS:**

- PMMs can produce acute compression of the airway.
- Understanding specific airway anatomy via imaging and bronchoscopy in a patient with PMM can help develop a plan to relieve acute obstruction.
- Paralysis in the setting of dynamic airway compression due to PMM can facilitate ventilation.
- High PEEP and positive pressure ventilation peri-operatively and post-operatively may be needed in the setting of post-obstructive pulmonary edema from mediastinal mass.
- Prompt interdisciplinary communication and collaboration between anesthesiology, otolaryngology, cardiac surgery and general surgery facilitated the successful management of this airway emergency.



S-462.**THE ANEURYSM IS COILED -- NOW WHY IS MY PATIENT NOT WAKING UP?****AUTHORS:** A. C. Reilly, S. Shaikh;**AFFILIATION:** Anesthesiology, University of Massachusetts, Worcester, MA

INTRODUCTION: Mild intraoperative hypothermia has dire consequences for patients undergoing surgery, ranging from wound infection, cardiac morbidity, and prolonged hospitalization.^{1,2} Anesthesia impairs thermoregulatory mechanisms, with the greatest rate of heat loss occurring in the period immediately following induction.³ In this case, a 55-year-old female underwent cerebral angiography and intraoperative hypothermia led to delayed emergence. We will discuss mild intraoperative hypothermia and its implications during the perioperative period.

CASE REPORT: A 55-year-old female, 5'7" 64 kg, with a past medical history of anxiety presented to the Emergency Department after experiencing episodes of headache. MRI/MRA demonstrated a 2 mm right posterior communicating artery aneurysm. She returned for an elective cerebral angiography and coiling of the vessel. General anesthesia was induced using propofol, fentanyl, and rocuronium. An endotracheal tube was placed and anesthesia was maintained with a combination of sevoflurane, remifentanyl and propofol infusions.

The procedure, which lasted a total of four hours, was complicated by perforation of distal M3 artery during wire placement. Tamponade was achieved through rapid balloon inflation and the artery was coiled, with a CT scan showing subarachnoid hemorrhage. Systolic blood pressure remained in the range of 100-130 throughout the case and there were no episodes of hypotension. The procedure required frequent periods of apnea and it was requested that the forced-air blanket be disconnected during apnea to facilitate coiling.

At the end of the case, the patient experienced delayed emergence, which was attributed to persistent hypothermia of 34.1 degrees Celsius. She was actively warmed using both upper and lower body forced-air warming blankets. After nearly 2 hours, the patient awoke and was able to follow commands. Following extubation, there were no signs of any neurological deficits. On admission to the post-anesthetic care unit, her temperature was noted to be 36 degrees Celsius. She was admitted to the intensive care unit for postoperative monitoring. She recovered without complication and was discharged on postoperative day 8 in good condition.

CONCLUSION: Our patient experienced delayed awakening from anesthesia, which was ultimately attributed to hypothermia during the intraoperative period despite use of forced air warming blankets. This case illustrates one potential consequence of hypothermia and the effects of post-anesthetic recovery. The importance of vigilance and aggressive maintenance of normothermia is highlighted in this case.

REFERENCES:

1. Kurz, A, Sessler, DI, Lenhardt, R. Perioperative Normothermia to Reduce the Incidence of Surgical Wound Infection and Shorten Hospitalization. *New England Journal of Medicine*, 1996. 334:1211-1215.
2. Sessler, DI. Temperature Regulation and Monitoring. In: Miller RD. *Miller's Anesthesia*. 8th Ed. Philadelphia, PA: Elsevier Saunders, 2015
3. Sessler, DI. Mild perioperative Hypothermia. *New England Journal of Medicine*. 1997;336:1730-1737.

S-463.**INTRA-OPERATIVE 3-D ECHOCARDIOGRAPHY:
GUIDING THE SURGICAL APPROACH IN LEFT
VENTRICULAR TUMOR RESECTION****AUTHORS:** K. K. Chaichana, A. Yasuda, W. Keeyapaj**AFFILIATION:** Anesthesia, Critical Care, and Pain Medicine,
Massachusetts General Hospital, Boston, MA

INTRODUCTION: Myxomas are the most common cardiac tumor, typically originating in the left atrium (LA). Recurrence in the left ventricle (LV) after resection of a LA myxoma is rare. A trans-mitral or trans-aortic surgical approach to a LV myxoma influences the completeness of resection. We demonstrate the use of 3-D transesophageal echocardiography (TEE) to determine the optimal surgical approach to resection of a recurrent LV myxoma.

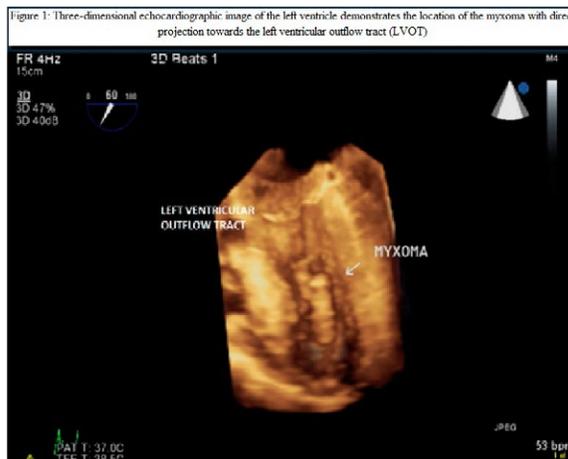
CASE REPORT: A 47 year old man with a history of hypertension and rheumatoid arthritis was found to have new LV masses on surveillance echocardiogram one year after LA myxoma removal. It showed two irregularly-shaped masses in the LV cavity at the base of the posteromedial papillary muscle and LV endocardium. LV tumor resection was planned and the surgical and anesthesia teams discussed the best surgical approach to maximize tumor visualization. Intra-operative 3-D TEE showed multiple echogenic masses along the inferolateral wall of the LV originating at the base of papillary muscle extending toward the LV apex with a direct trajectory towards the left ventricular outflow tract (LVOT). Given this data, the surgeon decided the trans-aortic approach would provide the best opportunity for complete resection. Tumor debulking was performed and diagnosed disseminated myxomatous tumor of the LV wall. The remainder of the surgery was uneventful; the patient came off bypass and recovered uneventfully.

CONCLUSIONS: LV myxomas account for 2.5% of all cardiac myxoma cases. Recurrence in the LV after LA myxoma resection is uncommon. Complete resection is essential in preventing tumor recurrence. Multiple myxomatous masses in the LV carry a unique challenge. A trans-mitral approach may not provide optimal exposure of the LV cavity, especially of the mitral sub-valvular area. In contrast, the trans-aortic approach provides better exposure of the mitral sub-valvular area but not of the LV septal wall. Thus, a clear understanding of the tumor location and its spatial relation to cardiac structures is crucial and is best determined before cardiopulmonary bypass. For this purpose, intra-operative 3-D TEE provides superior information compared to 2-D TEE. The 3-D TEE also facilitates collaboration between the anesthesiologist and surgeon regarding the peri-operative plan.

In our patient, intra-operative 3-D TEE showed the majority of tumor burden was located on the inferolateral wall of the LV at the posteromedial papillary muscle. Reconstructed 3-D images showed a direct trajectory towards the LVOT. Therefore, we decided to perform the surgical resection via the trans-aortic approach. It is in complicated cases such as this that intra-operative 3-D TEE provides valuable information to help the surgical team make decisions that provide the best surgical outcome for the patient.

REFERENCES:

1. Abad C. Myxoma of the left ventricle. *Tex Heart Inst J.* 2014 Aug; 41(4):395-400.
2. Seethala S. Left ventricular myxoma: Missed vs metastatic. *World J Cardiol.* 2013 Oct 26;5(10):387-90.
3. Nijmeh G. Utilizing 3-D Echocardiography in Cardioscopic Left Ventricular Myxoma Resection. *Echocardiography* 2013;30:E44-46.



S-464.

WITHDRAWN.

S-465.**RETAINED THROAT PACK: MIRACLE ANESTHETIC?****AUTHORS:** S. Pak¹, I. Ianov¹, K. McCaskey²**AFFILIATION:** ¹Anesthesiology, Univ of Florida College of Medicine – Jacksonville, Jacksonville, FL, ²Oral & Maxillofacial Surgery, Univ of Florida College of Medicine – Jacksonville, Jacksonville, FL**INTRODUCTION:** Surgeons routinely place hypopharyngeal (throat) packs during oral and nasal procedures to decrease risk of aspiration and postoperative nausea/vomiting^{1,3}. Throat pack retention is a rare, but possibly devastating complication. Only a few cases have been presented showing the different side effects. We present an unusual case of a retained throat pack and the immediate improvement in patient status upon its removal.**CASE REPORT:** A 64 yr old male with history of hypertension, HIV, and 20 pack yr smoking history presented for teeth extraction and alveoplasty under general anesthesia. Systems review and exam revealed no prior complications with anesthesia, no known allergies, poorly controlled hypertension, HIV, Mallampati I, normal respiratory and cardiac exams, GCS 15, BMI 20, and ASA 3.

After uneventful induction (2mg midazolam, 100mcg fentanyl, 140mg propofol, 120mg succinylcholine), nasal intubation was successful with a 7mm nasal rae. Throat packs (fig 1) are routinely cut in half by nurses before being placed by surgeons. Anesthetic records noted placement at 0856. Vitals signs remained relatively stable throughout. Prior to end of case, instrument and equipment counts were correct. Medications of note included: 300mcg fentanyl and 10mg morphine. Removal of throat pack was visualized and noted by the anesthesia provider at 1028. Patient was breathing

spontaneously and was extubated deep before being transferred to post-anesthesia recovery unit (PACU). In PACU, patient was found to have altered mental status, no gag reflex, labored breathing, and pinpoint pupils. Oxygen saturation (SpO₂) was 100% on 10L oxygen. Naloxone was administered multiple times (total 0.16mg) with mild improvement in mental status. Over the next five minutes, SpO₂ dropped and ABG revealed pH 6.9, PCO₂ 147, PO₂ 54, HCO₃ 28.8, BE -8.3, and glucose 183. The decision was made to reintubate. During direct laryngoscopy, a retained piece of throat pack was visualized in the hypopharynx and removed. Within 30 seconds, the patient's mental status and respiratory pattern improved and vital signs remained stable without re-intubation.**CONCLUSIONS:** Retained throat packs carry the risk of airway obstruction or worse, death². Retention has been known to occur^{2,3}, however, equipment count was noted to be correct in this case. Was this a situation of the throat pack coming apart or being inadvertently cut while in the hypopharynx? Interestingly, how did removal of the retained portion immediately cause improved patient status and respiratory acidosis? Anesthesiologists are always looking for the perfect anesthetic: sedates patients rapidly and awakens quickly, however, no such drug exists. The outcome of this case allows us to observe one effect that a retained throat pack may have on patients. Future cases should check that the throat pack is indeed intact once removed. If there is any question in the integrity of the throat pack, a direct laryngoscopy should be done to visualize a clear pharynx² prior to extubation.**REFERENCES:**

1. Ir J Med Sci 2011; 180:181-183
2. Br J Oral & Max Surg 2008; 46:473-476
3. Otolaryngol-Head & Neck Surg. 2007; 137:552-554



S-466.**MULTIDOSE ADENOSINE USED TO FACILITATE CLIPPING OF A CEREBRAL ANEURYSM COMPLICATED BY INTRAOPERATIVE RUPTURE****AUTHORS:** R. J. Vealey, A. Koht, C. A. Wong**AFFILIATION:** Anesthesiology, Northwestern University, Chicago, IL**INTRODUCTION:** Several anesthetic techniques are available in vascular neurosurgery to facilitate cerebral aneurysm clipping by providing temporary arterial flow arrest. Such methods provide a brief decrease in aneurysm wall tension for clip application, decreasing the likelihood of rupture. Of these techniques, adenosine is used in neuroanesthesia to provide the surgeon with brief circulatory arrest in cases of particularly complex anatomy or inadvertent rupture.**CASE REPORT:** We present a case of a 61 year-old female with a left MCA aneurysm who presented with subarachnoid hemorrhage. Preoperative CT angiography revealed a left MCA 4.4 mm aneurysm (2mm neck) arising from the left MCA and projecting inferiorly and medially at the level of the MCA bifurcation. A subsequent pterional craniotomy for microsurgical clipping was complicated by intraoperative rupture due to the degree of manipulation required for clip placement. Despite suctioning, the aneurysm position and poor visibility of the vascular defect led to significant, uncontrolled blood loss. Six doses of adenosine were required over the course of several minutes to provide the surgeon with the visibility and exposure needed to gain hemostatic control via temporary clip occlusion (0.4mg/kg or 24mg per dose). The patient recovered without evidence of neurologic or cardiac dysfunction.**CONCLUSIONS:** Adenosine used for temporary flow arrest has been shown in prior case reports and series to be both safe and effective, frequently given as a single dose as a surrogate for temporary clip application. This case supports these previous findings that adenosine is safe and effective in appropriately selected patients. In addition, our experience demonstrates repeated doses of adenosine can be used in cases of persistent hemorrhage with little concern for significant morbidity from its use.**REFERENCES:**

1. Bebawy JF, Zeeni C, Sharma S, Kim ES, DeWood MS, Hemmer LB, Ramaiah VK, Bendok BR, Koht A, Gupta DK. Adenosine-induced flow arrest to facilitate intracranial aneurysm clip ligation does not worsen neurologic outcome. *Anesth Alg.* 2013 Nov; 117(5): 1205-10
2. Khan SA, McDonagh DL, Adogwa O, Gokhale S, Toche UN, Verla T, Zomorodi AR, Britz GW. Perioperative complications and 30-day mortality in patients undergoing intracranial aneurysm surgery with adenosine-induced flow arrest: a retrospective comparative study. *Neurosurgery.* 2014 Mar; 74 (3): 267-72
3. Wright JM, Huang CL, Sharma R, Manjila S, Xu F, Dabb B, Bambakidis NC. Cardiac standstill and circulatory flow arrest in surgical treatment of intracranial aneurysms: a historical review. *Neurosurg Focus.* 2014 Apr; 36 (4): E10
4. Benech CA, Perez R, Faccani G, Trompeo AC, Cavallo S, Beninati S, Berardino M. Adenosine-induced cardiac arrest in complex cerebral aneurysms surgery: an Italian single-center experience. *J Neurosurg Sci.* 2014 Jun; 58 (2): 87-94
5. Khan SA, Berger M, Agrawal A, Huang M, Karikari I, Nimjee SM, Zomorodi AR, McDonagh DL. Rapid ventricular pacing assisted hypotension in the management of sudden intraoperative hemorrhage during cerebral aneurysm clipping. *Asian J Neurosurg.* 2014 Jan; 9 (1): 33-5

S-467.

WITHDRAWN.

S-468.**REPLACEMENT OF A DILATED AORTIC ROOT IN A PREGNANT MARFAN SYNDROME PATIENT****AUTHORS:** A. Quan, V. Ng, M. Rollins**AFFILIATION:** Anesthesiology, UCSF, San Francisco, CA**INTRODUCTION:** Marfan syndrome is an autosomal dominant disease characterized by connective tissue abnormalities in the skeletal, ocular, and cardiovascular systems. We present the case of a woman in her second trimester of pregnancy with Marfan's scheduled for aortic root replacement.**CASE REPORT:** A 21 year-old G2P0 with Marfan's presents at 11-weeks gestation for obstetric care. A previously stable aortic root diameter of 43mm is now noted to be 49mm. The patient declined termination and elected for an aortic root replacement during her second trimester.

Following arterial line and central line placement, the patient was induced with fentanyl, midazolam, and rocuronium and maintained with isoflurane and fentanyl boluses. Tranexamic acid was given and the patient heparinized with appropriate ACT response. During cardiopulmonary bypass (CPB), the patient was cooled to 30°C with MAP's in the 60-70's, hematocrit kept > 24, and bypass flow of 6 liters/min. Bypass time was 127 minutes with successful aortic valve sparing root replacement. One episode of uterine contraction occurred which resolved with increased isoflurane. The patient recovered in the ICU intubated, sedated, with infusions of nitroglycerin and dopamine for tocolysis and hemodynamic stability. The patient was extubated on postoperative day (POD) 1. Fetal heart tones remained in the 130's without further uterine contractions. Patient was discharged home on POD 10. The patient had an uneventful cesarean delivery at 39 weeks. Baby is now 5 months old and is doing well with plans for genetic testing for Marfan's.

CONCLUSIONS: Aortic dissection is the leading cause of premature death in patients with Marfan's. Patients are at increased risk during pregnancy due to cardiovascular changes including hormonally mediated changes in the aortic wall. These risks are magnified at the time of delivery due to the physiologic demands of the delivery process. AATS guidelines recommend that aortic root dilation > 40 mm is replaced before pregnancy. Our patient highly desired her pregnancy and elected to have the replacement while pregnant in hopes of an uneventful delivery.

Advances in cardiac surgery and CPB have decreased mortality so that pregnant and nonpregnant patients have a similar risk of 3%. However, fetal mortality remains high (16-33%) and is likely due to the hemodynamics of CPB, alteration in blood composition, and hypothermia. Ideal CPB would maintain high flow, pressure, hematocrit, and normothermia. In our case, the fetus was pre-viable and the surgery was performed with optimal conditions for maternal outcome.

REFERENCES:

1. Mulder, et al. *J Am Coll Cardiol* 2012;46(3):403-10.
2. Golland, et al. *Circ* 2009;119:619-23.
3. Parry et al. *Annals of Thor Surg* 1996;61(6):1865-69.
4. Strickland, et al. *Mayo Clin Proc* 1991;66:411-29.
5. Chandrasekhar, et al. *Cardiac Surgery in the Parturient. Anesth Analg* 2009;108:777-85.
6. Patel, et al. *Tex Heart Inst J* 2008;35(3):307-12.

S-469.

RARE LEIOMYOSARCOMA OF THE RIGHT INTERNAL ILIAC VEIN METASTATIC TO THE RIGHT HEART: A CASE REPORT

AUTHORS: A. C. Lee, S. Lo;

AFFILIATION: Anesthesiology, Columbia University Medical Center, New York, NY

INTRODUCTION: Venous leiomyosarcomas are rare entities with the predominance arising from the inferior vena cava (IVC,^{1,2}). These tumors tend to be insidious in nature and present with large tumor burden and metastases. Based on survival data from primary IVC tumors, the prognosis is poor after surgical resection, with five- and ten-year survival rates of 31-34% and 7.4%, respectively^{2,3}.

CASE REPORT: A 37-year-old woman with saddle pulmonary embolism was found to have a vascular mobile mass in the right atrium and right ventricle (RV) extending to the main pulmonary artery on imaging. The mass had a blood supply originating from the right internal iliac vein via an umbilical structure through the IVC. Transthoracic echocardiography showed severely increased RV size with moderately decreased function and signs of RV outflow tract (RVOT) obstruction.

A multidisciplinary approach for tumor resection was undertaken involving the cardiothoracic (CT), gynecologic oncology, and liver transplant surgical teams and the CT anesthesia team. Prior to induction of general anesthesia, the left groin was prepped for venoarterial extracorporeal membrane oxygenation (VA ECMO), inhaled nitric (iNO) was available and a dobutamine infusion was started. Central access was obtained via the right internal jugular vein after confirming no extension of the mass into the superior vena cava with transesophageal echocardiography (TEE). Under circulatory

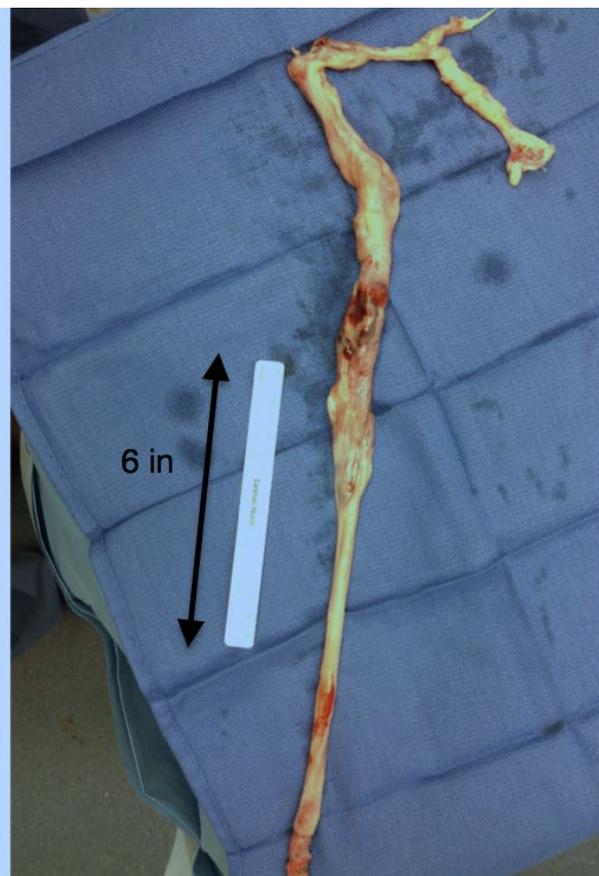
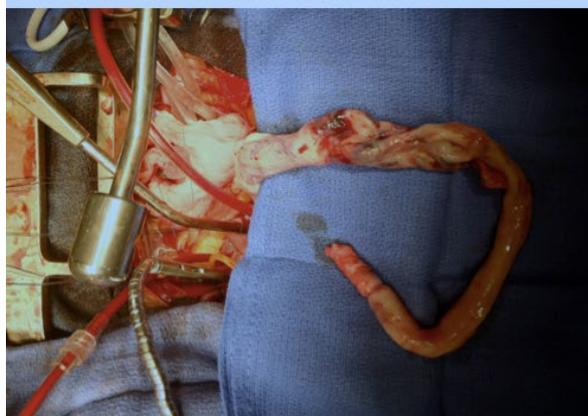
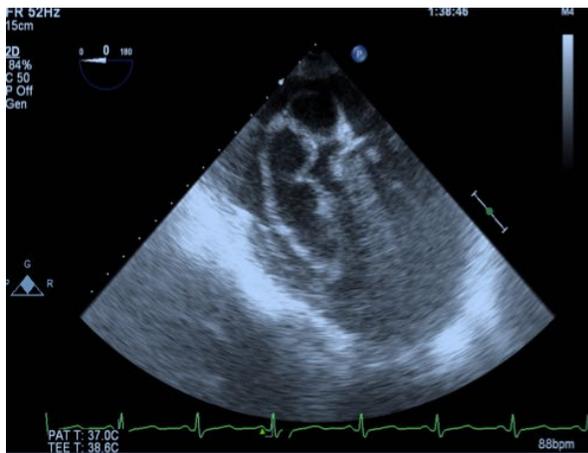
arrest (CA), bilateral pulmonary thrombendarterectomies (PTEA) were performed and the mass was removed en bloc through a right atriotomy (see figure). Transplant surgery was on standby for possible portal vein involvement and IVC reconstruction. Using TEE, remnant tumor was identified in the coronary sinus and resected.

The patient's postoperative course was uncomplicated and she was transferred out of the CT intensive care unit on postoperative day (POD) 3 and discharged from the hospital on POD 10. Final pathology of the intracardiac mass was consistent with a leiomyosarcoma.

CONCLUSIONS: Given the extent of the tumor, operative planning was crucial for strategizing the sequence of the surgery and locations for central access. The severity of the RVOT obstruction posed a significant risk for cardiovascular collapse after induction of general anesthesia and warranted preparation for ECMO cannulation, iNO, and pharmacologic inotropic support. The prolonged circulatory arrest times for tumor resection and PTEA placed the patient at higher risk for stroke, coagulopathy and postoperative mortality. This case also demonstrated how TEE was instrumental in detecting remanant tumor burden in the heart, important in preventing local recurrence which may be as high as 50%³.

REFERENCES:

1. Gage MJ et al. Non-vena cava venous leiomyosarcomas: a review of the literature. *Annals of Surg Onc* 2012; 19:3368–3374.
2. Kieffer E et al. Leiomyosarcoma of the inferior vena cava: experience in 22 cases. *Annals of Surg* 2006; 244: 289-295.
3. Mingoli A et al. International registry of inferior vena cava leiomyosarcoma: analysis of world series on 218 patients. *Anticancer Res* 1996; 16: 3201-3205.



S-470.**A RARE GENETIC VARIANT OF THE RYANODINE RECEPTOR IN A SUSPECTED MALIGNANT HYPERTHERMIA SUSCEPTIBLE PATIENT****AUTHORS:** E. MacKay¹, C. Wilkerson², T. Kennedy²**AFFILIATION:** ¹Anesthesiology, Thomas Jefferson University Hospital, Philadelphia, PA, ²Anesthesiology, Sidney Kimmel Medical College, Philadelphia, PA**INTRODUCTION:** We describe the management of a suspected intraoperative malignant hyperthermia (MH) episode. Subsequent genetic testing of the ryanodine (RYR1) receptor found a quite rare variant of unknown significance (VUS) that has been reported in only one other individual with confirmed MH susceptibility.**CASE REPORT:** A healthy 17 year old male underwent C4-C6 fusion for a C5 fracture he suffered while body surfing. He was in a halo brace and was therefore wake-fiberoptically intubated. General anesthesia was TIVA without the use of muscle relaxants. During wound closure, TIVA was discontinued and switched to volatile anesthetics (desflurane/N₂O then sevoflurane). At the end of the case with the patient supine and still intubated the patient developed severe rigors, tachycardia to 130 bpm, systolic hypertension over 200 mm Hg, EtCO₂ in the 70s with a spontaneous minute ventilation of over 21 L/minute on high FGF and increasing esophageal temperature (38.4C). With his worsening vital signs, we decided to empirically treat for MH. Dantrolene (2.75 mg/kg) administration resulted in a rapid improvement in hemodynamics and hypercarbia. The patient was extubated 6 hours later in the ICU without further dantrolene and recovered uneventfully. Lab values for CK and myoglobin were mildly elevated and all electrolytes normal.

A muscle biopsy (the gold standard but too invasive) was declined by the parents and opted instead for the less sensitive (50-70%) genetic test. The RYR1 genetic test found a quite rare VUS c.12553G>A (p.Ala4185Thr) reported in only one other individual confirmed to be susceptible to MH1. Genetic predictive programs of SNPs Polyphen-2, SIFT and Mutation Taster predict the VUS as “deleterious” “possibly damaging” and “disease-causing” respectively.

CONCLUSION: A Caffeine Halothane Contracture Test (CHCT) performed on a muscle biopsy has a sensitivity >99% and would offer a definitive diagnosis (covered by insurance), but the family is reluctant to proceed with surgery. Genetic testing (\$1690 out of pocket, not covered by insurance) found a variant that has not been characterized and has been reported in only one other individual who is susceptible to malignant hyperthermia. The significance of the VUS is not clear. Genetic predictive programs of SNPs suggest the VUS could be a causative mutation for MH but these programs are imperfect. Our patient had a suspected MH episode intraoperatively but subsequent genetic testing failed to provide a definitive answer. If the family or the patient (when he is 18) decides to proceed with a CHCT, the patient will have the opportunity to contribute to the general fund of MH knowledge whether he is MHS or MH negative!**REFERENCES:**

1. Kraeva N, Riazi S, Loke J, et al. Ryanodine Receptor Type 1 Gene Mutations Found in the Canadian Malignant Hyperthermia Population. *Can J Anesth* 2011;58:504-513.
2. Allen GC, Larach MG, Kunselman AR, et al. The Sensitivity and Specificity of the Caffeine-Halothane Contracture Test: A Report from the North American Malignant Hyperthermia Registry. *Anesthesiology* 1998;88:579-88.

S-471.**THE BEST-LAID PLANS: A CASE REPORT OF AN EPIDURAL ANESTHETIC GONE AWRY IN A MEDICALLY CHALLENGING PATIENT****AUTHORS:** H. C. Goucher, Y. Asher**AFFILIATION:** Department of Anesthesiology, Northwestern University, Chicago, IL**INTRODUCTION:** With an incidence as high as 7%, intravascular placement of epidural catheters (EC) is a common procedural complication. Negative test doses occur as often as 2.3%. Failure to detect intravascular placement can result in local anesthetic systemic toxicity (LAST). Patients with heart failure (HF) and depressed ejection fraction (EF) are at increased risk of LAST. However, epidural anesthesia can be an ideal anesthetic for these patients, as incremental dosing of local anesthetic provides a graded sympathectomy that allows careful titration of hemodynamics. We report a case of an undetected intravascular EC causing LAST in a patient with non-ischemic cardiomyopathy.**CASE REPORT:** A 60 year-old, 66 kg woman presented for a ventral hernia repair. She was listed as Status 2b on the UNOS transplant list due to a history of HOCM; she had an EF of 25% on recent echocardiogram. She had a St Jude Medical CRT-D bi-ventricular pacemaker/implantable cardioverter-defibrillator (DDD programmed). Medications included carvedilol 6.25 mg BID and aspirin 81 mg. The patient and surgeon agreed with an epidural anesthetic. An arterial line was placed. Initial vitals: EKG A-V paced, HR 70 and BP 128/72. One mg midazolam and 25 ucg fentanyl were given. An EC was then placed using loss of resistance (LOR) technique with air at the T7-T8 interspace using a 17-gauge Tuohy needle. The catheter threaded easily after finding LOR at 5 cm and was left 10 cm at skin.

Three cc of lidocaine 2% with 5 ucg/mL epinephrine (LAE) were injected after a vigorous negative aspiration of the EC with a 5 cc syringe. Systolic BP increased by 10 mmHg; there was no change in HR or EKG. She denied any tinnitus, metallic taste, slurred speech, or motor ataxia. After several minutes, an additional 5 cc of LAE were given. She appeared sedated, but had a T10 level to temperature. An additional 5 cc of LAE were administered on the way to the operating room (OR). She was very drowsy in the OR but again appeared to have a T10 level to pinprick. An additional 5 cc of LAE were given. Within 30 seconds of injection, she began to writhe on the OR table and was unresponsive to voice or sternal rub. PVCs were now noted on EKG, HR increased to 85, and BP increased to 160/85. Repeated aspirations prior to previous injections had been negative, but aspiration of the EC with a 1 cc syringe now revealed heme. Intralipid 150 mL was given via peripheral IV with rapid normalization of her mental status. The EC was removed and she suffered no other ill-effects. Surgery was postponed.

CONCLUSIONS: The drowsiness she experienced after minimal sedation was likely indicative of early CNS toxicity. Her CRT-D was found to be poorly-rate responsive, and given concurrent beta-blockade, the lack of change in vitals after repeated administration of LAE was attributed to chronotropic incompetence. Patients with a low EF are prone to dose “stacking,” and a high degree of vigilance for LAST is recommended. Precautions to facilitate intravascular detection include repeated aspirations, judicious and incremental dosing, and use of pharmacologic markers with reliable responses.**REFERENCES:**

- Regional Anes & Pain Med. 2010; 35(2):152-61

S-472.**TREATMENT OF AMNIOTIC FLUID EMBOLISM
ASSOCIATED DIC IN A LABOR PATIENT WITH
RECOMBINANT FACTOR VIIA****AUTHORS:** J. N. Aluyen¹, T. S. Wen², H. Li¹, R. B. Vadhera³**AFFILIATION:** ¹Department of Anesthesiology, The Univ of Texas Med Branch, Galveston, TX, ²Department of Obstetrics and Gynecology, The Univ of Texas Med Branch, Galveston, TX, ³Department of Anesthesiology, The University of Texas Medical Branch, Galveston, TX**INTRODUCTION:** Amniotic fluid embolism (AFE) is a rare syndrome that can complicate pregnancy and labor. It often has debilitating and lethal consequences. One serious sequela of AFE is disseminated intravascular coagulation (DIC). Presentation of a parturient with sudden cardiopulmonary arrest during labor, directly associated with amniotic fluid embolism with subsequent DIC which responded to treatment with Recombinant Factor VIIa.**CASE REPORT:** A laboring 32 year old G2P1 Hispanic woman was found unresponsive in her room with frothy discharge from her mouth. She was emergently intubated with subsequent forceps assisted vaginal delivery for fetal distress. After delivery, bleeding related to uterine atony was initially managed with fundal massage, pitocin, hemabate, and cytotec. Arterial and central venous catheters were placed for resuscitation and a bedside transthoracic echocardiogram showed adequate filling of the left ventricle. Bleeding from the intravascular access sites as well as initial labs showing an elevated INR and low fibrinogen suggested DIC related to an AFE. She remained coagulopathic with persistent uterine bleeding despite multiple transfusions of PRBCs, FFP, and cryoprecipitate prompting ligation of the uterine arteries in the operating room. She received more blood products intraoperatively along with Recombinant Factor VIIa (1000 mcg). Repeat labs showed a normalized INR, coagulopathy improved, and vaginal bleeding stopped after ligation of the uterine arteries. She was discharged 17 days later from the ICU after full recovery with no residual neurological deficits.**DISCUSSION:** The routine use of recombinant activated factor VIIa in cases of massive hemorrhage is debatable but has been shown, in some cases, to reverse DIC and be successful. The use of recombinant activated factor VIIa should be considered in patients with massive obstetric hemorrhage in whom standard measures of stabilization are unsuccessful. In addition to all the traditional therapeutic means, Recombinant Factor VIIa may be an option for patients with amniotic fluid embolism associated DIC unresponsive to conventional treatment.

S-473.

**LOCAL ANESTHETIC SYSTEMIC TOXICITY
RECOGNITION AND MANAGEMENT**

AUTHORS: S. Rotchel, P. Suresh

AFFILIATION: Anesthesiology, University of California, San Diego, San Diego, CA

INTRODUCTION: Local anesthetic systemic toxicity (LAST) is a serious complication that can result from neuraxial or regional blocks. The management of LAST with lipophilic local anesthetics like bupivacaine has received much attention and its management is well described.¹ The management of LAST from lidocaine in pregnancy is a unique and infrequent occurrence that requires discussion in order to address the pros and cons of lipid emulsion therapy in this context.

CASE REPORT: A 26 year old G2P1 female with cryptogenic cirrhosis presented at 38 weeks of gestation in active labor. Her preoperative history and physical exam was significant for mild anemia but normal liver function and coagulation tests. The first two attempts for a lumbar epidural resulted in intravascular catheters. The third epidural placement was successful and confirmed by a negative test dose and a positive sensory block. Five hours later, the patient was taken to the OR for a cesarean section secondary to active phase arrest. Incremental administration of 25 cc of 2% lidocaine with bicarbonate and epinephrine resulted in a progressive increase in her block level, but at 30 minutes was inadequate for surgical anesthesia. At that point, replacing the epidural was discussed, but the patient did not want any new neuraxial procedures. Given that we were at the maximum recommended dose of lidocaine, we chose to switch to chloroprocaine (CP) to take advantage of the low likelihood of toxicity due to its rapid clearance from the plasma. 10 cc of 3% CP was given incrementally with a progressive rise in her sensory level. Following that, she became increasingly anxious and noted difficulty breathing. After ruling out a high block, we questioned regarding other symptoms at which time she described perioral numbness and blurry vision. With concern for progressive CNS toxicity from LAST, 2 mg of midazolam were given to prevent seizures and 100% oxygen was administered while ensuring adequate ventilation. Lipid emulsion (LE) therapy was considered but not given. We then proceeded to general anesthesia resulting in an uneventful intra and postoperative course.

CONCLUSIONS: This patient's history of liver disease and pregnancy potentially made her more susceptible to LAST via decreased clearance and metabolism of both amide and ester local anesthetics. This case demonstrates symptoms of LAST and initial steps in its management including ensuring adequate ventilation and oxygenation and seizure prevention. Seizures may lead to rapid development of hypoxia and respiratory and metabolic acidosis,² which can increase the toxicity of LA. Although LE therapy has been shown to be effective for bupivacaine toxicity, its benefit for less lipid soluble LA like lidocaine is controversial.³ LE therapy was not given in this case because of the low likelihood of cardiac toxicity from lidocaine and chloroprocaine and the inadequate data on its use in pregnancy.

REFERENCES:

1. Reg Anesth Pain Med. 2012 Jan-Feb;37(1):8-15.
2. Anesthesiology, 53(3)(1980): 259-260.
3. Anesthesia & Analgesia 117.6 (2013): 1293-1301.

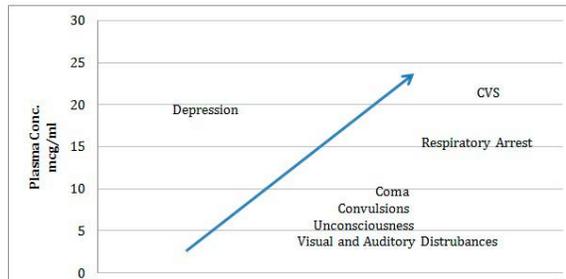


Figure 1 Relationship of signs and symptoms of local anesthetic toxicity to plasma concentrations of lidocaine.

British journal of anaesthesia 47:1 (1975): 56-61. Cousins, Michael J., and Phillip O. Bridenbaugh. Cousins and Bridenbaugh's neural blockade in clinical anesthesia and pain medicine. Philadelphia: Lippincott Williams & Wilkins. 2009. Print.

Central Nervous System Toxicity	Cardiovascular Toxicity
<p><i>Subjective symptoms</i></p> <ul style="list-style-type: none"> • Agitation • Auditory changes • Difficulty focusing • Dizziness/lightheadedness • Metallic taste • Tinnitus • Abrupt onset of psychiatric symptoms <p><i>Objective signs</i></p> <ul style="list-style-type: none"> • Coma • Muscle tremors • Seizures • Respiratory arrest 	<p><i>Direct cardiac effects</i></p> <ul style="list-style-type: none"> • Depression of sinus node pacemaker activity • Depression of rapid phase of depolarization in Purkinje fibers and ventricular muscle • Depression of cardiac contractility <p><i>Peripheral vascular effects</i></p> <ul style="list-style-type: none"> • Low concentration—vascular smooth muscle vasoconstriction • High concentration—vascular smooth muscle vasodilation

Figure 2- Signs and Symptoms of Local Anesthetic Toxicity

Anesthesiology 120.4 (2014): 987-996.

S-474.**A MULTIDISCIPLINARY APPROACH FOR A NEWBORN WITH A LARGE CERVICAL TERTOMA AND HYPOPLASTIC RIGHT HEART SYNDROME****AUTHORS:** J. E. Colon, S. Couch**AFFILIATION:** Anesthesiology, Ochsner Medical Center, New Orleans, LA**INTRODUCTION:** Congenital cervical teratoma and hypoplastic right heart are life-threatening congenital anomalies which require a multidisciplinary approach for optimal outcome. Our infant presented one day prior to delivery, requiring a rapid, coordinated plan for managing the above conditions.**CASE REPORT:** A 20 year old G2P1 at 36 weeks 4 days gestation with no prior prenatal care was admitted to labor and delivery upon diagnosis of fetal neck mass and complex congenital heart defect. Ultrasound showed a neck mass measuring 10.5 x 10.4 x 9.5cm as well as a single ventricle with L-transposition of the great arteries. On MRI, the mass was shown to invade the airway at the level of the larynx. Plans were made for cesarean to be performed the following week with EXIT procedure for management of the newborn's airway. The day after admission, the mother experienced preterm labor; the decision was made to proceed with cesarean. Cesarean section was performed under general anesthesia. After uterine incision and before separation from placental circulation, the newborn was intubated by Pediatric ENT using a Parsons laryngoscope®. At five days of age, under general anesthesia, the newborn had pulmonary artery banding by pediatric cardiac surgery immediately followed by resection of the neck mass by two ENT surgeons. At 13 days of age, the infant returned to the OR for controlled extubation, which was tolerated. The infant was later discharged home and in good condition at most recent follow-up.**CONCLUSION:** Congenital cervical teratoma is a benign lesion, but proximity to the upper airway may cause life-threatening airway obstruction. The EXIT procedure has been established for initial management of a variety of fetal conditions and has significantly improved survival rates for congenital cervical teratoma. A concomitant heart defect is rare in congenital cervical teratoma.¹ In a typical cesarean, the goal is to minimize fetal exposure to anesthetic agents and preserve uterine tone to decrease maternal hemorrhage. In contrast, in an EXIT procedure, high levels of inhalation anesthetics are used to maximize uterine relaxation to preserve uteroplacental gas exchange.² Our infant had a predisposition to the deleterious effects of volatile anesthetics on myocardial contractility and heart rate, yet tolerated high-dose Desflurane® without hemodynamic compromise after delivery. This infant underwent successful orotracheal intubation, delivery, and two complex surgeries, with effective coordination of care that allowed discharge from the hospital.**REFERENCES:**

1. Ferruh Bilgin, Nedim Cekmen, Yavuz Ugur, Ercan Kurt, Sadettin Güngör, and Cuneyt Atabek. "Congenital Cervical Teratoma: Anaesthetic Management (The EXIT Procedure)." *Indian J Anaesth*. 2009 December; 53(6): 678-682.
2. Ngamprasert and Wong. "Update in Fetal Anesthesia for EXIT procedure". *Int Anesth Clinics*. 2012 Fall; 50(4): 26-40.



S-475.

CASE SERIES: FOUR PATIENTS WITH POSTOPERATIVE DELIRIUM FOLLOWING ELECTIVE ORTHOPEDIC SHOULDER SURGERY

AUTHORS: J. J. Pena¹, J. G. Gaudet¹, A. E. Wilhelm², A. R. Brown¹, D. Ludwin¹

AFFILIATION: ¹Anesthesiology, Columbia University Medical Center, New York, NY, ²Anesthesiology, Maimonides Medical Center, Brooklyn, NY

INTRODUCTION: Postoperative Delirium (POD) is an underdiagnosed phenomenon that is associated with poor outcomes and is defined as an acute and fluctuating change in mental status following surgery¹. While the pathophysiology of POD is not well understood, it has been shown that markers of subcortical ischemia are predictive of POD following cardiac procedures². Although the hemodynamic changes known to occur during procedures in beach-chair position (BCP) are not associated with increased incidence of stroke³, they have been associated with decreased cerebral blood flow and transient cerebral oxygen desaturation events^{4,5}. We hypothesize that these changes may be associated with increased incidence of POD following shoulder surgeries in BCP. To date, 4 out of 30 prospectively-enrolled participants have screened positive for POD.

CASE REPORT: Demographics: 4 patients (2 M, 2 F, Ages 60-84, ASA 2-3) who underwent elective orthopedic shoulder procedures in BCP. One day prior to surgery, patients were screened for relevant medical and social risk factors⁶ and cognitive status was assessed using the Telephone Interview for Cognitive Status (TICS) questionnaire⁷ (Table 1).

Intraoperative Course: Intraoperative anesthetic management and changes in HR, BP, and SpO₂ at multiple time intervals were recorded (Table 2). All patients became hypotensive during the procedure, with a median decrease in MAP of -36mmHg from baseline.

Postoperative Course: On postop days 0, 1, and 2 a designated close relative of each patient was contacted and the Family-Confusion Assessment Method was used to screen for POD. One patient screened positive for POD on day 0, two patients on day 1, and one patient on day 2.

CONCLUSIONS: These patients share several known risk factors for POD. For example, they all meet the TICS criteria for baseline mild cognitive impairment. Some of the anesthetic agents common to these four procedures are known to influence the incidence of POD, including perioperative midazolam⁸, fentanyl⁸, and ketamine⁹. Our current POD incidence of 13.3% is consistent with literature for elective orthopedic cases¹⁰. Cerebral autodyregulation¹¹, neuroinflammation⁸, and failure to compensate for intraoperative systemic hypotension may all be contributing factors. At this point we cannot conclude that surgical positioning affects the incidence of POD, and recent evidence suggests that surgeries in BCP do not increase the risk of long term cognitive dysfunction¹².

REFERENCES:

1. Anesth Analg. 112(5):1202-11. 2011.
2. Am J Geriatr Psychiatry 21(10): 938-945. 2012.
3. Reg Anesth Pain Med; 36:430-5 2011.
4. Anaesth Intensive Care 38:486-91. 2010.
5. Clin. Orthop. Relat. Res. 471:4027-34. 2013.
6. Minerva Anesthesiol. 79(9):1066-76. 2013.
7. J Geriatr Psychiatry Neurol. 22:103-109. 2009.
8. Anaesthesia, 67: 280-293. 2012.
9. J. Cardiothorac. Vasc. Anesth. 23:651-7. 2009.
10. Int Psychogeriatr 19:197-214. 2007.
11. J Clin Ultrasound. 23:125-38. 1995.

Table 1

Patient	A	B	C	D
Gender	Male	Female	Female	Male
Age	61	71	65	66
BMI	25.5	24.4	43.2	25.5
ASA Class	2	2	3	2
Hypertension (HTN)	X			
Hyperlipidemia (HLD)	X			
Diabetes (DM)			X	
Coronary Artery Disease (CAD)				
Chronic Pain >3 months			X	
Respiratory Disease (On Cont. O2)			X	
OSA or STOP score >2	X		X	
TICS Score <28	X	X	X	X
Hearing/Visual Impairment				
Anemia (Hb>10)				
Abn. Electrolytes (K, Na, Gluc)				
History of CVA/TIA				
History of ICU Stay				
Previous POD	X			
Previous Orthopedic Surgery		X	X	X
Physical Impairment (i.e. Difficulty w/ daily living activities)			X	
Smoking History			X	
Alcohol/Drug Abuse or CAGE Score >2				

Table 2

Patient	A	B	C	D	Summary
Type of Procedure	Shoulder Arthroscopy	Shoulder Arthroscopy	TSR	Shoulder Arthroscopy	
Regional Block Performed	Interscalene	Interscalene	Interscalene	Interscalene	4
Received Pre-op Midazolam	X	X	X	X	4
Pre-Op Midazolam Dosage (mg)	2	2	3	2	Median 2 mg
Received General Anesthesia			X		1
Induction Regimen	Propofol only			X	1
	Midazolam only	X			1
Maintenance Agents Used	Propofol + Midazolam	X	X		2
	Propofol	X	X	X	3
	Sevoflurane		X		1
	Ketamine	X	X	X	4
Lowest MAP (Dec. from baseline)	62mmHg (-32)	63mmHg (-26)	44mmHg (-41)	58mmHg (-40)	Median -36mmHg
Analgesia: Total Fentanyl Received [mcg]	75	75	75	75	Median 75mcg
Total Crystalloids Received [ml]	1000	800	2700	800	Median 1100ml.
EBL [ml]	0	100	700	10	Median 55ml.
Received PHE/EPH	X		X	X	
Duration of Procedure	1:39	2:03	3:22	1:45	Median 1:54
Postop Pain Management	Percocet 5-325	Percocet 5-325	Oxycodone 10mg	Percocet 5-325	
POD on Post-Op Day#	1	0	1	2	Median Day 1

S-476.

WITHDRAWN.

S-477.**DO NOT BLAME ANESTHESIOLOGY:
POSTPARTUM HEADACHE IS NOT ALWAYS
POST-DURAL PUNCTURE HEADACHE!****AUTHORS:** K. M. von Kriegenbergh¹, S. Chaudhuri², K. Chaudhuri²**AFFILIATION:** ¹Anesthesiology, Texas Tech University Health Sciences Center, Lubbock, TX, ²Anesthesiology, Texas Tech Univ Health Sciences Center, Lubbock, TX**INTRODUCTION:** Acute postpartum headache is a potentially debilitating disorder that can occur within 6 weeks after delivery. The etiology is multifactorial, including migraines, post-dural puncture headache (PDPH), tension headache, hypertensive headache, and vasospasm-associated headache.**CASE REPORT:** A 38 year old multiparous female with no significant past medical illnesses presented to an outlying hospital with a history of “thunderclap headache” that started 3 days postpartum. She reported an uncomplicated pregnancy that ended in an uneventful vaginal delivery with epidural analgesia, which took 6 attempts for successful catheter placement. Her headache was consistent with the symptomatology of PDPH with imaging studies to support intracranial hypotension (often seen after dural puncture), as well as diffuse hyperdensities suggestive of a different headache etiology. However, she was admitted with a diagnosis of PDPH, treated conservatively with IV fluids and narcotics, and discharged 3 days later.

The next day, en route to the ER for altered mental status, the patient experienced a tonic clonic seizure and was transferred to our hospital for higher level of care. She complained of a non-positional headache; it worsened with recumbency and resolved with narcotics. New complaints included blurred vision without diplopia and central circles in her field of vision. Imaging showed worsening of previous findings and new subdural hematomas. Anesthesiology was consulted for possible blood patch; however, since the characteristics of her headache changed from those usually seen with PDPH, the decision to perform an epidural blood patch was deferred. Because of her altered mental status and associated tonic-clonic seizure, the patient was initially diagnosed with posterior reversible edema syndrome (PRES), associated with eclampsia. Subsequently, due to her varying symptoms and MRI imaging, she was officially diagnosed with reversible cerebral vasoconstriction syndrome (RCVS). Over the next 48 hours, her symptoms completely resolved and she was discharged from the hospital in good condition.

CONCLUSION: RCVS is characterized by “thunderclap headache” and diffuse cerebral artery spasm without subarachnoid hemorrhage or aneurysmal bleeding that spontaneously resolves within 3 months. Similarities exist between RCVS and PRES; some experts classify PRES as a subset of RCVS, indicating that it may be within the spectrum of one disease process with the same underlying pathophysiology. Our patient presented with symptoms and radiologic evidence suggestive of RCVS during her first admission. However, this was masked by symptoms of PDPH supported by a history of difficult epidural placement. The acute change in mental status, seizure, visual disturbances and other radiologic studies that followed strongly support a diagnosis of RCVS. Anesthesiologists should be able to recognize RCVS as a differential diagnosis for postpartum headache because prompt treatment of vasospasm can prevent permanent neurological damage.**REFERENCES:**

1. Ducros A. Lancet Neurol. 2012
2. Fletcher JJ et al. Neurocrit Care. 2009

S-478.**SUSTAINED INCREASE IN BISPECTRAL INDEX DURING EPISODES OF SPONTANEOUS REENTRY TACHYCARDIA IN A PATIENT WITH WOLFF-PARKINSON-WHITE SYNDROME****AUTHORS:** D. Hanidziar;**AFFILIATION:** Anesthesiology, Tufts Medical Center, Boston, MA

INTRODUCTION: Bispectral index (BIS) monitor uses an algorithmically processed EEG and EMG to generate a dimensionless integer ranging from 0 (no brain activity) to 100 (complete wakefulness). Certain beta receptor agonists (isoproterenol, ephedrine) are known to increase BIS in patients undergoing general anesthesia. This effect is believed to be mediated by direct stimulatory properties of these agents on central nervous system (CNS)¹. Whether a primary increase in heart rate (such as spontaneous tachyarrhythmia) can trigger BIS changes has not been reported. Herein we present a case of sustained BIS elevations in a patient with Wolff-Parkinson-White syndrome that occurred during the episodes of reentry tachyarrhythmia >150 bpm and a return of BIS values to the baseline during normal sinus rhythm.

CASE REPORT: A 32 year old patient with Wolff-Parkinson-White syndrome and a 10 year history of paroxysmal supraventricular tachycardia underwent general endotracheal anesthesia for the electrophysiologic study and the ablation of the accessory conduction pathway. Standard ASA monitors and BIS monitor were applied and the values were continuously recorded by an automated anesthesia system. General anesthesia was induced with intravenous propofol (2mg/kg), fentanyl (2mcg/kg) and rocuronium (0.6 mg/kg) and maintained with sevoflurane titrated to BIS values 40-50. Muscle relaxation was maintained with rocuronium at one twitch of TOF. When in sinus rhythm, patient's HR ranged between 80-100 bpm and BIS values fluctuated between 40-50 under general anesthesia. Three episodes of spontaneous atrioventricular reentry tachycardia (abrupt increase of HR to 150-170 bpm) lasting 1-2 minutes occurred at 180, 210 and 250 minutes after the induction of anesthesia. BIS values rapidly increased during tachycardia and fluctuated between 60 and 67. A return of BIS values to the baseline was noted upon spontaneous conversion to sinus rhythm. Patient remained hemodynamically stable during episodes of tachycardia with MAP 60-70 mmHg. The episodes have not coincided with any surgical stimulation (femoral vein access) and were not triggered by pacing.

CONCLUSIONS: Continuous BIS monitoring during general anesthesia may provide further insights into a relationship between heart rate and neuronal activity. Cardiac electrophysiology studies provide a unique opportunity to delineate this relationship, given that the patients often present with spontaneously occurring tachy- or bradyarrhythmias. Our observation suggests that an intrinsic change in heart rate such as during supraventricular tachyarrhythmia can trigger changes in BIS. BIS-guided maintenance of general anesthesia should therefore be considered in patients with certain arrhythmias or those requiring continuous infusions of beta-adrenergic agonists.

REFERENCES:

1. J Interv Card Electrophysiol (2012) 34:137-142

S-479.**METHEMOGLOBINEMIA DURING AMBULATORY SURGERY****AUTHORS:** D. McGovern, S. Affifi;**AFFILIATION:** Anesthesiology, Northwestern University, Chicago, IL

INTRODUCTION: Methemoglobin (MetHb) forms when normal Hb is oxidized from its ferrous state (Fe²⁺) to the ferric state (Fe³⁺), which is unable to bind and transport O₂. To return normal function, MetHb is reduced back to the ferrous state by cytochrome b5 reductase, or NADPH MetHb reductase using cofactors NADH and NADP, respectively. Physiologically MetHb concentration is typically ≤1% in the absence of excessive oxidative stress (ex. nitrate, aniline derived meds). A functional anemia develops at higher concentrations causing signs and symptoms related to hypoxia: cyanosis (> 15%); fatigue, dizziness, nausea and vomiting (20-30%); tissue ischemia, seizures, arrhythmias and coma (> 45%); and death (> 70%). We report a case of methemoglobinemia due to an uncommon etiology diagnosed in the ambulatory setting.

CASE REPORT: A 52 year-old, 72 kg woman with hypertension, GERD, nephrolithiasis presented for left kidney stone extraction. She underwent a left ureteral stent placement one month prior, and had been taking OTC Pyridium for bladder pain, estimated 100-200 mg po bid. Pre-op exam noted O₂ saturation (SpO₂) at 96%. In the OR, induction of general anesthesia was uneventful. Hypoxia ensued (SpO₂ 88-90%) and persisted despite FiO₂ 1.0, clear bilateral breath sounds, recruitment maneuvers, peak airway pressures < 21cm H₂O, and intratracheal endotracheal tube placement confirmed with fluoroscopy C-arm. Arterial blood gas was obtained: pH 7.49, PaCO₂ 33, PaO₂ 313, and oxyhemoglobin saturation 80%. After extubation, the patient complained of dyspnea. Co-oximetry analysis reflected MetHb of 10%. She was treated with 2 mg/kg methylene blue (Me Blue) IV and admitted to PACU where SpO₂ was 93-96% on 2L O₂ by nasal cannula. One hour later, repeat co-oximetry showed MetHb 3%, and a second dose of 1mg/kg Me Blue was given. She was observed overnight in the surgical ICU and discharged on high-dose ascorbic acid the following day. Retrospectively, our patient offered additional history of daily use of Pyridium in the preceding month (far exceeding the recommended 2-3 day course), and daytime lethargy in the prior week (one instance of falling asleep while seated on a toilet).

CONCLUSIONS: Typically, the first clinical sign of methemoglobinemia is low SpO₂. (SpO₂ is the calculated absorbance ratio of deoxyhemoglobin and oxyhemoglobin at 660nm and 940nm wavelengths, respectively). MetHb species will absorb at both wavelengths (calculated SpO₂ ~ 85%). Co-oximetry is the diagnostic gold standard, and differentiates between Hb species with an expanded range of light. Treatment begins with cessation of offending agent followed by administration of Me Blue to reduce MetHb to its ferrous state. Judicious use of oxidizing agents must be exercised in select patients with severe anemia, coronary or pulmonary disease, or those with decreased reducing capacity such as infants or G6PD deficiency to prevent iatrogenic MetHb formation. A diagnosis of methemoglobinemia should be considered in the setting of refractory hypoxia.

REFERENCES:

1. Cortazzo JA et al. J Cardiothorac Vasc Anesth. 2014;28(4):1055-9.
2. Landman J et al. J Urol. 1997;158(4):1520-1

S-480.**MIND THE GAP - MULTIFACETED AIRWAY MANAGEMENT IN TRACHEOESOPHAGEAL FISTULA REPAIR****AUTHORS:** G. Mickus, A. Martin**AFFILIATION:** Anesthesiology, Mayo Clinic Florida, Jacksonville, FL**INTRODUCTION:** Tracheoesophageal fistula (TEF) repair presents a unique opportunity for anesthesiologists intraoperatively. Cautious airway management is the foundation for guiding patients safely through the operative period.**CASE REPORT:** 52 y/o F presented to an outside facility with tachypnea. Medical history was significant for orthotopic liver transplant complicated by postoperative esophageal ischemia and esophageal stricture, treated with stent placement.

On admit after transfer, imaging revealed posterior tracheal wall erosion 4.5 cm proximal to the carina with esophageal stent visualization. The patient was emergently scheduled for tracheal Y-stent placement via rigid bronchoscopy and TEF repair. Due to the potential for exacerbation of the defect if exposed to positive pressure ventilation, an anesthetic plan was designed to minimize adverse effects on the airway.

The patient was premedicated with glycopyrrolate 0.4 mg and midazolam 1 mg, and induced via sevoflurane inhalation. We converted the patient to total intravenous anesthesia (TIVA) that would blunt reflexes during rigid bronchoscopy and maintain spontaneous ventilation throughout. These goals were achieved by slow upward titration of IV anesthetic. A dexmedetomidine 1 mcg/kg loading dose was given, then a 1 mcg/kg/hr infusion followed by ketamine 50 mg, topical lidocaine, 1000 mg IV acetaminophen, 0.2 mcg/kg/min remifentanyl infusion, and 125 mcg/kg/min propofol infusion.

Due to malfunctioning surgical equipment during rigid bronchoscopy, Y-stent placement was aborted. Left mainstem intubation past the defect was selected to achieve initial airway goals, allowing a right thoracotomy approach for posterior tracheal repair. The patient's anatomical variant required an extended 5.5 ETT to achieve left lung isolation.

Postoperatively, the patient was transferred to the ICU with the ETT in place. Prior to placement on the ventilator, we removed the ETT from the left mainstem and positioned it in the right mainstem for lung recruitment. Finally, the patient was extubated and a 7.5 ETT was placed via fiberoptic bronchoscopy 3.5 cm proximal to the carina above the TEF repair. The oscillating ventilator was connected, and the patient was extubated the next day.

CONCLUSIONS: The case illustrates several challenging components in airway management. Initially, inhalational induction was performed after premedication to maintain spontaneous ventilation. We converted the patient to a spontaneous breathing TIVA technique to allow optimal surgical conditions given planned tracheal stent placement via rigid bronchoscopy. Upon unexpected intraoperative change of surgical technique, airway goals were maintained by placement of a left mainstem ETT. Prior to extubation and placement of the patient on a high-flow oscillating ventilator, right mainstem ETT placement aimed to recruit the atelectatic lung. In addition to providing adequate postoperative oxygenation and ventilation, a high-flow oscillating ventilator was selected to protect the surgical repair with lower peak airway pressures, and minimize ventilator-induced lung injury.

S-481.**PULMONARY HYPERTENSION, CARDIAC TAMPONADE AND ON CALL – THE TRIPLE THREAT****AUTHORS:** E. Tayler, M. Ingoglia**AFFILIATION:** Anesthesiology, Albany Medical Center, Albany, NY

INTRODUCTION: Pulmonary hypertension in the surgical setting warrants cautious management and anticipation of cardiovascular compromise during anesthesia. Pulmonary hypertension with a cardiac tamponade physiology requires a heightened level of vigilance. It is often the anesthesiologist's duty to rank comorbidities and manage the most pressing problems. With the aforementioned disease states, they were difficult to separate as we considered both to be equally precarious. Resources during overnight responsibilities can be suboptimal even within the most tightly run facilities and can add to the stress of an already difficult scenario. We present a case of cardiac tamponade in a setting of pulmonary hypertension while on call and corresponding anesthetic management.

CASE REPORT: A 61-year-old female presented emergently at 10:30 PM for drainage of a known pericardial effusion that had transformed into a tamponade. The patient's past medical history was significant for pulmonary hypertension (World Health Organization Class III), severe chronic obstructive pulmonary disease, obstructive sleep apnea, oxygen dependent, and non-insulin dependent diabetes mellitus. The patient quit smoking tobacco 13 years prior but had smoked for 20 pack-years. The patient's pulmonary hypertension was so severe that a continuous infusion of epoprostenol (a prostanoid vasodilator) was infusing between two bags of ice. Home medications included metformin, fluticasone/salmeterol, alprazolam, potassium chloride, furosemide, glimepiride and amlodipine. On physical exam the patient was extremely anxious, sweating and with labored breathing. Prior to induction, a radial arterial line was placed, large bore intravenous access secured and the patient was prepped and draped for incision. The patient's blood pressure prior to incision was 130/80 mmHg, heart rate 105 beats/minute and oxygen saturation 95% on high liter nasal cannula. Following an uncomplicated rapid-sequence intubation, the surgeon drained 550 mL of serous pericardial fluid and with minimal changes in hemodynamics. At the conclusion of the procedure, the patient's oxygen saturation was 88% on 100% oxygen. The patient met all extubation criteria except for the poor oxygen saturation. The decision was made to extubate the patient to high flow oxygen and observe. After extubation, the patient's oxygen saturation rose to 91% and was transported to the PACU on 6L/min nasal cannula. The patient did surprisingly well over the next couple of days but then required increasing dosages of epoprostenol. As the medication was titrated up, the patient started to feel more side effects. A CT of her chest was performed due to worsening of her shortness of breath and showed bilateral pleural effusions. Attempted pigtail placement was unsuccessful and drained minimal fluid. The patient declined CT-guided chest tube placement and decided that she would prefer to be made comfort care only. The actual worldwide incidence of pulmonary hypertension is unknown and can be due to a number of factors. The most common cause of pulmonary hypertension in the developing world is schistosomiasis,

a parasitic infection in which the parasite's eggs can lodge in and obstruct the pulmonary arteries. The World Health Organization has classified the five different types of pulmonary hypertension. Because pulmonary hypertension can be of five major types, a series of tests must be performed to distinguish pulmonary arterial hypertension (PAH) from venous, hypoxic, thromboembolic, or miscellaneous varieties. The molecular mechanism of PAH is not known yet, but it is believed that the endothelial dysfunction results in a decrease in the synthesis of endothelium-derived vasodilators such as nitric oxide and prostacyclin. Moreover, there's a stimulation of the synthesis of vasoconstrictors such as thromboxane and vascular endothelial growth factor (VEGF). Consequences of severe disease include a fixed cardiac output, V/Q mismatch, peripheral edema, ascites, pericardial effusions and left recurrent laryngeal nerve paralysis. Treatment can include oxygen, anticoagulation, diuretics, calcium channel blockers, phosphodiesterase inhibitors, nitric oxide, prostacyclins or surgery. The decision to extubate a patient requires knowledge of specific criteria as well as adverse effects of prolonged intubation. In our patient, positive pressure ventilation may have been more deleterious by inhibiting venous return, decreasing systemic vascular resistance and leading to coronary ischemia. The fact that the patient did so well initially may have resulted from the body being used to low oxygen stores from prolonged COPD couple with enough of a catecholamine surge to maintain perfusion to vital organs. It is somewhat puzzling as to why the patient's oxygen saturation improved after extubation and is still a topic of debate. Preparation for drainage of the pericardial effusion and good communication with the surgeon led to the success of the patient's survival. In retrospect it may have been useful to obtain a blood gas prior to extubation in order to compare pre-operative to intra-operative values, however it might not have changed our management. Cardiovascular changes with volatile anesthetics may have been avoided by infiltrating local anesthetic at the sternum to allow drainage of the pericardial effusion under monitored anesthesia care conditions, however the surgeon was not amenable to such a route.

CONCLUSION: Regardless of the cause of pulmonary hypertension, knowing the consequences of the disease and how to manage them is paramount. Preventing cardiovascular collapse with cardiac tamponade requires an adequate systemic vascular resistance so as to maintain preload. This task can be difficult when trying to avoid an increased afterload in a chronically stressed right ventricle. The balancing act we partook with our patient left little margin for error. If the patient had suffered any combination of hypercarbia, hypoxia, bradycardia or hypo/hypertension, irreversible pulmonary and hemodynamic changes could have led to a very different outcome. Unfortunately for the patient, the morbidity associated with her disease was significant. Due to the aging population and smoking prevalence within certain areas of the country, we may be seeing more patients with severe pulmonary hypertension in the near future.

REFERENCES:

J Am Coll Cardiol. 2009;54: S43-S54, Journal of the American College of Cardiology, Vol. 53. Issue 17, Internal Medicine Journal. 2009;39: 495-501

Resident Abstracts

Neuroscience in Anesthesiology
and Perioperative

S-482.

REMOTE ISCHEMIC PRE-CONDITIONING CAN MODULATE THE SYSTEMIC RESPONSE TO VVS AND DECREASES SYNCOPAL EPISODES IN RAT MODELS

AUTHORS: S. Soliman¹, D. McBride², J. Zhang³, R. Applegate⁴, J. Tang², A. Barnett⁵

AFFILIATION: ¹Anesthesia, Loma Linda University Health, Redlands, CA, ²Neuroscience, Loma Linda University Health, Loma Linda, CA, ³Neuroscience, Loma Linda University, Loma Linda, CA, ⁴Anesthesiology, Loma Linda University School of Medicine, Loma Linda, CA, ⁵Anesthesia, Loma Linda University Health, Loma Linda, CA

INTRODUCTION: Syncope involves transient self-limited loss of consciousness and spontaneous recovery within minutes. It should have at least one of the following elements: 1) features pointing towards reflex syncope and/or 2) absence of other causes for the loss of consciousness. Reflex syncope affects about 25% of the population. Vasovagal syncope (VVS) is a subclass of reflex syncope, which also includes cardiac and orthostatic hypotension. All of these cause decreased cerebral perfusion as a result of low cardiac output and low blood pressure. Treatment options for VVS are few, and often disappointing with an author from a Cochrane Database Review stating “there is insufficient evidence to support the use of any of the pharmacological or pacemaker treatments for vasovagal syncope”. The goal of this study is to determine if remote ischemic limb preconditioning (RIPC) will lessen the effect of a vasovagal event and potentially offer a new, unique alternative treatment for people that suffer from VVS.

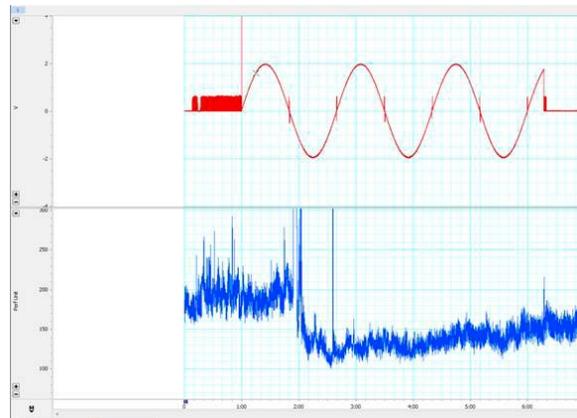
METHODS: Loma Linda University Institutional Animal Care and Use Committee approved all protocols in this experiment. Adult male Sprague-Dawley rats were anesthetized using intraperitoneal ketamine/xylazine mixture. After anesthesia induction, surgery was done to create a burr hole to allow cerebral blood flow measurement by laser Doppler flowmetry (Ad instruments). Femoral catheterization was used for blood pressure and heart rate monitoring, and for blood collection. Sinusoidal galvanic stimulation (sGVS) was used as this achieves similar hemodynamic effects to VVS. We induced sGVS using needle electrodes placed over the mastoids. Blood was drawn both before and after syncope for catecholamine level measurement by ELISA. RIPC is produced by placing a tourniquet on the hindlimb (about 200 mmHg) for 10 minutes at a time followed by 10-minute breaks for 4 cycles on 5, 10, or 15 consecutive days in different groups. Following RIPC, syncope will again be induced using sGVS. The hemodynamic response, CBF and catecholamines will be measured before and after sGVS again to check for a blunted response.

RESULTS: Our results indicate a vasovagal event occurs with the initiation of sGVS. The average heart rate before sGVS was 216, falling to 177 (p<0.05) after sGVS. The mean pressure (p<0.01) and CBF fell during sGVS as shown in the table. CBF was measured in terms of perfusion units, showing a trend to falling CBF with sGVS. The results from the RIPC portion will be done by December 2014.

CONCLUSIONS: sGVS produced by binaurally applied current induces a decrease in blood pressure, heart rate, and cerebral blood flow. This stimulates a vasovagal event and it is hypothesized that RIPC will decrease the effect of this and thus potentially be translated to humans who suffer from vasovagal syncopal episodes. Data from the planned RIPC experiments (expected to be completed by December 2014) will be presented.

REFERENCES:

1. *Autonom Neurosci* 2014;184:3
2. *Autonom Neurosci* 2014;184: 60-65
3. *Cochrane Database Syst Rev* 2014;184:60
4. *FNINS*. 2012. 3 (4), 2-15
5. *Circ* 2006;113:316



Pulse and Mean Arterial Pressure on Eight Rats Before and After Syncope

Animal	Pulse Before	Pulse After	MAP Before	MAP After
1	207	83	115	83
2	240	137	119	95
3	201	192	103	90
4	261	235	106	102
5	254	248	103	99
6	186	173	108	97
7	217	176	114	105
8	164	160	112	104

S-483.**TREATMENT OF REFRACTORY VENTRICULAR
ARRHYTHMIAS WITH DEXMEDETOMIDINE:
TWO CASE REPORTS****AUTHORS:** A. Quan¹, J. Turnbull²**AFFILIATION:** ¹Anesthesiology, UCSF, San Francisco, CA,
²Anesthesiology, University of California, San Francisco, San
Francisco, CA**INTRODUCTION:** Various sedatives, including propofol, benzodiazepines and opioids, are often administered to patients experiencing recurrent ventricular tachyarrhythmias, a clinical syndrome termed VT storm. Several case reports describe the use of dexmedetomidine, a potent alpha-2 agonist, for termination of tachyarrhythmias in the pediatric population. We describe two cases of termination of recurrent ventricular tachycardia following the addition of dexmedetomidine in adult patients with ischemic cardiomyopathy.**CASE REPORT 1:** A 79-year-old man with a history of ESRD on HD, CHF with an EF of 15%, and CAD was admitted to the ICU following a cardiac arrest at home due to an in-stent thrombosis of a recently placed bare metal stent. Following revascularization, the patient developed recurrent episodes of unstable ventricular tachyarrhythmias requiring multiple rounds of ACLS and chemical cardioversion. Despite multiple anti-arrhythmics, the patient continued to have daily episodes of unstable ventricular tachycardia. In attempt to avoid intubation, a dexmedetomidine infusion at 0.4 mcg/kg/min was initiated followed by stabilization of his cardiac rhythm. Despite aggressive medical management, the patient's overall condition worsened and he was transitioned to comfort care.**CASE REPORT 2:** A 66-year-old man with severe multi-vessel CAD and ischemic cardiomyopathy with an EF of 15% presented to the ED with >100 ICD discharges in 24 hours. Despite multiple, high dose anti-arrhythmic infusions, recurrent unstable ventricular tachycardias continued. Following the addition of a dexmedetomidine infusion at 0.6 mcg/kg/min, the occurrence of arrhythmic events significantly decreased and allowed the patient to participate in physical therapy. Subsequent weaning of the infusion led to an increase occurrence of unstable ventricular tachycardia. The infusion was continued until the patient received a Heartware LVAD as a bridge to transplant.**CONCLUSIONS:** We describe two cases of adult patients with ischemic cardiomyopathy and refractory ventricular tachyarrhythmias that responded to the addition of low-dose dexmedetomidine infusions. It is hypothesized that the antiarrhythmic effect is due to a combination of attenuated adrenergic tone via decreased norepinephrine release and prolonged repolarization and refractory period via enhanced vagal activity. Unlike propofol and fentanyl infusions, dexmedetomidine provides analgesia, sedation and suppression of adrenergic activity without requiring endotracheal intubation. Such patients avoid the risks of mechanical ventilation while allowing participation in activities such as physical therapy. Further studies and prospective trials are needed to define more clearly the role of dexmedetomidine in the prevention and treatment of malignant arrhythmias.**REFERENCES:**

- LeRiger M, et al. *Annals of Cardiac Anesthesia* 2012;15(3):224-228.
- Chrysostomou C, et al. *Congenit Heart Dis* 2013;8:48-56.
- Tobias J, et al. *Pediatr Cardiol* 2013(34):779-785.
- Eifling M, et al. *Texas Heart Institute Jour* 2011(38);111-28.

S-484.**ACUTE PAIN AFTER CRANIOTOMY IN NEUROVASCULAR SURGERY**

AUTHORS: W. Smith¹, J. Chang¹, M. Lecours², L. Hannegan³, M. Lawton³, A. Gelb¹, C. Lee¹

AFFILIATION: ¹Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA, ²Anesthesia and Perioperative Care, Hopital Enfant-Jesus, Quebec, QC, Canada, ³Neurosurgery, University of California, San Francisco, San Francisco, CA

INTRODUCTION: Acute post-craniotomy pain is a potentially debilitating postoperative complication, negatively impacting a patient's quality of life.¹ In patients undergoing craniotomy for neurovascular lesions, little is known regarding factors, mechanisms and prevention of acute pain as well as potentially effective interventions, with the exception of a few small studies.^{1,2} The primary aim of this study was to examine perioperative risk factors specific to patients with neurovascular lesions as well as intraoperative treatment modalities that may be associated with mitigation of post-craniotomy pain.

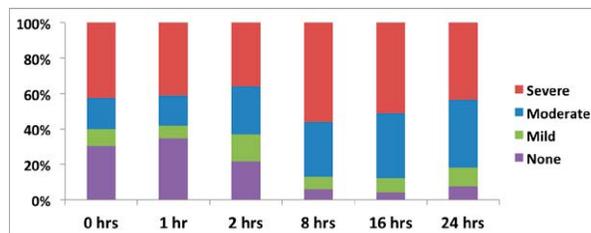
METHODS: This was a retrospective review of neurovascular surgery cases performed from July 2012 through October 2014. The Committee for Human Research approved the study protocol. Adult patients who had a Glasgow Coma Scale ≥ 13 and received elective craniotomy for intracranial vascular lesions were included in the study. The primary outcome was incidence of moderate to severe pain in the first 24 hours after surgery, defined as self-reported pain score ≥ 4 on a scale of 0 to 10. Preoperative risk factors including comorbidities and medications as well as intraoperative medications were also reviewed.

RESULTS: 479 patients with intracranial vascular lesions who underwent craniotomy, at a large academic medical center, were included in the study. Among them 174 patients had postoperative pain scores recorded at intensive care unit admission, 1, 2, 8, 16 and 24 hours. The majority of these patients experienced moderate to severe postoperative pain within the first 24 hours (Figure 1). Younger age was found to be associated with a higher incidence of moderate to severe acute postoperative pain ($p < 0.001$). Neither preoperative comorbidities of headache, depression, anxiety, or seizure nor preoperative medications, including anti-depressants, anxiolytics, anti-epileptics, and chronic narcotic use were significantly associated with postoperative pain in the first 24 hours. Intraoperative use of Remifentanyl or Tylenol also had no difference in patients experiencing moderate to severe post-operative pain within the first 8 hours.

CONCLUSION: Our data shows a strikingly high incidence of postoperative pain after craniotomy in the neurovascular patient population that does not appear to be associated with discrete preoperative risk factors. This suggests that intraoperative anesthesia management may be the area to exact change and would support future prospective studies focused on identifying these potential variables that can be used to decrease acute postoperative craniotomy pain.

REFERENCES:

1. Cephalalgia 2007, 28, 41-48.
2. Headache 2013; 53:1613-1623.



S-485.

UTILITY OF LONG ARM CENTRAL VENOUS LINE IN NEUROSURGICAL PROCEDURES WITH VENOUS AIR EMBOLISM (VAE)

AUTHORS: A. S. Abcejo, J. Pasternak, W. Perkins

AFFILIATION: Department of Anesthesiology, Mayo Clinic, Rochester, Rochester, MN

INTRODUCTION: VAE is a known complication of neurosurgical procedures in the sitting position. Physiologic consequences of VAE range from clinically insignificant to catastrophic hemodynamic collapse. As such, several methods of detection, prevention and treatment of VAE have been established. Specifically, the placement a long-arm central venous pressure catheter (LaCVP) prior to surgical incision is widely considered anesthetic standard-of-practice as a potential VAE treatment. However, no studies have examined its therapeutic efficacy in an extensive series of VAE. This study aims to determine LaCVP utility as a treatment for VAE.

METHODS: After IRB approval, the medical records of patients having neurosurgical procedures performed in the sitting position at Mayo Clinic Rochester between Jan 2000 and Oct 2013 were identified. The corresponding neurosurgical operative reports and anesthetic records were searched for the intraoperative diagnosis and documentation of VAE. Each VAE was manually reviewed and stratified by severity: mild (of no clinical significance -- requiring no intervention), moderate (significant hemodynamic or end-expired CO₂ change requiring any pressor support or surgical intervention) and severe (moderate criteria in addition to requiring emergent surgical closure or supine positioning). Patient demographics, anesthetic, monitoring techniques, and all VAE diagnoses/events/interventions were recorded.

RESULTS: 1889 neurosurgical procedures were performed in the sitting position. 526, 1027, and 337 craniotomies, cervical procedures (laminectomies/peripheral denervations) and deep-brain stimulator (DBS) implantations were performed respectively. 105 VAE occurred during these procedures. VAE were diagnosed by precordial Doppler and transesophageal echocardiography. The majority of VAE were mild in severity. However, there were 31 moderate and 5 severe VAE events. The highest rate of VAE occurred during craniotomy procedures and DBS implantations, 11.2% and 4.7%, respectively. The rate of severe VAE was 0.3%. Three groups were identified amongst this VAE cohort for analysis (Table 1): those without LaCVP, those with LaCVP without a documented attempt to aspirate air, and those with LaCVP with aspiration attempt. There were no significant demographic differences among these groups. The largest quantity of air aspirated was 10 mL of “frothy blood and air”. However, of the 70 patients in whom a LaCVP was placed, there were only 15 occurrences where a measurable amount of air was aspirated. An attempt to aspirate air via the LaCVP was documented in 32 patients, yet only 47% aspirated discernable air. There were no beneficial effects attributable to LaCVP aspiration. In patients with severe VAE, there were no significant post-operative adverse events or findings that were attributable to VAE.

CONCLUSIONS: The majority of VAE events in the sitting position are mild and of little or no clinical significance despite the type of neurosurgical procedure. LaCVP was of no demonstrable therapeutic benefit in this large series of neurosurgical cases performed in the sitting position.

Table 1. Long-Arm CVP use in the setting of VAE

	No CVP placed	CVP placed prior to VAE	
		CVP not aspirated during VAE	CVP aspirated during VAE
Total	35	32	38
ASA			
I	2	1	3
II	19	18	23
III	13	13	12
IV	1	0	0
Gender			
Male	16	17	22
Female	19	15	16
Physical characteristics			
Height (cm)	170 ± 10.2	170.4 ± 10.5	173.9 ± 10.6
Weight (kg)	76.1 ± 17.2	72.9 ± 21.2	78.0 ± 23.3
Surgery type			
Craniotomy	8	22	27
Cervical	11	11	12
Awake DBS implantation	16	0	0
VAE Severity			
Mild	24	18	27
Moderate	10	11	10
Severe	1	3	1

S-486.

REDUCED SURGICAL BLEEDING WITH PRETREATMENT OF SPRAGUE DAWLEY RATS WITH C. ATROX VENOM: IDENTIFICATION OF POTENTIAL TARGET PROTEINS

AUTHORS: M. Barnhart¹, R. N. Raval¹, K. L. Hay², S. Soliman³, R. Applegate⁴, J. Zhang⁵

AFFILIATION: ¹Anesthesiology, Loma Linda University, Loma Linda, CA, ²Hematopathology, Loma Linda University, Loma Linda, CA, ³Anesthesiology, Loma Linda University Health, Redlands, CA, ⁴Anesthesiology, Loma Linda University School of Medicine, Loma Linda, CA, ⁵Physiology, Loma Linda University, Loma Linda, CA.

INTRODUCTION: *Crotalus atrox* venom has cytotoxic, myotoxic, and hemorrhagic effects¹, and contains proteins (serine proteases, zinc metalloproteases, L-amino oxidase and PLA₂)² known to affect platelet aggregation, blood coagulation, and fibrinolysis³, and greatly reduce fibrinogen clot formation⁴. We previously found preconditioning with 2% LD50 of *C atrox* venom decreased bleeding and increased fibrinogen levels in a rat surgical brain injury model. Work to purify the venom into smaller sets of proteins showed that these purified fractions, when recombined, exhibited identical platelet activation and coagulation profile in vitro with whole human blood to commercially available non-manipulated whole venom.

This in vitro work investigates coagulation profiles of purified *C atrox* venom fractions. We hypothesize that proteins in specific fractions disrupt the formation of cross-linked fibrin clots and disrupt platelet aggregation and that this effect triggers a compensatory response in rats ultimately leading to decreased bleeding in a surgical model.

METHODS: Whole *C atrox* venom was separated into ten major fractions by size exclusion chromatography using a Superdex prep grade column. The fractions were lyophilized, then resuspended in HEPES-buffered saline to a concentration of 8 ug/ul. Each fraction was then incubated with whole human blood for measurement of coagulation parameters with a minimum n=6 trials. At each time point, time to formation of platelet micro-clumps, time to formation of larger platelet clumps with sticking to vial wall, and whole-sample coagulation were measured, as were soluble fibrin levels.

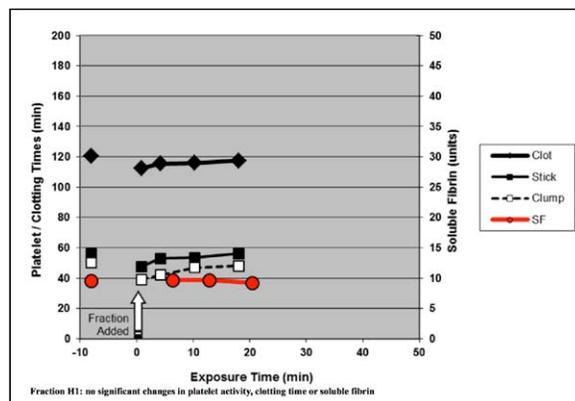
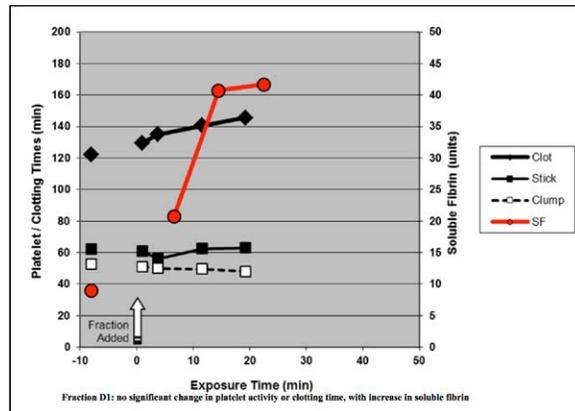
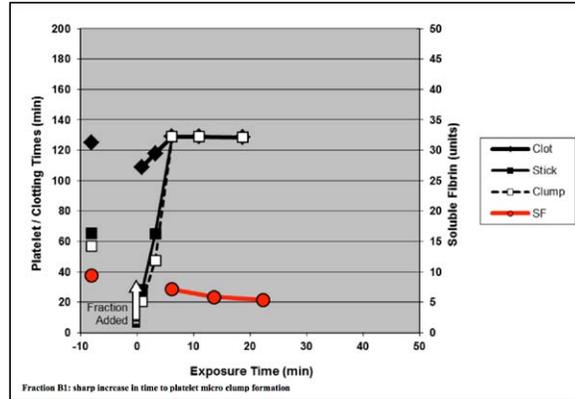
RESULTS: Target proteins in the fractions show dramatic differences in platelet activation and fibrin formation. Fraction B1 shows a sharp increase in platelet micro-clump formation time and time to vial wall stick between 4 and 12 seconds, indicating loss of platelet activity. Clotting time in this fraction is slightly prolonged, with no significant change in soluble fibrin. Fraction D1 shows no significant change in platelet activity or clotting time, but significant soluble fibrin increase. Fraction H1 had no significant effect on platelet function, clotting time, or soluble fibrin.

CONCLUSIONS: Platelet activation and coagulation times for fractions of purified *C atrox* venom differ. Fraction B1 proteins specifically affect platelet function with no effect on clotting time or soluble fibrin levels. Fraction D1 significantly increases levels of soluble fibrin with no apparent effects on platelets. In this fraction clotting time is unchanged, suggesting fibrin cross-link malfunction since soluble fibrin increased. Fraction H1 shows no significant change in platelet activation time, clotting time, or soluble fibrin.

We expect that further work will identify the active proteins in fractions such as B1 and D1 that confer the decreased surgical bleeding effect found in rats following pretreatment with 1/50th LD50 of *C. atrox* venom.

REFERENCES:

1. Campbell JA, Lamar WW 2009
2. J Proteome Res 2009; 8:3055
3. Pathophys Haemostasis Thrombos 2005;34:200
4. Biophys J.2009;96:2415



S-487.

PROTECTIVE ROLE OF FINGOLIMOD (FTY720) IN RATS SUBJECTED TO SUBARACHNOID HEMORRHAGE

AUTHORS: F. Vetri¹, H. Xu¹, D. A. Pelligrino¹, C. Paisansathan¹, F. Testai²

AFFILIATION: ¹Anesthesiology, University of Illinois at Chicago, Chicago, IL, ²Neurology, University of Illinois at Chicago, Chicago, IL

INTRODUCTION: Neuroinflammation is being increasingly recognized as a key contributing factor in multiple models of brain injury (a,b,c), including subarachnoid hemorrhage (SAH) (d). Fingolimod (FTY720) is a sphingosine 1-phosphate receptor blocker, which exerts its immunomodulatory action by interfering with lymphocyte trafficking. In the present study, we examined whether fingolimod had any neuroprotective effects in rats subjected to SAH.

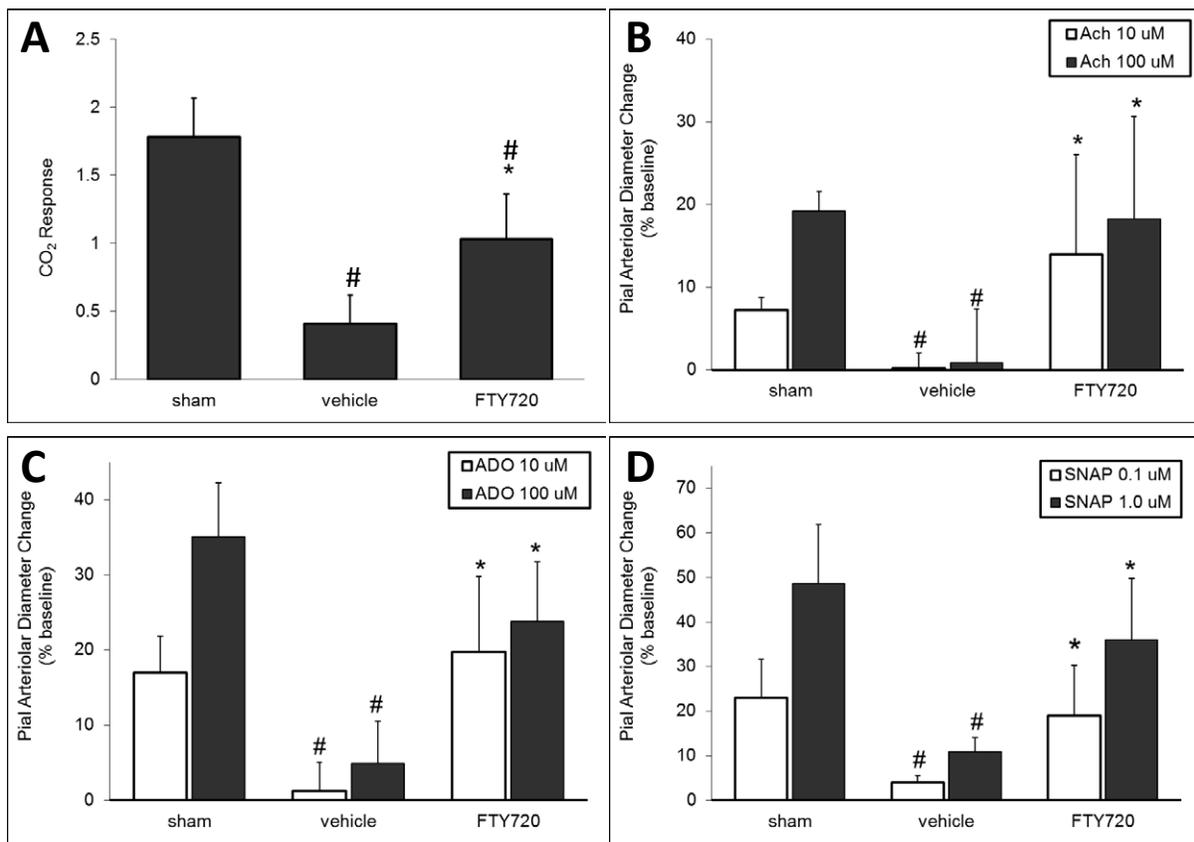
METHODS: In accordance with the institutional animal care committee guidelines, we utilized an endovascular perforation model of SAH. Animals were divided into three groups of n=5 each: (1) sham surgical control; (2) vehicle-treated SAH; and (3) fingolimod-treated SAH. In group (2) and (3) rats received either vehicle solution or fingolimod (0.5 mg/kg) intraperitoneally 3h post-SAH. Neurological function was evaluated via a series of neurobehavioral (sensory-motor) tests as previously described (d). After neurological testing, animals were anesthetized, and a closed cranial window model with intravital microscopy was used to assess neuroinflammation, which was represented by rhodamine-6G-labeled leukocyte trafficking in pial venules at 48h post-SAH. Moreover, pial arteriolar dilatory responses to a variety of vasodilators, including hypercapnia, topically applied acetylcholine, adenosine, and S-nitroso-N-acetyl penicillamine were tested (Fig.1).

RESULTS: Neuro-behavioral scores obtained at 48h post-SAH indicated significant neurologic deficits in the vehicle-treated group (vs. sham control). Those deficiencies were partially prevented by fingolimod (p<0.0001 compared to the vehicle group). Compared to sham-control rats, vehicle-treated SAH animals displayed a 4-times greater increase in pial venular intraluminal leukocyte adhesion. Treatment with fingolimod largely prevented the intravascular leukocyte adhesion. Vehicle-treated SAH animals displayed a significant decrease in pial arteriolar responses to all the vasodilators tested (Fig.1), and that vascular reactivity was preserved, to a significant degree, in the presence of fingolimod.

CONCLUSIONS: Treatment of rats with fingolimod was associated with improved neurological outcome in rats subjected to SAH, possibly due to a marked limitation in the intravascular adhesion of leukocytes to pial venules, and a preserved pial arteriolar dilating function.

REFERENCES:

- a) Pradilla et al. Inflammation and cerebral vasospasm after subarachnoid hemorrhage, *Neurosurg. Clin. N. Am.*, 2010, 21, 365-379.
- b) Watcharotayangul, J. et al. Post-ischemic vascular adhesion protein-1 inhibition provides neuroprotection in a rat temporary middle cerebral artery occlusion model, *J. Neurochem.*, 2012, 123 Suppl 2, 116-124.
- c) Ma, Q. et al. Vascular adhesion protein-1 inhibition provides antiinflammatory protection after an intracerebral hemorrhagic stroke in mice, *J Cereb. Blood Flow Metab*, 2011, 31, 881-893.
- d) Xu HL, et al. Pharmacologic blockade of vascular adhesion protein-1 lessens neurologic dysfunction in rats subjected to subarachnoid hemorrhage. *Brain Res.*, 2014, Oct 24;1586:83-9.



S-488.**EXTRACELLULAR GLUTAMATE IS SIGNIFICANTLY ELEVATED IN THE HIPPOCAMPUS OF AWAKE-BEHAVING AGED FISCHER-344 RATS COMPARED TO YOUNG RATS FOLLOWING CRANIOTOMY**

AUTHORS: M. L. Humeidan¹, S. Bergese¹, V. A. Davis², G. A. Gerhardt³

AFFILIATION: ¹Anesthesiology, The Ohio State University Wexner Medical Center, Columbus, OH, ²Laboratory Animal Resources, Veterinary Research Services, University of Kentucky, Lexington, KY, ³Anatomy and Neurobiology, University of Kentucky College of Medicine, Lexington, KY

INTRODUCTION: Post-operative cognitive disorders (POCD) are a frequent and costly complication of surgery. Advancing age is consistently demonstrated as a risk factor for POCD. Glutamate (Glu) is the predominant excitatory neurotransmitter in the central nervous system, and excess Glu (excitotoxicity) is linked to multiple nervous system pathologies. Glu may be implicated in POCD as a result of dysregulation secondary to aging, or due to surgical inflammation or ischemia in the hippocampus, the brain region responsible for learning and memory. Additionally, effects of anesthetic agents on Glu regulation must be considered. According to clinical studies, peri-operative lidocaine may protect against POCD, possibly by neuronal membrane stabilization and decreased neuronal activity. The studies presented here investigate post-operative regulation of hippocampal extracellular glutamate of neuronal origin in a rat model of human aging. The effects of isoflurane anesthesia on Glu neurotransmission were measured, in addition to effects of bolus IV lidocaine on potassium chloride (KCl) evoked hippocampal Glu release in vivo.

METHODS: All protocols and procedures were approved by the Institutional Animal Care and Use Committee at the University of Kentucky. Following craniotomy under isoflurane anesthesia, we used chronically implanted microelectrode arrays in the hippocampus of Fischer 344 rats to measure in vivo extracellular glutamate in real-time. Starting at a minimum of forty-eight hours post-craniotomy, in vivo extracellular basal glutamate levels were measured in unanesthetized rats and compared across age groups (young (3-6 months), late-middle aged (18 mo.), aged (24 mo.)). In a subset of each age group we measured real-time glutamate during emergence from a second exposure to isoflurane. Finally, in vivo KCl-evoked glutamate release was measured in the hippocampus of young rats before and after tail vein lidocaine bolus (3 mg/kg) to evaluate neuronal stability while under isoflurane anesthesia.

RESULTS: Older rats had significantly elevated post-operative extracellular glutamate levels in the hippocampus compared to young rats (Mean \pm SEM, $8.4 \pm 1.1 \mu\text{M}$ vs $16.7 \pm 3.2 \mu\text{M}$, $n = 38$, $p < 0.05$). Isoflurane anesthesia had no effect on extracellular glutamate neurotransmission in the hippocampus (Mean \pm SEM, iso $16.5 \pm 4.0 \mu\text{M}$, awake $16.3 \pm 4.1 \mu\text{M}$), $n = 5$ per age group). Bolus IV lidocaine significantly decreased the magnitude of evoked glutamate release in vivo following KCl stimulation ($6.7 \pm 2.2 \mu\text{M}$ vs $4.7 \pm 1.8 \mu\text{M}$, $p < 0.01$). Conclusions: Aging animals demonstrate post-operative dysregulation of glutamate neurotransmission in the hippocampus, which could be important to development of POCD via an excitotoxic mechanism. Isoflurane does not appear to acutely cause changes in glutamate regulation. Bolus IV lidocaine in the peri-operative setting may be protective against increased neuronal glutamate release associated with excitotoxicity. We hope to incorporate behavioral assessments into future studies to correlate glutamate levels with cognitive performance post-operatively.

S-489.

THE INTRAOPERATIVE EFFECT OF METHADONE ON SOMATOSENSORY EVOKED POTENTIALS.

AUTHORS: M. M. Higgs¹, R. J. Hackworth¹, J. King¹, R. Riffenburgh¹, J. Tomlin², B. Wamsley¹

AFFILIATION: ¹Anesthesia, Naval Medical Center San Diego, San Diego, CA, ²Neurosurgery, Naval Medical Center San Diego, San Diego, CA

INTRODUCTION: Evoked potentials (EP), both somatosensory (SSEP) and transcranial motor (TcMEP) are often used during complex spinal surgery to monitor the integrity of spinal pathways during operations in or around the spine. Changes in these monitored EP signals (increased latency and decreased amplitude) may result from ischemia, direct surgical injury, changes in blood pressure, chemical milieu of the patient, hypoxia or changes in CO₂ tension, and anesthetic agents. Typically a clinically significant change is defined as an increase in latency >10% or a decrease of amplitude >50%.¹⁻⁴ Opioids have been shown to both increase latency and decrease the amplitude of SSEPs, although this change is usually not clinically significant. 5-10 There has been a renewed interest in methadone use for spine and other complex surgeries.¹¹⁻¹³ However, the effect of methadone on intraoperative monitoring of SSEPs and TcMEPs is unknown. We present the first human study, to our knowledge, to look at effects of methadone on SSEP and TcMEP monitoring during complex spine surgery.

METHODS: This was an observational study. The primary endpoint was methadone’s effect on SSEPs, and the secondary endpoint was methadone’s effect on TcMEPs. Adult patients undergoing spine surgery requiring intraoperative neuromonitoring were induced with general anesthesia and had a baseline set of SSEPs and TcMEPs recorded. Next, methadone dosed 0.2 mg/kg lean body weight was given. Repeat SSEPs and TcMEPs were recorded at 5, 10, and 15 minutes. Post-operatively, adverse events from methadone administration were collected.

RESULTS: There was a statistically significant difference found in SSEPs for N20 latency (95% confidence interval (CI) 0.17 to 0.53); p=0.028), P37 latency (95% CI 0.65 to 1.25); p= 0.001), and N20 amplitude (95% CI 0.09 to 0.32 ; p=< 0.001), but not for P37 amplitude (95% CI -0.19 to 0.00; p=0.634) (table 1-2). There was no significant effect found for TcMEP, the secondary endpoint of the study, and there were minimal adverse events post-operatively (table 3). Conclusion: Under general anesthesia, an IV bolus of methadone at a dose of 0.2mg/kg per lean body mass statistically decreased the amplitude and increased the latency of somatosensory evoked potentials between 5-10 minutes after methadone administration, without a return to baseline. However, this statistical significance was not found to be of clinical significance during the study.

REFERENCES:

1. Spine 1984;9:256-61
2. EEG 1984;59:318-27
3. Can J Anesth 1988;45:387-92.
4. J Cardiothorac Vasc Anesth 1999;13:538-43
5. Anesthesiology 2003;99:716-37
6. Anesth Analg 1984;63:833-7
7. J Cardiothoracic Anesth 1988;2:758-64
8. Anesthesiology 1986;65:584-9
9. BJA 1990;65:169-72
10. Br J Anaesth 1996;76:795-801
11. Anesth Analg 2011;112: 218-23
12. J Clin Anesth 1991 Mar-Apr;3(2):112-6
13. Anesth Analg 2011;112:13-16

Table 1. SSEP, ANOVA Results for N20 and P37 Latency and Amplitude.

Dimension	Nerve	Overall Model		p-Value Changes in Minutes		
		F	p	0-5 v. 5-10	0-5 v. 10-15	5-10 v. 10-15
Latency	N20	3.70	0.028	0.031	0.216	0.662
	P37	8.41	<0.001	0.001	0.011	0.722
Amplitude	N20	12.66	< 0.001	< 0.001	0.002	0.442
	P37	0.46	0.634	0.642	0.948	0.828

N20 = median nerve, P37 = posterior tibial nerve

S-489 • continued

Table 2. Mean Baseline, Mean Differences (MD), Percent change in the mean (%), and Confidence Intervals (CI) of the Differences.

EP Source	Dimension	Nerve	Mean Baseline	0 vs 5 min MD (%) (CI)	5 vs 10 min MD (%) (CI)	10 vs 15 min MD (%) (CI)	0 vs 15 min MD (%) (CI)
SSEP	Latency	N20	22.50 MS	0.26 (1.16%) (0.14 to 0.38)	0.00 (0.00%) (-0.13 to 0.13)	0.09 (0.40%) (-0.08 to 0.25)	0.35 (1.56%) (0.17 to 0.53)
		P37	43.52 MS	0.64 (1.47%) (0.39 to 0.90)	0.10 (0.23%) (-0.09 to 0.29)	0.21 (0.47%) (0.07 to 0.36)	0.95 (2.18%) (0.65 to 1.25)
	Amplitude	N20	1.95 mV	0.19 (9.74%) (0.10 to 0.29)	-0.02 (-1.14%) (-0.07 to 0.02)	0.03 (1.69%) (0.00 to 0.07)	0.20 (10.26%) (0.09 to 0.32)
		P37	0.84 mV	-0.05 (-5.95%) (-0.13 to 0.04)	-0.01 (-1.12%) (-0.05 to 0.03)	-0.04 (-4.44%) (-0.07 to 0.00)	-0.10 (-11.90%) (-0.19 to 0.00)
TcMEP	Latency	APB/ADM	28.67 MS	-0.30 (-1.05%) (-1.09 to 0.49)	-0.41 (-1.41%) (-1.07 to 0.26)	0.56 (1.91%) (0.00 to 1.11)	0.04 (0.15%) (-0.58 to 0.67)
		AHL	49.59 MS	0.07 (-0.14%) (-0.54 to 0.68)	-0.19 (-0.38%) (-0.94 to 0.55)	0.29 (0.58%) (-0.25 to 0.84)	0.32 (0.65%) (-0.61 to 1.26)
	Amplitude	APB/ADM	678.53 mV	40.0 (5.93%) (-60.6 to 141.1)	-47.4 (-7.42%) (-135.5 to 40.8)	33.2 (4.68%) (-37.3 to 103.6)	27.5 (4.1%) (-84.9 to 140.0)
		AHL	189.45 mV	-66.8 (-35.26%) (-114.9 to -18.7)	18.7 (7.14%) (-69.0 to 106.4)	-54.3(-23.78%) (-145.6 to 37.2)	-102.3 (-54.0%) (-165.7 to -38.9)

MS = milliseconds, mV = microvolts, N20 = median nerve, P37 = posterior tibial nerve
 APB = abductor pollicis brevis, ADM = abductor digiti minimi, AHL = abductor hallucis longus
 SSEP = somatosensory evoked potentials, TcMEP = transcranial evoked motor potentials

Table 3. Post Operative Adverse Events

Side effects	PACU	POD 0-3
Postoperative nausea and/or vomiting*	3	4
Need for supplemental oxygen therapy	1	0
Serious adverse events	0	0
Respiratory depression (RR<10)**	2	2
SPO2 <90%	1	0
Arrhythmias	0	0
Naloxone administration	1	0
Need for postoperative intubation	0	0
Rapid Response team or code blue called	0	0
Transfer to intensive care unit	0	0

*All PONV events except one were triggered after other narcotics had been administered postoperatively.

**All respiratory events except one were noted after other opioids had been given postoperatively. Lowest RR recorded was four.

Resident Abstracts

Obstetric Anesthesiology

S-490.**EPIDURAL ANESTHESIA IN HISPANIC WOMEN: MYTHS, TRUTHS, AND WHY WE SHOULD CARE****AUTHORS:** D. Hansen¹, B. Scott², R. Measom³**AFFILIATION:** ¹Anesthesiology, Mayo Clinic, Scottsdale, AZ, ²Pediatrics, University of Nevada School of Medicine, Reno, NV, ³Medical School, University of Nevada School of Medicine, Reno, NV**INTRODUCTION:** Neuraxial anesthesia, especial epidural anesthesia (EA), is the most commonly used form of labor pain management in the United States¹. Despite its prevalence, ethnic disparities in the utilization of EA exist. Recent studies have shown that in the United States, Hispanic laboring women underutilize EA compared to other ethnic groups². Several studies have suggested that misinformation regarding EA might contribute to the underutilization by Hispanic women³. We hypothesized that increased EA information would be associated with a normalization of EA utilization. We examined if a simple educational intervention would impact EA utilization in Hispanic women.**METHODS:** After IRB approval, we initiated our prospective, single-blinded study. Self-described Hispanics > 18 years of age were recruited at a single center during the second/third trimester of pregnancy. The initial cohort was randomly assigned into an experimental or a control group. The experimental group was provided an educational pamphlet regarding epidural anesthesia while the control group was given a standardized bacterial vaginosis pamphlet routinely used at the center. All materials were provided in both Spanish and English. No active education was undertaken and any questions were deferred to the participants' care providers. After delivery, the participants were contacted for follow up and their medical chart was reviewed.**RESULTS AND MAJOR FINDINGS:** Analysis of our intervention suggests that a simple educational pamphlet does not make a statistically significant impact on epidural rates among our study participants. Our preliminary results show an epidural rate of 50% (n = 16) in the experimental group and an epidural rate of 47% (n = 15) in the control group. P value is equal to 0.87.**CONCLUSIONS:** Results of this small study suggest passive educational efforts do not affect EA use among Hispanic women. Further elucidation of the decision making process and our role in educating Hispanic labor patients regarding EA and peripartum labor analgesia is needed. Hispanic women account for over 16% of US females and have the highest fertility rate of any major ethnic group. As such, obstetric anesthesiologists ought to ensure their patients are well informed when making decisions regarding EA.**REFERENCES:**

1. ACOG Committee. "ACOG committee opinion. No 339: Analgesia and cesarean delivery rates." *Obstet Gynecol* 2006; 107(6): 1487-8.
2. Glance LG, Wissler R, Glantz C. "Racial differences in the use of epidural analgesia for labor." *Anesthesiology* 2007; 106: 19-25.
3. Orejuela FJ, Garcia T, Green C. "Exploring factors influencing patient request for epidural analgesia on admission to labor and delivery in a predominantly latino population." *J Immigrant Minority Health* 2012; 14(2): 287-91.
4. Green CR, Anderson KO, Baker TA. "The unequal burden of pain: confronting racial and ethnic disparities in pain." *Pain Medicine* 2003; 4(3):277-294.

S-491.**WITHDRAWN.**

S-492.**INCIDENCE OF REVERSAL OR ABSENCE OF END DIASTOLIC FLOW IN THE UMBILICAL ARTERY DURING OPEN FETAL SURGERY****AUTHORS:** J. Sinsky, M. Rollins, M. Fersch**AFFILIATION:** Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA

INTRODUCTION: Umbilical artery (UA) Doppler ultrasound is a noninvasive method to assess for possible uteroplacental insufficiency during pregnancy. Absent or reversed (AR) end diastolic flow (EDF) in the umbilical artery (UA) may represent underlying fetal stress, and is associated with increased fetal and perinatal mortality. Fetuses with AREDF have a higher incidence of intrauterine growth restriction, neonatal intensive care unit admission, maternal cesarean section for fetal distress, and lower average birth weight¹. One study notes increased odds ratios for perinatal mortality of 4.0 in pregnancies with absent EDF and 10.6 in those with reversed EDF compared to those with normal forward EDF². We describe the use of UA Doppler as an intraoperative assessment method during open fetal surgery. AREDF in the UA could be considered a sign of intraoperative fetal distress during open fetal surgery.

METHODS: Following IRB approval, a retrospective review of patients who underwent open in utero fetal myelomeningocele repair between 2008-2013 at a US tertiary care hospital was performed. Intermittent umbilical artery ultrasound and fetal echocardiography were used to monitor the fetus intraoperatively. Medical records were reviewed to determine the incidence of UA Doppler abnormalities. Further review was performed for cases of fetuses that developed AREDF or other abnormalities during surgery.

RESULTS: 21 of 37 patients (56.76%) were found to have UA Doppler abnormalities intraoperatively. Of these patients, 9 (24.32%) had reversed EDF, 9 (24.32%) had absent EDF, and 3 (8.11%) had other UA abnormalities. Most AREDF episodes happened immediately following maternal induction of general anesthesia or with uterine incision. One patient had fetal asystole with intraoperative demise and was noted to have absent EDF prior to arrest. One case was aborted without uterine incision due to presence of reversed EDF and bradycardia; no other adverse outcomes were noted. AREDF improved in 4 patients with volume infusion into the uterus. Pre- and post-operative fetal ultrasound examinations showed normal UA Doppler patterns in all patients excluding the one case of fetal demise.

CONCLUSIONS: Doppler ultrasound can provide useful information about fetal wellbeing during open fetal surgery. AREDF in the UA has been shown to correlate with higher fetal mortality and morbidity. In our review, over 50% of patients undergoing open fetal surgery had UA Doppler abnormalities. These episodes occurred during times associated with considerable hemodynamic changes that can cause fetal distress. Changes in UA Dopplers have the potential to alert the perioperative team of impending fetal distress and should be evaluated at critical points of open fetal surgery. Anesthesiologists may have a role in preventing or reversing these abnormalities by optimizing maternal-fetal hemodynamics. Future longitudinal studies of fetuses with AREDF in the UA during open fetal surgery are needed to help guide perioperative care in these patients.

REFERENCES:

1. Am J Obstet Gynecol. 1987; 156(5):1213-8.
2. Lancet. 1994; 344(8938):1664-8.

Resident Abstracts

Pain Mechanisms

S-493.**IDENTIFICATION OF SPINAL CORD CELLS EXPRESSING MU AND DELTA OPIOID RECEPTORS IN THE MOUSE****AUTHORS:** V. L. Tawfik, D. Wang, S. Low, G. Scherrer**AFFILIATION:** Anesthesiology, Perioperative and Pain Medicine, Stanford University, Palo Alto, CA**INTRODUCTION:** Chronic pain is a widespread disease that anesthesiologists are uniquely positioned to treat. Aberrant neuronal signaling and CNS glial cells (astrocytes and microglia) are involved in the generation of pain. Opioids are the mainstay of therapy for pain and act on mu opioid receptors (MORs) in the CNS. The MOR is notably expressed in populations of neurons of the spinal cord dorsal horn, which is thought to contribute to opioid-induced analgesia. The localization of the delta opioid receptor (DOR), however, which we have recently shown is expressed in myelinated cutaneous mechanoreceptors, remains unclear. The goal of this work was twofold: (1) To determine if spinal cord glia express MOR or DOR and (2) To resolve the molecular identity of the spinal cord cells expressing MOR and DOR and determine if there are populations in which the two receptors are co-expressed.**METHODS:** All studies were performed in mice in accordance with policies set forth by the local IACUC. For the first part of the study, we performed in situ hybridization for mu (*Oprm1*) and delta (*Oprd1*) mRNA in wild type or CX3CR1-GFP mice, which exhibit green labeling of microglial cells, combined with immunohistochemistry. For both portions of the study we took advantage of mice expressing DOR as a fusion protein coupled to the reporter green fluorescent protein (DOR-eGFP) crossed with mice expressing the MOR fused to the red mCherry reporter (MOR-mCherry). Mice were deeply anesthetized, transcardially perfused and spinal cord tissue was removed and stained for neuronal markers (NeuN, calbindin, PKC γ), microglial markers (CX3CR1) and/or astrocyte markers (GFAP). Confocal images were acquired using the Leica TCS SPE microscope.**RESULTS:** In situ hybridization revealed that *Oprm1* and *Oprd1* were not expressed in either microglia or astrocytes. In the double reporter DOR-eGFP; MOR-mCherry mice we found that the vast majority of spinal cord cells that were DOR or MOR positive co-expressed the neuronal marker, NeuN. In contrast, there was no overlap between DOR or MOR and microglia or astrocyte markers. DOR-eGFP⁺ neurons are present throughout the grey matter and are especially abundant in the most ventral part of inner lamina II (~55% of DOR-eGFP⁺ neurons in the dorsal horn). Coimmunolabeling revealed that the majority of these lamina II DOR-eGFP⁺ neurons are calbindin⁺, a marker of excitatory interneurons, and a subset also expressed PKC γ . We identified a small population, about 15% of neurons in the spinal cord dorsal horn, that co-expressed both MOR and DOR.**CONCLUSIONS:** Our preliminary results suggest that glial cells in vivo do not express the MOR or DOR. This controversial finding may be explained by technique or species differences with prior studies being performed either in vitro or in the rat. Interestingly, we have uncovered that distinct populations of dorsal horn neurons express MOR compared to DOR. There is rare co-expression of these two receptors in the dorsal horn and further characterization of these unique subpopulations will allow us to better understand and eventually target specific neuronal subtypes for the treatment of pain.

Resident Abstracts

Pain Medicine

S-494.**SEVERE UPPER EXTREMITY CONTRACTURE AND INTERNAL-ROTATION RELEASE FOLLOWING A SUPRACLAVICULAR BLOCK****AUTHORS:** A. M. Manvar¹, A. Rakic²**AFFILIATION:** ¹Department of Anesthesiology, University of Illinois-Chicago, Chicago, IL, ²Department of Anesthesiology, University of Illinois Chicago, Chicago, IL

INTRODUCTION: A 25 year-old male presented to clinic from a corrections facility with left arm pain and muscle spasm. Pain started 4 months prior with no inciting event. He woke up one morning with pain and sudden onset of internal rotation and muscle spasms of left upper extremity. His medical history was significant for left arm fracture and ORIF complicated by compartment syndrome resulting in multiple fasciotomies. The patient was unable to move his arm secondary to severe pain and limited range of motion. The arm was fixed, internally rotated and contracted, with the elbow rotated 180 degrees (image). His fingers and wrist were flexed and contracted without voluntary or forced release. He had decreased strength with absent reflexes and his arm was cold to the touch. There were no obvious skin changes, as erector pili were observed with normal nail beds, a strong radial pulse and good capillary refill. His pain was not relieved with ibuprofen.

METHODS/RESULTS: A stellate ganglion under fluoroscopy was performed and a total of 10mL 0.25% bupivacaine was injected. This resulted in partial contracture release and worsening pain. A supraclavicular brachial plexus block was subsequently performed using ultrasound, injecting a 30mL of 0.25% bupivacaine. The procedures were complicated by increased involuntary, sporadic muscle spasms and increased pain with allodynia. Miosis and ptosis were observed in the ipsilateral eye. The patient was sent to ED for admission for pain management. Orthopedic evaluation recommended no surgical intervention. The following day the contracture was at baseline and another supraclavicular block however with 30mL of 0.5% bupivacaine was injected.

Following the second block, his arm returned to normal anatomical position with significant pain relief.

The patient returned to clinic one year later after being symptom free during the interim with a similar presentation. His LUE was contracted and internally-rotated with hyperalgesia and allodynia after being handcuffed. MRI head/neck were negative for any acute process. A repeat supraclavicular block was performed in clinic using 30cc of 0.5% bupivacaine. Five minutes post procedure, the patient's contractures involuntarily, slowly released. He developed analgesia and immediately went to sleep. His post procedure physical exam was notable for full ROM, improved strength, good radial pulse with capillary refill and 2+ reflexes.

CONCLUSION: Complex regional pain syndrome (CRPS) is characterized by sensory, motor and autonomic dysfunction. Pathophysiology, diagnosis and treatment are often multifactorial, making management difficult. Chronic CRPS is shown to lead to pain radiation, diminished motor control, joint dislocation or contracture. This study provides support for a supraclavicular block as an effective management of a patient with CRPS affecting the upper limb. Immediate resolution of contracture and allodynia allowed the patient to tolerate normal range of movement and function.

REFERENCES:

- Eur J Neurol; 17:649-660. 2010
Lancet Neurol; 10:637-648. 2011
Anesthesiology;101(5):1215-24. 2004



S-495.**RIGHT NEPHRECTOMY AND EXPLANTATION AS A
COMPLICATION OF AUTOTRANSPLANTATION FOR
LOIN PAIN HEMATURIA****AUTHORS:** S. E. Dodd, B. Hoelzer;**AFFILIATION:** Anesthesiology, Mayo Clinic, Rochester, MN**INTRODUCTION:** Loin pain hematuria is a diagnosis of exclusion that should be carefully made as many of the interventional therapies have significant risks and low long-term success rates. Nephrectomy is an uncommon, but serious complication of autotransplantation and patients may have impaired renal function long-term.**CASE REPORT:** A 43 year old female with a history of fibromyalgia was referred to our institution for evaluation and treatment of suspected right-sided loin pain hematuria of six months duration. Prior to her evaluation she required tramadol, hydrocodone, and cyclobenzaprine for pain control and was in danger of losing her employment due to functional decline. After evaluation by nephrology and a multidisciplinary fibromyalgia team she was felt to have failed conservative management and the decision was made to proceed directly to renal autotransplantation.

She underwent uneventful hand-assisted right nephrectomy with autotransplantation; however, she developed severe right flank pain in the post-anesthesia care unit. Ultrasound revealed hypoperfusion of the lower pole and the lower renal artery was not well visualized. She was taken back to the operating room the same evening and during repositioning of the autotransplanted kidney, a large tear formed in the renal vein resulting in hemorrhage and ultimate explantation of the kidney. Her postoperative course was complicated by incisional pain with opioid tolerance and acute blood loss anemia requiring transfusion. At a one-week postoperative clinic visit, she did endorse resolution of her flank pain and her creatinine had stabilized at 1.3 mg/dl (eGFR 45 ml/min/BSA), compared to 0.7 mg/dl preoperatively.

CONCLUSIONS: Loin pain hematuria is a rare chronic pain syndrome without consensus diagnostic criteria or confirmed pathophysiology, but may be neuropathic or visceral in origin. Renal autotransplantation is an accepted therapy for these patients, but it is generally agreed upon that they should be meticulously screened for and have undergone a substantial attempt at conservative management. In one case series of 22 patients undergoing autotransplant for the indication of loin pain hematuria, 18 of the 26 autotransplant procedures (69.2%) provided pain relief at 5 years and 6 ultimately resulted in nephrectomy.**REFERENCES:**

1. Moeschler S. et al. (2013) Clin J Pain 29(11):e26-9
2. Smith, H. et al. (2012) Clin J Pain 28(7):646-51
3. Chin, J. et al. (1998) J Urol.160(4):1232-5

S-496.

PRESCRIBING PATTERNS OF DISCHARGE PAIN REGIMEN FOR PATIENTS UNDERGOING COMMON SURGICAL PROCEDURES

AUTHORS: B. Lai¹, E. Viscusi², A. Rangavajjula³

AFFILIATION: ¹Department of Anesthesiology, Thomas Jefferson University Hospital, Philadelphia, PA, ²Department of Anesthesiology, Thomas Jefferson University, Philadelphia, PA, ³Department of Internal Medicine, Yale-New Haven Hospital, New Haven, CT

INTRODUCTION: Pain control is a major concern of most patients undergoing surgery. Pain can be relieved using multiple drugs and multiple techniques, otherwise known as a multimodal analgesia. The ideal discharge pain regimen achieves the goal of analgesia with minimal side effects. Opioids are still a primary treatment for postoperative pain. Opioids are associated with troubling and often dose limiting side effects. Furthermore, excessive postoperative opioid prescribing may contribute to availability of opioids for abuse and diversion. The goals of this study were to: 1) determine which opioids were being prescribed postoperatively and in what quantity and duration, 2) determine the pattern and prevalence for use of

non-opioid analgesics. In order to narrow the scope of the study and reduce confounding variables, five common surgical procedures were chosen as a focal point of this study (Hip Replacements, Laparoscopic Cholecystectomies, Hysterectomies, Tonsillectomies, and Knee Replacements)

METHODS: Following IRB approval, a retrospective data query of discharge analgesia prescriptions at a university tertiary care center for five surgical procedures was performed using data between the years 2011 and 2012.

RESULTS: Approximately 50 patients from each of the five common surgical procedures (total N=250) were included.

CONCLUSIONS: Opioid combination agents remain the most commonly prescribed oral analgesics upon discharge following surgery. The use of multimodal analgesia is supported by acute pain guidelines, and the orthopedic surgeons and gynecologic surgeons at our institution embrace it while the ENT and general surgeons still prescribe opioids as a primary treatment for postoperative pain. Our data also suggests that at our institution, only a moderate quantity of opioid is prescribed limiting the risk of exposure and diversion. Further prospective studies are warranted to determine what patients actually consume of their discharge prescriptions.

Table 1: Most Commonly Prescribed Discharge Medication for Different Surgical Procedures with Mean Number Quantity Dispensed and Calculated Duration of Prescription

	Most Commonly Prescribed Medication	Percentage of Patients Receiving Drug	Mean Number of Tablets Prescribed or ml Prescribed	Calculated Duration of Prescription
Hip Replacements	Tramadol 50 mg	90%	40	5-10 days
	Hydrocodone-APAP 7.5-325 mg	83%	40	3-7 days
Laparoscopic Cholecystectomy	Oxycodone-APAP 5-325 mg	88%	33	3-7 days
Hysterectomy	Ibuprofen 600 mg	88%	45	8-15 days
	Oxycodone-APAP 5-325 mg	67%	33	3-8 days
Tonsillectomy	Oxycodone-APAP 5-325 mg Solution	42%	317 ml	3-17 days
Knee Replacements	Hydrocodone-APAP 7.5-325 mg	94%	40	3-7 days
	Tramadol 50 mg	84%	40	5-10 days

* NOTE the duration of medication was estimated using the parameters in the described prescription and assumed that patients were not taking them PRN but exactly as prescribed. Using these assumptions, the number of pills consumed per day was determined and that was divided into the total number of pills to estimate the duration of the prescription.

Table 2: Percentage of Patients Receiving Multimodal Analgesia vs. Combination Products vs. Opioid Only Regimens

Case Type	% Patients Receiving Multimodal Analgesia	% Patients Receiving Combination Products (ie: Oxycodone-APAP)	% Patients Receiving Opioids Only including Combination Products	Calculated Duration of Prescription
Hip Replacements	83%	90%	8%	5-10 days
Laparoscopic Cholecystectomy	9%	94%	88%	3-7 days
Hysterectomy	88%	79%	12%	3-7 days
Tonsillectomy	12%	72%	68%	8-15 days
Knee Replacements	94%	97%	10%	3-8 days

S-497.

APPROACHES TO THE SAPHENOUS NERVE BLOCK; IS ONE APPROACH SUPERIOR? A REVIEW OF CURRENT PRACTICE

AUTHORS: D. Mitchell, D. I. Smith, A. L. Hoefnagel

AFFILIATION: Anesthesiology, University of Rochester School of Medicine, Rochester, NY

INTRODUCTION/OBJECTIVES: The saphenous nerve, the distal branch of the femoral nerve, provides sensory innervation to the medial aspect of the lower leg. Saphenous nerve blockade is often performed when regional anesthesia is administered for lower extremity surgery involving the medial aspect of the lower leg or ankle. Numerous approaches have been described; using anatomic landmarks, nerve stimulation, and ultrasound. Here we will review literature to compare various approaches to the saphenous nerve block, in an attempt to identify a superior approach. We will focus on the success rates of sensory blockade, incidence of complications and unintentional secondary motor blockade.

METHODS: References were identified by searches of PubMed and Embase from January 1993 until September 2014 with related terms. Sixteen different approaches to saphenous nerve blockade from prospective randomized controlled trials and case-series reports were reviewed; 7 ultrasound approaches, (2 in conjunction with nerve stimulation), 3 approaches with nerve stimulation, and 6 anatomic approaches.

RESULTS:

See tables

CONCLUSIONS: The preponderance of approaches to saphenous nerve blockade likely reflects the inconsistency of results among the different techniques. Of the sixteen different approaches reviewed only four were able to demonstrate a 100% success rate, with an endpoint of complete absence of sensation to pinprick in

the distribution of the saphenous nerve. This common endpoint however, misses the primary perioperative goal, which is increased intraoperative and postoperative analgesia. This discordance is reflected by a reported 100% success rate when testing for sensory loss (1), but only a 78% success rate for intraoperative analgesia and 67% success rate for postoperative block success for a near identical approach (6). Additionally, no single approach was without complication, or limitation reported by the author and therefore, no single approach to the saphenous nerve can yet be deemed as superior.

REFERENCES:

1. Feasibility and efficacy of ultrasound-guided block of the saphenous nerve in the adductor canal. *Reg Anesth Pain Med* 2009; 34:578-80
2. A comparison of ultrasound-guided and landmark-based approaches to saphenous nerve blockade: A prospective, controlled, blinded, crossover Trial. *Anesthesia-analgia* 2013; 117: 265-270.
3. Transsartorial approach for saphenous nerve block. *Can J Anaesth* 1993; 40:542-6
4. Comparison of the different approaches to saphenous nerve block. *Anesthesiology* 2005; 102:633-8
5. A paravenous approach for the saphenous nerve block. *Reg Anesth Pain Med* 2001; 26:504-6
6. Efficacy of an ultrasound-guided subsartorial approach to saphenous nerve block: a case series. *Can J Anaesth* 2010; 57:683-8
7. Anatomy and clinical implications of the ultrasound-guided subsartorial saphenous nerve block. *Reg Anesth Pain Med.* 2011; 36(4) 399-402.
8. Prospective randomized comparison between ultrasound-guided saphenous nerve block within and distal to the adductor canal with low volume of local anesthetic. *J Anaesthesiol Clin hamacol* 2014; 30(3): 378-82.

4)	Trans-sartorial-anatomical + NS	Palpate sartorius muscle just above the medial side of the patella. Needle inserted 3-4cm superior and 6-8cm posterior to the superomedial border of the patella. Insert NS needle caudally at 45 degree angle and slightly posteriorly. Paresthesia elicited at 3-5cm depth.	- Complete loss of sensation to pinprick in distribution of the SN in the foot and leg -100% medial leg -80% medial foot (100% if not for dual innervation from superficial peroneal nerve)	No motor weakness -All subjects had myalgias for 1-2 days	-Longer procedure time
4)	Block at Medial Femoral Condyle	Palpate medial condyle of femur. LA injected in fan-wise direction between skin and periosteum of medial surface of condyle and slightly posterior the condyle.	-Complete loss of sensation to pinprick in distribution of the SN in the foot and leg -10% medial leg -0% medial foot		-Posterior location of the saphenous nerve and not medial in relation to the medial femoral condyle.
4)	Below the knee anatomic field block	A linear subcutaneous injection of LA is made in an anterior to posterior direction at a level 3-4 cm distal to the tibial condyle.	- Complete loss of sensation to pinprick in distribution of the SN in the foot and leg -70% medial leg -20% medial foot		
4)	Field block at medial malleolus	LA injected subcutaneously above and anterior to the MM of the foot, around the great saphenous vein, extends anteriorly and posteriorly above MM	- Complete loss of sensation to pinprick in distribution of the SN in the foot and leg -60% medial foot		
5)	Para-venous field block	Subcutaneous LA infiltration medial and lateral to the saphenous vein at the level of the tibial tuberosity, 5 mls	Anesthesia to cold and pinprick in SN distribution (over medial aspect of distal two thirds of lower leg) -100% success rate	-35% of subject developed a painless hematoma -Difficulty identifying the SV in obese people -Absence of vein in pts s/p SV stripping -Occasional use of a tourniquet to make saphenous vein prominent	"23 G needle used because its length was more convenient for subcutaneous infiltration approach, a 27G needle could be used which will probably reduce the size of any hematoma"

S-497 • continued

<p>6)</p> <p>US-sub-sartorial + some NS (proximal to Manickam approach)</p>	<p>Supine position, probe placed on medial aspect of leg at mid-thigh level, identify the FA deep to the sartorius muscle. SN is identified as a hyper-echoic structure medial to the FA. Needle inserted laterally to the FA then advanced to approach medial aspect. 10-20cc LA</p> <p>US used in all 39 cases NS utilized in 35/39 cases, capture of the vastus medialis or patella tendon</p> <p>All patients received a concurrent sciatic nerve block</p>	<p>Endpoint in preoperative block-minimal intraoperative opioids (<200 mcg fentanyl or equivalent) and denied pain (VRS=0) in PACU and did not require additional analgesia</p> <p>-Preoperative block success rate of 78%</p> <p>-Postoperative block-if pts VRS score reduced to 0 within 30 minutes of block without additional analgesic dosing</p> <p>-Postop block success 67% (2/3 pts); Unsuccessful patient had a reduction of VRS to 3-5 but not to zero.</p>	<p>-No complications</p> <p>-10/39 performed by attending anesthesiologist</p> <p>-29/39 blocks performed by supervised resident-limited experience, may lead to an underestimation of true efficiency</p> <p>-Pain intraoperatively was considered a failed block, but retrospective study and unable to delineate the distribution of pain intraop/postop because not recorded (ie vs sciatic block distribution)</p> <p>-Unable to standardize the "soak" time before start of surgery-may have contributed to higher intraop pain (data not included in study of block to OR time)</p>	<p>-NS capture elicited in only 23% of patients - Lower success rates than similar techniques reported by other authors but more stringent and clinically applicable endpoint measured in this study. (ie preoperative pinprick may not correlate with intraoperative and postoperative analgesia)</p>
<p>7)</p> <p>US- sub-sartorial</p>	<p>Supine, transducer placed medial surface midthigh between knee and inguinal crease. Cross section femoral artery and sartorius muscle identified. Transducer moved caudally until femoral vessels visualized to exit inferior foramen of adductor canal, vastoadductor membrane faded and pass through adductor hiatus. 10mls LA injected into the compartment between the Sartorius muscle and FA.</p>	<p>-Complete absence of sensation to pinprick in 2 areas (proximal to medial malleolus and midpoint between MM and tibial tuberosity)</p> <p>-95.6% success rate</p> <p>-Strength of hip flexors and knee extensors</p>	<p>-No motor blocks</p> <p>-One subject had mild systemic symptoms of local anesthetic toxicity (LH, perioral numbness).</p>	

<p>8)</p> <p>US-adductor canal (AC)</p>	<p>US-guided SN block within the distal part of the adductor canal, medially to the femoral artery</p>	<p>-Complete absence of sensation to pinprick in 2 areas (proximal to MM and below the tibial tubercle) after 15 mins</p> <p>-55% success rate</p> <p>-Percentage of complete or partial motor block of the VM nerve at 15 mins</p> <p>-No complete vastus medialis blockade, 36.3% weakness</p>	<p>Three patients with transient paresthesia</p>	<p>No statistical difference in success of nerve blockade between AC and DAC cohorts</p> <p>-AC group VM weakness significantly higher than DAC group</p> <p>-No significant difference in complications.</p>
<p>8)</p> <p>US-distal adductor canal (DAC)</p>	<p>Ultrasound-guided SN block at the compartment between the Sartorius muscle and the femoral artery distal to the inferior foramina of the adductor canal (described by Saranteas, et al)</p>	<p>-Complete absence of sensation to pinprick in 2 areas (proximal to MM and below the tibial tubercle) after 15 mins</p> <p>-59% success rate</p> <p>-Percentage of complete or partial motor block of the VM nerve at 15 mins</p> <p>-No complete blockade or weakness of the VM (0/22)</p>	<p>-1 patient with vascular puncture</p> <p>-1 patient with transient paresthesia</p>	

S-498.**TREATMENT OF CHRONIC ABDOMINAL WALL PAIN USING ULTRASOUND-GUIDED RADIOFREQUENCY ABLATION****AUTHORS:** S. Harshman, A. Rakic;**AFFILIATION:** Anesthesiology, University of Illinois at Chicago, Chicago, IL

INTRODUCTION: An estimated 10 to 30% of patients presenting with chronic idiopathic abdominal pain can have their source attributed to the abdominal wall.^{1,2} Prompt recognition of the abdominal wall as the source of pain could significantly reduce an array of unnecessary tests and procedures as well as help curb ever rising healthcare costs. While the mainstay of treatment remains injection of local anesthetic with corticosteroid, effective long term treatment remains varied. We present a novel method for the treatment of distal intercostal nerve irritation causing refractory abdominal wall pain using Ultrasound-Guided Radiofrequency Ablation (RFA).

METHODS/RESULTS: A 23 year old female presented with refractory abdominal wall pain secondary to a history of multiple abdominal surgeries required for VP shunt management. An Ultrasound-Guided Transversus Abdominis Plane (TAP) block was utilized to confirm the diagnosis of abdominal wall pain. The patient subsequently underwent Ultrasound-Guided RFA of the right distal T9 intercostal nerve. The nerve was identified via ultrasound using the costal margin and the 9th and 10th ribs as landmarks. A 20g RF needle was passed, in plane, to the nerve. Stimulation at 0.25 mA elicited the patient's typical pain. Following local anesthetic administration, RFA was performed using a 1cm cannula tip for 90 seconds at 80oC. The procedure resulted in immediate resolution of the patient's abdominal wall pain. Follow up revealed complete resolution of pain lasting approximately 5 weeks, requiring no additional medications for pain control. Once pain returned, it was intermittent in nature and decreased in intensity. Repeat RFA was performed 42 days following the initial procedure. Pain relief lasted approximately 6 weeks and upon return was again intermittent in nature. A third ablation was performed 58 days after the second procedure with similar results.

DISCUSSION: Given the significant percentage of patients affected by chronic abdominal wall pain and the substantial burden to the healthcare system, a long term treatment modality is desirable. RFA has been successfully demonstrated in the treatment of numerous other chronic pain syndromes.^{3,4,5} One study has further demonstrated increased effectiveness of RFA over other treatment modalities.⁶ Additionally, the widespread use and availability of ultrasound has greatly increased our ability to visualize, identify, and treat neurologic sources of pain that develop into complex regional pain syndromes.

REFERENCES:

1. Greenbaum et al. American Journal of Gastroenterology. 2002;97(4):824-830.
2. Kanakarajan et al. Pain Medicine. 2011; 12:382-386.
3. Napoleon et al. Pain Physician 2009; 12:997-1000.
4. Garcea et al. ANZ Journal of Surgery. 2005;75(8):640-644.
5. Kapural L, Mekhail N. Current Pain Headache Reports. 2001;5(6):517-525.
6. Cohen et al. Pain Physician 2006;9(3):227-235.

S-499.

ADVERSE EVENT REPORTING IN ACUTE POSTOPERATIVE PAIN RANDOMIZED CONTROLLED TRIALS

AUTHORS: D. N. Hoffer¹, J. Parlow¹, R. Allard¹, S. M. Smith², I. Gilron¹

AFFILIATION: ¹Anesthesiology and Perioperative Medicine, Queen’s University, Kingston, ON, Canada, ²School of Medicine and Dentistry, University of Rochester, Rochester, NY

INTRODUCTION: Quality documentation in randomized controlled trials is important to ensure reliability and to assist the interpretability of studies. The Consolidated Standards of Reporting Trials (CONSORT) is a continually updated statement of recommendations formed to help standardize and improve the quality of randomized controlled trial (RCT) reporting.¹ An extension to the CONSORT statement in 2004 addresses reporting of adverse events² However, a recent study showed that randomized controlled trials of pain medications in three major pain journals frequently failed to meet recommendations for adverse event reporting.³ The use of two anticonvulsants - pregabalin and gabapentin - for the treatment of acute postoperative pain is relatively novel, and their use for this indication is off-label. Therefore, documentation of their adverse events is of particular importance. Our study assessed the quality of adverse event reporting in acute postoperative pain RCTs using studies of pregabalin and gabapentin as a convenience sample.

METHODS: We reviewed studies of primary reports of RCTs of pregabalin and gabapentin use in acute postoperative pain for whether they met the 10 recommendations from the “CONSORT Extension for Harms.”² Articles were searched in the MEDLINE online database. All included articles were coded by the primary author using the descriptors from the CONSORT Extension for Harms (see Table 1).² We compared scores between the two drugs, in two time periods.

RESULTS: Database search revealed a total of 85 RCTs: 25 testing pregabalin, 58 testing gabapentin, and two testing both pregabalin and gabapentin. These RCTs met, on average, 6.4 out of 10 CONSORT Extension for Harms. The mean number satisfied by pregabalin trials was 6.9, and by gabapentin 6.1. The breakdown of scores between the two drugs, in two time periods is shown in Figure 1.

CONCLUSIONS: In conclusion, significant improvements need to be made in adverse event reporting for acute postoperative pain RCTs. Insufficient adverse effect reporting undermines our ability to understand the risks of treatments being studied.

REFERENCES:

1. Ann Intern Med. 2010; 152:726-732
2. Ann Intern Med. 2004; 141:781-788
3. PAIN® 2012; 153:2415-2421

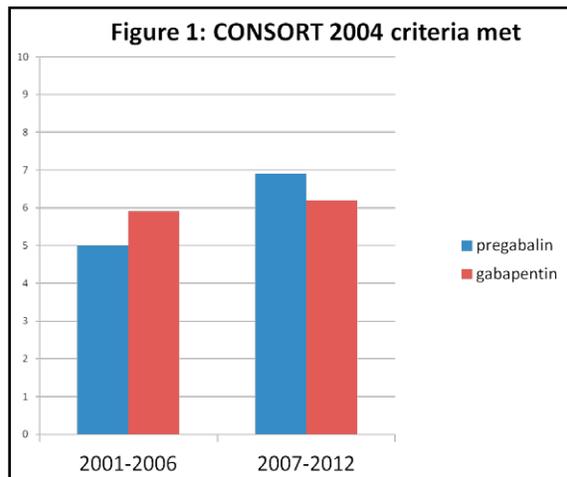


Table 1: Extension to CONSORT Recommendations

1. If the study collected data on harms and benefits, the title or abstract should so state.
2. If the trial addresses both harms and benefits, the introduction should so state.
3. List addressed adverse events with definitions for each (with attention, when relevant, to grading, expected vs. unexpected events, reference to standardized and validated definitions, and description of new definitions).
4. Clarify how harms-related information was collected (mode of data collection, timing, attribution methods, intensity of ascertainment, and harms-related monitoring and stopping rules, if pertinent).
5. Describe plans for presenting and analyzing information on harms (including coding, handling of recurrent events, specification of timing issues, handling of continuous measures, and any statistical analyses).
6. Describe for each arm the participant withdrawals that are due to harms and their experiences with the allocated treatment.
7. Provide the denominators for analyses on harms.
8. Present the absolute risk per arm and per adverse event type, grade, and seriousness, and present appropriate metrics for recurrent events, continuous variables, and scale variables, whenever pertinent.
9. Describe any subgroup analyses and exploratory analyses for harms.
10. Provide a balanced discussion of benefits and harms with emphasis on study limitations, generalizability, and other sources of information on harms.

S-500.**MULTIDISCIPLINARY TREATMENT OF CHRONIC PAIN PATIENTS: DOES OBESITY AFFECT TREATMENT OUTCOME?****AUTHORS:** B. J. Thelen¹, D. Cates², E. Lyden¹, K. K. Haynes-Henson¹**AFFILIATION:** ¹Anesthesiology, University of Nebraska Medical Center, Omaha, NE, ²Psychology, Nebraska Medicine, Omaha, NE.**INTRODUCTION:** Multidisciplinary pain treatment centers or comprehensive pain programs (CPP) are designated programs that successfully coordinate involvement of several health care providers including physicians, nurses, psychologists, and therapists in the treatment of chronic pain patients. These programs offer treatment to patients who have failed therapies including surgical intervention and medication management. A retrospective cohort study was performed analyzing the multidisciplinary Nebraska Medicine Pain Management Program to identify if BMI along with other patient demographics correlate with treatment outcome.**METHODS:** A database with validated measures including the Multidimensional Pain Inventory (MPI), a visual analog pain scale (VAS) and the McGill pain questionnaire was designed to monitor the outcomes of patients in the chronic pain program since 2010. The difference in the validated measures taken at the time of admission and discharge of patients in the three to four week program was used to evaluate program success. BMI was categorized two ways: 1) <25 vs. 25 to <30 vs. ≥ 30; 2) <30 vs. ≥ 30. Patients were also classified as going through the standard pain program versus going through the standard program plus an opioid taper. Chart reviews were completed to identify pain diagnoses along with secondary patient factors including age, race, marital status, substance use, psychological diagnosis, and work status.**RESULTS:** A total of 238 medical records were reviewed and 90.3% of patients completed the program. A total of 43.4% of patients underwent an opioid taper. Patients with BMI over 30 accounted for 48.2% of patients in the program. Back and neck pain accounted for 38.7% of primary pain diagnoses with a diagnosis of failed back surgery syndrome accounting for 28.6% of cases. There was no statistically significant difference for program completion when comparing the BMI subgroups. There were no statistically significant differences in any of the VAS, MPI, and McGill admission scores and the median change of scores for the VAS and McGill for the BMI subgroups. Patients with BMI ≥ 30 had a significantly greater change in Activities Away from Home compared with patients with BMI <30 (-0.5 vs. -0.3, p=0.016). There was a significantly greater change in the MPI Pain Severity scale for patients with BMI <25 when compared to patients with BMI ≥ 25 to <30 (median change: -2.3 vs. -1.3, p=0.01).**CONCLUSION:** The Nebraska Pain Program has had a high completion rate over the last 5 years while having a large percentage of patients who underwent a complete taper of opioids. While the pain program had a higher proportion of patients classified as obese compared to the US population, those patients showed decreases in pain severity and functional limitation, with relatively little difference in treatment outcomes compared to normal weight patients. With an increased body mass index showing increased negative outcomes in elective spine surgery, patients could benefit from earlier referral to a CPP.**REFERENCES:**

Proceedings (BUMC), 2009; 22(3): 211-214.

J. AMA. 2014; 311(8): 806-814

Spine. 2014; 39(18): 1520-1530

S-501.**THE INCIDENCE OF POLYPHARMACY IN THE PAIN CLINIC POPULATION****AUTHORS:** M. Kim¹, S. Lofgreen², J. Melendez¹, J. Galinkin¹**AFFILIATION:** ¹Anesthesiology, University of Colorado, Denver, CO, ²School of Medicine, University of Colorado, Denver, CO**INTRODUCTION:** Little data is available to evaluate the prevalence of poly-pharmacy (P-P) and drug abuse in the pain population¹. We aimed to establish the nature and rates of P-P and drug abuse in our pain clinic population. We developed a novel urine toxicology confirmatory screen that can detect up to 112 different drugs/metabolites of abuse and pain management using liquid chromatography and mass spectroscopy (LC-MS/MS) technology with proprietary software.**METHODS:** This was an IRB-approved observational study. The patients were recruited from our chronic pain and interventional pain clinics. Signed consent and urine samples were collected from 361 subjects. We enrolled any non-gravid adults older than 18 years of age, with the final enrollment of 192 from the interventional pain clinic and 169 from the chronic pain clinic. The urine samples were collected, de-identified prior to analysis, and analyzed by the LC-MS/MS technology^{1,2}. This allows for a lower level of quantification, ranging from 2.5 to 100 ng/ml. Drugs tested include: anesthetics, analgesics, anticonvulsants, anti-depressants, anti-histamine, antipsychotics, barbiturates, benzodiazepines, cannabinoids, ethanol, illicit, muscle relaxants, nicotine, opiates, stimulant, and z-drugs.**RESULTS:** Our pain populations studied demonstrated a high incidence of P-P, both prescription and non-prescription. However, the incidence of P-P varied in our two clinic populations. Only 6% and 1% of the patients tested negative for all drugs in the interventional pain and chronic pain clinics, respectively. The average numbers of drugs per subject in the groups were 5.41 in the interventional pain clinic patients and 7.55 in the chronic pain clinic patients. Approximately 3% of interventional pain clinic and 17% of the chronic patients were on illicit drugs. Cannabinoid use was well-represented with 9% and 17% prevalence in the interventional and chronic pain patients. Overall, a total of 361 patients from chronic pain and interventional pain clinics were studied, and more than 75% of patients were found to be on 4 or more drugs.**CONCLUSION:** There is significant presence of poly-pharmacy. This includes opiates, benzodiazepines, anticonvulsants, alcohol, and illicit drugs. Given this data, should our patients undergo random drug testing to better optimize our medical care? If so, which settings are appropriate: chronic pain clinic, pre-operative clinic, and/or opiate pharmacy clinic^{3,4}? The dangers of poly-pharmacy are numerous with many potential drug-drug interactions and increased morbidity⁵. The proprietary test utilized in this study is simple and tests for an expansive list of drugs. This test can be easily integrated into routine standard practice at pain clinics, to help gather accurate medication history on patients to improve the care we provide to our pain clinic patients^{3,4}.**REFERENCES:**

1. J Chromatogr B Analyt Technol Biomed Life Sci. 969:272-84, 2014 Oct 15

2. J Anal Toxicol. 38(7):387-96. 2014 Sep

3. Pain Physician. 17(5):401-14. 2014 Sep-Oct

4. Pain Physician. 17(5):E559-E564. 2014 Sep-Oct

5. Am J Hosp Palliat Care. 2014 Apr 16

Resident Abstracts

Patient Safety

S-502.

WITHDRAWN.

S-503.

WITHDRAWN.

S-504.**NASOTRACHEAL SUCTIONING POLICIES
AND PROCEDURES: A SURVEY OF LEAPFROG
2012-TOP HOSPITALS**

AUTHORS: B. M. Owens¹, L. Felts¹, B. Silkey², S. Toy¹, J. Walker¹

AFFILIATION: ¹Anesthesiology, University of Kansas School of Medicine – Wichita, Wichita, KS, ²Research, Via Christi Hospitals Wichita, Inc., Wichita, KS

INTRODUCTION AND GENERAL PURPOSE OF THE STUDY: Nasotracheal suctioning (NTS) has long been used for removal of accumulated saliva, secretions, and other foreign material from the trachea and nasopharynx that cannot be removed by the patient's cough or other less invasive procedures.¹ NTS carries significant risks associated with it, including, but not limited to, hypoxia, laryngospasm, misdirection of the catheter and intraventricular hemorrhage.¹ Despite the potential hazards concerning NTS, our review of the literature revealed a wide variation in airway suctioning policies and practices among nurses and respiratory therapists both within and across hospitals.²

The primary purpose of this study was to survey the top performing, Leapfrog, hospitals regarding their written policies or guidelines for NTS in their intensive care units (ICU).

METHODS: This is a cross-sectional, descriptive survey study. Medical, nursing, and respiratory therapy directors of combined single ICUs, surgical ICUs, medical ICUs and neuro ICUs at the 67 top performing urban hospitals identified by Leapfrog in 2012 were asked to participate. Each potential respondent was contacted by phone to determine his or her preference for response: email, or phone or mail survey, or refusal. An introductory clinical scenario was used, and the remaining survey items inquired about NTS policies, strategies for ensuring safe NTS, awareness of any NTS-related adverse events, and contraindications specified by their NTS policies.

RESULTS AND MAJOR FINDINGS: The overall response rate was 37.6%, with institutional response rate of 86.3% (at least one respondent). By institution, 56.1% reported having a policy for NTS, 10.5% responded no, 5.3% didn't know, and 28.1% are unknown (answers from institution respondents did not correlate). Of the institutions who reported "yes" to having a policy, 71.9% have contraindications listed on their policies, 12.5% had no contraindications listed, 9.4% left no response, and 6.2% are unknown.

Respondents report adverse events associated with NTS at 16%. Only 9.4% of respondents state that compliance with the hospital's NTS policy is "required and tracked", with 40.6% being "required but not tracked or documented." Knowledge, skills, risks associated with, evaluation and performance were ensured by peer-to-peer evaluations.

CONCLUSIONS: Our survey of the 2012 top performing, Leapfrog urban hospitals revealed that over half had policies for NTS, and that few of these policies are being tracked to ensure safe practices. Much of the education and performance is implemented through peer-to-peer evaluations. It can be concluded that knowledge of contraindications and risks of the procedure are being overlooked, and that there is much room for improvement across the country to ensure safe practice of NTS.

REFERENCES:

1. AARC Clinical Practice Guideline: Nasotracheal Suctioning - 2004 Revision and Update. *Respir Care*. 2004 Sept; 49(9): 1080-84.
2. Sole ML, Byers JF, Ludy JE, Zhang Y, Banta CM, and Brummel K. A multi-site survey of suctioning techniques and airway management practices. *Am J Crit Care*. 2003;12:220-232.

S-505.**THE INCIDENCE OF CORING AND FRAGMENTATION OF MEDICATION VIAL RUBBER STOPPERS****AUTHORS:** J. Eskander, J. Cotte, F. Rosinia, E. Glenn**AFFILIATION:** Anesthesiology, Tulane Medical Center, New Orleans, LA

INTRODUCTION: Coring is a common occurrence that results in fragmentation of the rubber stopper in a medication vial during insertion of a cannula (Figures 1 and 2). Theoretically, the rubber fragment may be aspirated from the medication vial and then unknowingly injected intravenously. Possible iatrogenic complications reported by authors include occlusion of venous access devices^{1,2}, pulmonary infarction and granulomas, neurologic sequelae from paradoxical embolism, anaphylaxis in patients with latex hypersensitivity, and death³. It is particularly worrisome that manufacturers of medication vial stoppers still utilize natural rubber for production. Natural rubber may put hypersensitive patients at risk for iatrogenic latex exposure. A review of the literature demonstrates a case of anaphylaxis without exanthema⁴; it may be possible that coring of latex rubber stoppers with subsequent intravenous injection initiated this patient's anaphylaxis. The objective of this paper is to present coring rates obtained at our institution.

METHODS: This is a prospective trial, utilizing 10 anesthesia providers, to study the incidence of coring. A coring event was defined as the observation of a rubber fragment inside the vial after access by a cannula. The three devices used to access vials were: BD™ Blunt Plastic Cannula, BN1815 Smiths Medical Blunt Fill Needle 18G X 1.5", and BD™ Vial Access Cannula. The anesthesia providers used these devices to access a variety of medication vials listed in Table 1. From collected data, we were able to estimate the incidence of coring associated with each access device and vial.

RESULTS: Overall, coring was reported in 3.1% of vials accessed. The highest rate occurred with the BD™ Blunt Plastic Cannula at 9.9%. Surprisingly, coring was not observed with the BD™ Vial Access Cannula (Table 1). Our data is based on the visual occurrence of rubber fragments in solution and thus the actual microscopic occurrence may be significantly higher.

Conclusions: Coring is common at alarmingly high rates. Based on our prospective trial, rubber stoppers with larger surface areas tend to core more often, and plastic cannulas have the highest incidence of coring followed by blunt needles. Although the sample size is limited, the BD™ Vial Access Cannula was not associated with any coring events.

REFERENCES:

1. Cataldo R, et al. The mystery of the occluded port that allowed blood withdrawal: is it safe to use standard needles to access ports? A case report and literature review. *J. Surg. Oncol.* 2014;109:500–503
2. Riess ML, et al. Near-embolization of a rubber core from a propofol vial. *Anesth Analg.* 2008 Mar; 106(3):1020-1; author reply 1021.
3. Chaudhry T, et al. Coring and Fragmentation May Occur With Rubber Cap and Blunt Needles. *APSF NEWSLETTER* 2013 Volume 27, No. 3, 68
4. Holnberger H, et al. Anaphylactic shock without exanthema in a case of unknown latex allergy and review of the literature. *Ped. Anesth.* 2002; 12:544-551

S-506.

CLEAN WORKSTATION INITIATIVE DOES NOT INCREASE WASTE AND TRENDS TOWARD COST SAVINGS

AUTHORS: C. Tan, A. Vandeventer, K. McCarty, A. V. Agarwala, T. A. Anderson;

AFFILIATION: Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA

INTRODUCTION: The anesthesia workspace is a source of potential contamination during the practice of anesthesia. Studies show bacterial colonization of providers' hands,¹ IV tubing stopcocks,^{2,3} and high-traffic areas of the anesthesia machine^{3,4} which is associated with increased nosocomial infection and mortality.³

PURPOSE: In March 2013, a quality improvement project called the Clean Workstation Initiative (CWI) was instituted at the Massachusetts General Hospital (MGH) in Boston, MA. The CWI standardized a protocol for providers and technicians to designate areas of the anesthesia workstation as "clean" or "dirty." Providers were encouraged to reduce potential contamination by preparing and storing materials for the next operating room (OR) case on the "clean" anesthesia cart. Between cases, anesthesia technicians were instructed to dispose of items in "dirty" areas, to leave items in "clean" areas undisturbed, and to decontaminate the entire workstation. Additionally, alcohol-based hand sanitizer and surface disinfecting wipes were installed at each workstation. A survey of providers before and after the CWI showed improved perception of workspace cleanliness and increased use of alcohol-based hand sanitizer.⁵ Initial concerns included increased waste and cost from new disposal practices. This study addresses whether the CWI affected purchasing of equipment and drugs compared to the pre-intervention period.

METHODS: Purchasing data for frequently used OR equipment (endotracheal tubes, laryngeal mask airways, oral airways) and emergency drugs (epinephrine, ephedrine, phenylephrine, atropine, glycopyrrolate) were collected from February 2012 to August 2014, separated into "pre" and "post" CWI (March 2013) phases. Costs were adjusted for increasing case volume noted throughout the study period. Two-sided paired t-tests were performed in STATA.

RESULTS: There is no statistically significant difference between overall volume-adjusted main OR equipment or drug purchasing in the 12 months before vs. 18 months after initiation of the CWI. Sub-analyses of supplies and drugs show a trend toward significant reduction in the per-case cost of endotracheal tubes (ETT, p=0.08). See Table 1.

CONCLUSIONS: Despite initial concerns, there is no statistically significant difference in overall main OR purchasing patterns before and after the CWI. There is a trend toward cost savings in ETT purchasing, presumably because unused "backup" ETTs can be saved for subsequent cases. The CWI is a sustainable, low-impact model associated with improved cleanliness practices and clinician satisfaction that can benefit other areas of the hospital and other institutions. A longer follow-up period or multicenter study may identify further cost savings as the CWI expands in scale. More work remains to determine whether the CWI succeeds in its primary goal of reducing nosocomial infection.

REFERENCES:

1. Anesthesia & Analgesia. 2010 112(1): 98-105
2. Anesthesia & Analgesia. 2012 114(6): 1236-1248
3. Anesthesiology. 2008 109(3): 399-407
4. AANA Journal. 2002 70(1): 53-56
5. ASA Annual Meeting. New Orleans, LA. 2014 A2182

Item	Pre-CWI mean (\$/case)	Post-CWI mean (\$/case)	p
All	0.390	0.417	0.43
Supplies	0.299	0.318	0.51
Endotracheal tubes (all sizes)	0.347	0.315	0.08
Laryngeal Mask Airways (all sizes)	0.284	0.436	0.15
Oral Airways (all sizes)	0.154	0.152	0.31
Drugs*	0.607	0.653	0.67

*epinephrine, ephedrine, phenylephrine, atropine, glycopyrrolate

S-507.**INFORMED CONSENT FOR SURGICAL MISSIONS IN THE DEVELOPING WORLD: THE PATIENT PERSPECTIVE****AUTHORS:** C. D. Sutton, G. C. Lynde**AFFILIATION:** Department of Anesthesiology, Emory University, Atlanta, GA

INTRO: The continuum between paternalism and autonomy has garnered increasing attention in the recent past, and is the subject of debate in current medical ethics literature. Much of the discussion is centered on informed consent and the evolving Western values of the last century. It is clear that the medical community believes that universal standards for bioethics including the tenant of informed consent should be upheld in the setting of humanitarian medical missions. However, differences in culture, language, and infrastructure complicate the issue of how to best approach the consent process for short-term surgical missions.

The various obstacles to obtaining informed consent in the global health setting have been thoroughly discussed in the literature, but few if any studies have investigated these issues from the patient's perspective. Our study sought to understand the patient's experience of giving consent in the setting of a two-week surgical mission to Haiti. We conducted a survey in an effort to find a more culturally and ethically appropriate method of obtaining consent.

METHODS: A survey was created and administered using the iPad app Quicktap Survey. The survey was written in English at a Flesch Kincaid Grade Level of 2.2, and was then translated into Haitian Creole. An interpreter was present for every survey to help patients read, understand, and answer the questions. All patients selected for surgery were offered the opportunity to participate after the consent process for their surgery was complete.

RESULTS: We received complete survey results from 55 patients, of whom 80% were male and the average age was 40.9. 72% of patients had completed primary school or less, and 75% had never had surgery before. Regarding communication, 93% reported that they felt comfortable asking questions of an American doctor, and 67% felt equally or more comfortable asking questions to an American doctor as compared to a Haitian doctor. However, only 47% reported finding communication using an interpreter to be easy, and 9% felt that their questions were not always understood when using an interpreter. While 82% reported knowing the risks of their surgery, when asked to identify these risks 27% selected one or more sham answers. Regarding the idea of giving consent, 98% of patients felt it was important to understand their surgery and its risks, and 55 of 55 patients stated that signing a consent form that showed this understanding was important.

CONCLUSIONS: Our results highlight several areas needing improvement in our consent process including communication with use of interpreters and risk communication. Our survey strongly demonstrates that the process of obtaining informed consent for surgery is important to patients in the setting of short-term medical missions, and suggests that continued efforts to improve our methods are critical.

REFERENCES:

"Informed Consent: It's Not Just Signing a Form." *Thorac Surg Clin* 15 (2005) 451-460.

"Universal Declaration on Bioethics and Human Rights." UNESCO 2005.

"Ethical Issues of Medical Missions: The Clinicians' View." *HEC Forum* 23 (2011) 105-113.

S-508.

A SURVEY ON PREOPERATIVE FASTING PROTOCOLS AND PRACTICES

AUTHORS: N. S. Chima¹, J. R. Maltby², O. Ljungqvist³, R. N. Merchant⁴

AFFILIATION: ¹Anesthesia, Pharmacology, and Therapeutics, University of British Columbia, Vancouver, BC, Canada, ²Anesthesiology, University of Calgary, Jasper, AB, Canada, ³Surgery, Örebro University Hospital, Örebro, Sweden, ⁴Anesthesia, Royal Columbian Hospital, New Westminster, BC, Canada

INTRODUCTION: Seminal work by Maltby and others in the 1980s and 1990s demonstrated that clear fluids are cleared from the stomach within 2 - 3 hours, thus negating the need for long periods of fasting¹. Recent evidence suggests that starvation – “NPO from midnight” - for clear liquids is not only unnecessary to allow for gastric emptying, but could also have deleterious effects in the peri-operative period². The widespread adoption of these evidence-based fasting guidelines has been slow. We present data from a recent survey of Canadian anesthesiologists to determine current practices and perceptions around fasting guidelines.

METHODS: An anonymous electronic survey was created using a web-based survey company. Practicing anesthesiologists were solicited by email via provincial anesthesia societies.

RESULTS: 659 anesthesiologists agreed to participate in the survey. Fasting guidelines were determined by an anaesthesiologist in 86% of hospitals; however, they were routinely provided to patients by the preoperative clinic nurse (87%); only 34% of patients were informed by their surgeon. The majority (85%) of

respondents followed current CAS fasting guidelines, yet only 46% of anesthesiologists encouraged the drinking of clear fluid until 2 - 3 hours before the scheduled time of surgery. The most common reasons cited were a variable OR schedule (30.2%), and fear that the practice could not be safely implemented (21.1%). 23% of respondents allowed patients to digest solid food 6 - 8 hours before surgery, but only 10% allowed patients to drink a small volume of milk in tea/coffee. Interestingly, less than 1% of respondents stated they had ever seen a peri-operative aspiration event, yet more than 5% had seen adverse events from dehydration, and hypoglycemia. The majority of anesthesiologists reported having patients comment on not being allowed to drink prior to surgery (28.1% frequently; 59.4% rarely).

CONCLUSIONS: Current fasting guidelines allow for more liberal intake of fluids prior to surgery, yet clinical practice seems to lag behind current recommendations. Despite the majority of anaesthesiologists indicating that they follow current fasting guidelines, less than half of them encourage their patients to drink liquids prior to 3 hours to OR, citing variability of OR times, and perception around patient safety, as reasons. However, many anesthesiologists were comfortable with clear fluids up to 4 hours prior to surgery. Given the push for ambulatory surgery, quicker post-operative recovery programs (such as ERAS), and potential detrimental effects of fasting from midnight, we hope our survey will help reveal ways in which traditional fasting policies can be changed to follow more current guidelines. We are investigating by expanding the survey to Europe and Australia/NZ.

REFERENCES:

1. Best Pract Res Clin Anesthesiol. 20(3): 363-78, 2006.
2. Best Pract Res Clin Anesthesiol. 20(3): 483-91, 2006.

Figure 1: Who determines preoperative fasting guidelines in your hospital in 2014?



Figure 2: Do your fasting instructions follow Society Guidelines (CAS)?



Figure 3: Do your fasting instructions encourage drinking clear fluid until 2 or 3 hours before scheduled time of surgery?



Figure 4: Do your fasting instructions routinely allow some solid food the day of surgery?



Figure 5: Do your fasting instructions allow a small volume (20 – 30 mL) of milk in black tea or coffee?



S-509.**TRANSMISSION OF GRAM NEGATIVE BACTERIA FOUND IN THE ANESTHESIA WORK AREA**

AUTHORS: J. C. Peters¹, R. W. Loftus², N. W. Shworak³, H. M. Patel²

AFFILIATION: ¹Anesthesiology, Dartmouth Hitchcock Medical Center, Lebanon, NH, ²Anesthesiology, Dartmouth-Hitchcock Medical Center, Lebanon, NH, ³Medicine, Geisel School of Medicine, Lebanon, NH

INTRODUCTION: Gram negative organisms are a major healthcare concern with increasing prevalence of infection and community spread.¹ Our primary aim was to characterize the transmission dynamics of frequently encountered gram negative bacteria in the anesthesia work area (AWE) environment. Our secondary aim was to examine links between these transmission events and 30-day postoperative healthcare-associated infections (HCAs).

METHODS: Gram negative isolates obtained from the AWE (patient nasopharynx and axilla, anesthesia provider hands, and the adjustable pressure-limiting valve and agent dial of the anesthesia machine) at three major academic medical centers were identified as possible intraoperative bacterial transmission events by class of pathogen, temporal association, and phenotypic analysis [analytical profile indexing (API)].¹ The top five frequently encountered genera were subjected to antibiotic disk diffusion sensitivity to identify epidemiologically-related transmission events. Complete multivariable logistic regression analysis and binomial tests of proportion were then utilized to examine the relative contributions of reservoirs or origin and within and between-case modes of transmission. Transmitted isolates were compared by pulsed-field gel electrophoresis to disease causing bacteria for 30-day postoperative HCAs.

RESULTS: The top 5 frequently encountered gram negative genera included *Acinetobacter*, *Pseudomonas*, *Brevundimonas*, *Enterobacter*, and *Moraxella* that together accounted for 81% (767/945) of possible transmission events. Twenty-two percent (167/767) of possible transmission events were identified by antibiotic susceptibility patterns as epidemiologically related and underwent further study of transmission dynamics. Contaminated provider hand reservoirs were less likely (OR 0.12, 95% CI 0.03-0.50, $p=0.004$) than contaminated patient or environmental sites to serve as the reservoir of origin for epidemiologically-related transmission events. Within and between-case modes of gram negative bacilli transmission occurred at similar rates (7% between-case, 5.2% within-case, binomial p -value 0.176). In 8.0% (2/23) of those patients, gram negative bacteria were linked by pulsed-field gel electrophoresis to the causative organism of infection. Patients and provider hands were identified as the reservoirs of origin and the environment confirmed as a vehicle for between-case transmission events linked to HCAs.

CONCLUSIONS: Between and within-case AWE gram negative bacterial transmission occurs frequently and is linked by pulsed-field gel electrophoresis to 30-day postoperative infections. Provider hands are less likely than contaminated environmental or patient skin surfaces to serve as the reservoir of origin for transmission events.

REFERENCES:

- Loftus RW, Brown JR, Koff MD, Reddy S, Heard SO, Patel HM, Fernandez PG, Beach ML, Corwin HL, Jensen JT, Kispert D, Huysman B, Dodds TM, Ruoff KL, Yeager MP. Multiple reservoirs contribute to intraoperative bacterial transmission. *Anesth Analg*. 2012; 114:1236-48

S-510.**HARMS ASSOCIATED WITH SINGLE-UNIT PERIOPERATIVE BLOOD TRANSFUSION: A RETROSPECTIVE COHORT STUDY**

AUTHORS: E. L. Whitlock¹, H. Kim¹, A. D. Auerbach²

AFFILIATION: ¹Anesthesia & Perioperative Care, University of California, San Francisco, San Francisco, CA, ²Medicine, University of California, San Francisco, San Francisco, CA

INTRODUCTION: Perioperative transfusion of four or more units of packed red blood cells (RBCs) is independently associated with 2.5-fold increased odds of perioperative stroke or myocardial infarction (MI).¹ It is not known whether transfusion of less than 4 units is similarly associated with increased risk, although there is a far greater population exposed.

METHODS: Retrospective analysis of 1,583,819 adults from 346 hospitals in the Premier Perspective database undergoing major non-cardiac, non-intracranial, non-vascular surgery requiring overnight hospitalization between 1/1/2009 and 3/31/2012 (Figure 1). To avoid confounding by transfusion later in the hospitalization, we excluded patients undergoing RBC transfusion on postoperative days 2-7. Comorbidities, discharge or 30-day readmission diagnosis of stroke, MI, or ventricular tachycardia or fibrillation (VT/VF, used as a surrogate for MI), and procedure information were obtained from ICD-9 diagnosis and procedure codes. RBC transfusion dates and amount were derived from billing data. The final logistic regression model adjusted for demographics, comorbidities, and select interactions between transfusion and comorbidities, and allowed for clustering by hospital (Table 1).

RESULTS AND MAJOR FINDINGS: 41,421 (2.62%) of the patients received at least 1 unit of RBCs within 48 hours of surgery, and 8,044 (0.51%) suffered stroke or MI. Patients who were transfused were older, more likely to be female, and had more comorbid disease. Transfusion of 1 unit of RBCs was associated with an odds ratio (OR) of 2.02 [1.62-2.52] for perioperative stroke/MI, and the odds of stroke/MI increased with transfusion of 3 units or more (Table 1). Prespecified subgroup analysis by surgical procedure or excluding those receiving >1 unit of RBCs (Table 2), and post-hoc subgroups limited to a single outcome type (i.e., stroke, MI, and VT/VF analyzed separately) or excluding those transfused on postoperative day 1 revealed similar results (data not shown). Matched propensity score analysis reproduced the association and, assuming a causal relationship, suggested a number needed to treat to harm of 228 (Table 3). Two methods of modeling an unmeasured confounder suggest an OR of >10 with imbalance of up to 47% between transfused and non-transfused patients would be required to invalidate our results.^{2,3}

CONCLUSIONS: A one-unit perioperative RBC transfusion is associated with an OR of 2.02 for perioperative stroke and MI, even after extensive adjustment and subgroup and sensitivity analyses. Our results provide additional support for transfusion-sparing strategies as randomized trials are pursued.

REFERENCES:

- Circulation*. 2012; 126: 207-212.
- Biometrics*. 1998; 54: 948-63.
- Am J Epidemiol*. 2005; 162: 279-89.

Figure 1. Patient flow diagram.

Table 1. Primary logistic regression model for stroke/MI, with clustering by hospital.

S-510 • continued

Table 1. Primary logistic regression model for stroke/MI, with clustering by hospital.

Variable		No stroke/MI (n=1,575,775)	Stroke/MI (n=8,044)	Univariate OR	Multivariate OR
RBC use	0 units	1,524,850 (97.4%)	7,548 (93.8%)	(ref)	(ref)
	1 unit	12,715 (0.81%)	132 (1.6 %)	2.11 [1.78-2.51]	2.02 [1.62-2.52]
	2 units	21,420 (1.4%)	222 (2.8%)	2.11 [1.84-2.41]	2.04 [1.67-2.48]
	3 units	2,881 (0.18%)	45 (0.56%)	3.18 [2.36-4.27]	2.72 [2.02-3.67]
	4+ units	3,909 (0.25%)	97 (1.2%)	5.05 [4.12-6.18]	4.20 [3.27-5.39]
Age (mean +/- stdev, OR are per decade)	58.9 +/- 16.0	71.2 +/- 12.8	1.73 [1.71-1.76]	1.43 [1.40-1.47]	
Male gender (ref: F)	602,781 (38.3%)	4,830 (54.5%)	1.93[1.85-2.02]	1.45 [1.38-1.53]	
Race/ethnicity	Black	152,529 (9.7%)	896 (11.1%)	1.13[1.05-1.21]	1.47 [1.35-1.60]
	Hispanic	39,460 (2.5%)	110 (1.4%)	0.54 [0.44-0.65]	0.76 [0.61-0.96]
	Other	241,783 (15.3%)	1,097 (13.6%)	0.87 [0.82-0.93]	0.97 [0.87-1.08]
	White	1,142,003 (72.5%)	5,941 (73.9%)	(ref)	(ref)
Payor	Uninsured	54,847 (3.5%)	180 (2.2%)	1.66 [1.41-1.94]	1.66 [1.39-1.99]
	Indemnity	200,381 (12.7%)	488 (6.1%)	1.23 [1.10-1.37]	1.14 [1.01-1.29]
	Managed care, capitated	12,245 (0.78%)	29 (0.36%)	1.20 [0.83-1.73]	1.03 [0.72-1.48]
	Managed care, noncapitated	515,841 (32.7%)	1,022 (12.7%)	(ref)	(ref)
	Medicaid	102,009 (6.5%)	365 (4.5%)	1.81 [1.60-2.04]	1.78 [1.56-2.03]
	Medicare	665,941 (42.3%)	5,881 (73.1%)	4.46 [4.17-4.76]	1.37 [1.25-1.49]
	Other	24,511 (1.6%)	79 (0.98%)	1.63 [1.29-2.05]	1.39 [1.13-1.71]
Comorbidities	Cardiovascular risk factors*	295,042 (18.7%)	4,174 (51.9%)	7.21 [6.86-7.57]	2.45 [2.30-2.62]
	Cerebrovascular disease	10,641 (0.68%)	912 (11.3%)	18.8 [17.5-20.2]	8.24 [7.28-9.32]
	CAD or MI history	181,386 (11.5%)	3,235 (40.2%)	5.17 [4.94-5.41]	2.09 [1.97-2.23]
	Obesity	235,634 (15.0%)	890 (11.1%)	0.71 [0.66-0.76]	0.88 [0.80-0.96]
	Smoking	196,536 (12.5%)	940 (11.7%)	0.93 [0.87-0.99]	1.26 [1.16-1.37]
	Anemia	210,558 (13.4%)	1,711 (21.3%)	1.75 [1.66-1.85]	1.10 [1.02-1.18]
Surgery type	Spine/PNS	204,743 (13.0%)	726 (9.0%)	0.85 [0.78-0.92]	1.17 [1.06-1.30]
	General	389,943 (24.8%)	3,476 (43.2%)	2.13 [2.02-2.24]	2.58 [2.41-2.75]
	Thoracic	15,882 (1.0%)	309 (3.8%)	4.65 [4.13-5.24]	3.83 [3.36-4.37]
	Urogenital	96,129 (6.1%)	535 (6.7%)	1.33 [1.21-1.46]	1.18 [1.06-1.31]
	Gynecologic	203,123 (12.9%)	207 (2.6%)	0.24 [0.21-0.28]	0.78 [0.67-0.92]
	Orthopedic	617,863 (39.2%)	2,586 (32.2%)	(ref)	(ref)
	Integumentary	48,092 (3.1%)	205 (2.6%)	1.02 [0.88-1.17]	1.29 [1.12-1.49]

S-510 • CONTINUED ON NEXT PAGE

S-510 • continued

Table 2. Subgroup analyses using primary clustered logistic regression model.

Subgroup Variable		Colectomy (partial and total)	Small bowel resection	Hip/knee replacement or revision	Spine, including fusion and laminectomy	Hysterectomy	Excluding patients transfused 2 units or more
Number of patients		37,989	16,179	432,419	196,802	112,960	1,555,245
Number transfused (%)		1,748 (4.6%)	647 (4.0%)	15,516 (3.6%)	3,903 (2.0%)	1,747 (1.6%)	12,847 (0.83%)
Number of patients with stroke/MI (%)		689 (1.8%)	309 (1.9%)	1,447 (0.33%)	670 (0.34%)	115 (0.10%)	7,680 (0.49%)
RBC use	1 unit	2.31 [1.43-3.74]	2.04 [0.61-6.79]	1.25 [0.81-1.93]	1.39 [0.65-2.96]	5.21 [1.15-23.7]	1.77 [1.34-2.33]
	2 units	2.15 [1.25-3.70]	2.79 [1.38-5.65]	1.72 [1.12-2.65]	1.68 [0.89-3.16]	7.57 [3.33-17.2]	N/A
	3 units	2.48 [1.08-5.72]	1.77 [0.22-14.4]	3.30 [1.65-6.60]	3.79 [1.35-10.6]	4.79 [1.45-15.8]	
	4+ units	1.90 [0.71-5.07]	4.38 [1.52-12.6]	2.95 [1.28-6.81]	4.21 [1.88-9.43]	9.46 [2.29-39.0]	

Table 3. Propensity score analysis.

Variable		Whole dataset	Propensity score matched		P-value
			Not transfused	Transfused	
Number of Patients		1,583,819	41,121	41,121	
Number of patients with stroke/MI		8,044	314 (0.76%)	496 (1.1%)	<0.001*
Adjusted odds ratios for stroke/MI, using clustered logistic regression model	1 unit	2.02 [1.62-2.52]	2.00 [1.50-2.67]		<0.001*
	2 units	2.04 [1.67-2.48]	2.00 [1.50-2.65]		
	3 units	2.72 [2.02-3.67]	2.56 [1.81-3.64]		
	4+ units	4.20 [3.27-5.39]	3.61 [2.63-4.95]		

Resident Abstracts

Pediatric Anesthesiology

S-511.**THE ROLE OF INTRAOPERATIVE IV ACETAMINOPHEN IN POSTOPERATIVE PAIN MANAGEMENT IN PATIENTS UNDERGOING CLEFT LIP SURGERY****AUTHORS:** J. Sinskey, J. Feiner, M. Ferschl**AFFILIATION:** Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA

INTRODUCTION: Pediatric pain management has evolved considerably since a 1987 landmark study demonstrated that neonates are capable of feeling pain through functional pain pathways¹. Opiates provide excellent postoperative analgesia in children in the perioperative setting; however, these agents can have adverse effects, most notably respiratory depression. Acetaminophen is widely used for analgesia in pediatric patients as an alternative to opiates. Intravenous (IV) acetaminophen was first introduced to the US in 2011. The efficacy of IV acetaminophen was demonstrated in a recent randomized controlled trial which showed that patients <1 year old having major abdominal/thoracic (noncardiac) surgery who received IV acetaminophen postoperatively required significantly less morphine to achieve similar pain scores as those with a continuous morphine infusion². Patients undergoing cleft lip surgery could likely also benefit from IV acetaminophen. These procedures are performed in small infants (generally <6 months) who may be more susceptible to postoperative apnea. We sought to determine whether intraoperative IV acetaminophen reduced postoperative pain and/or opiate consumption in infants undergoing primary cleft lip repair.

METHODS: After IRB approval, a retrospective review of all primary cleft lip repairs in patients <8 months old between 6/2012-11/2013 at a US tertiary care hospital was performed. Comparisons of patients who received intraoperative IV acetaminophen vs. those who did not were analyzed using Mann-Whitney U test or Fisher's exact test.

RESULTS: 14 of 27 patients (51.9%) received IV acetaminophen intraoperatively. Time to first rescue opiate in the post-anesthesia care unit was longer in patients who received IV acetaminophen compared to those who did not; these results approached but did not achieve statistical significance (mean \pm SD: 115 \pm 131 vs. 46 \pm 71 minutes, median (interquartile range) 77.5 (20.3-164.5) vs. 16.0 (12.0-32.0) minutes, $p=0.069$). FLACC scores and opiate doses received 6 and 12 hours postoperatively did not differ significantly between groups.

CONCLUSIONS: Intraoperative IV acetaminophen may improve postoperative pain management. Our study is probably underpowered to detect difference between groups. This study provides preliminary data for a power analysis to plan a future prospective study to further determine the effects of IV acetaminophen on perioperative pain management in pediatric patients.

REFERENCES:

1. N Engl J Med. 1987; 317 (21): 1321-1329.
2. JAMA. 2013; 309 (2): 149-154.

S-512.

CASE SERIES: AIRWAY MANAGEMENT OF PATIENTS WITH RETINOBLASTOMA CAUSED BY CHROMOSOME 13Q DELETION

AUTHORS: E. Zininberg¹, D. Abramson², A. Afonso³

AFFILIATION: ¹Anesthesiology, Weill Cornell – New York Presbyterian, New York, NY, ²Ophthalmology, Memorial Sloan Kettering Cancer Center, New York, NY, ³Anesthesiology, Memorial Sloan Kettering Cancer Center, New York, NY

INTRODUCTION: Retinoblastoma (Rb) is an ocular malignancy caused by inactivation of the RB¹ tumor suppressor gene located on the long arm of chromosome 13. Cases in which Rb is associated with various deletions of chromosome 13q, patients can present with pleiotropic features including microcephaly, macroglossia, micrognathia, hypertelorism, proptosis, cleft palate, and hypotonia that can have a significant impact on anesthetic and airway management. Airway challenges in these patients was first reported by Toshiyuki et al.² in a case series describing two such patients who were unexpected difficult intubations. Given the historical challenge of managing children with this genotypic abnormality, we have taken an interest in analyzing airway management and complications seen in pediatric patients presenting with this chromosomal deletion.

METHODS: Utilizing retrospective chart analysis, patients with varying degrees of 13q deletion were selected for evaluation of anesthetic management during ophthalmic exam under anesthesia (EUA) at our institution.

RESULTS: Airway management of patients presenting for ophthalmic EUA is traditionally achieved with mask ventilation for the duration of the procedure. Table 1 summarizes the genetic analysis in our group of patients, their phenotypic presentation, and airway management during their cases along with any associated complications.

CONCLUSIONS: Certain dysmorphic features associated with chromosome 13q deletions including microcephaly, macroglossia, and facial asymmetry³ have historically contributed to challenging conditions in airway management. Our experience managing 4 patients with various 13q deletions suggests that ventilation challenges were anticipated and various precautions were taken to ensure safe airway securement. Patients who are normally managed via mask ventilation were often electively managed with an LMA; in one case intubation was required when ventilation via LMA was inadequate. We suggest that when providing anesthesia for patients with deletions of chromosome 13q, it is important to recognize the possible ventilation challenges and be prepared to utilize adjuncts. Furthermore, although we did not experience difficulties with endotracheal intubation in our patient requiring this intervention, it is important to understand that many of the facial dysmorphism seen in these patients can easily contribute to challenging intubating conditions which an anesthesia provider should be prepared for.

REFERENCES:

1. Mitter, D. et al. (2011). Genotype-phenotype correlations in patients with retinoblastoma and interstitial 13q deletions, *European Journal of Human Genetics* 19, pp. 947-958
2. Toshiyuki, S. et al. (1998). Difficult Tracheal Intubation in Patients with Retinoblastoma Caused by 13q Deficiency, *Japanese Journal of Clinical Oncology*, 28(8), pp. 507-510.
3. Grace, E. et al. (1971). The 13q- Deletion Syndrome, *Journal of Medical Genetics*, 8, pp. 351-357.

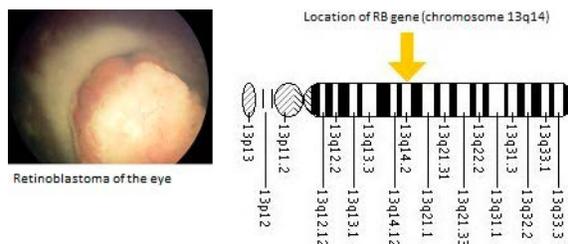


Table 1

	Genotype analysis	Phenotypic associations	Preoperative airway assessment	Airway management during EUA
Pt 1 3y/o F	- Mosaic deletion of 13q12-13q22 - 60% cells affected	- normocephaly - FTT (<3% for ht and wt) - - high palate - hypotonia - normal naso/oropharynx	Mallampati 2 - Noted history of laryngo/ tracheomalacia with baseline stridor when pt agitated	LMA for majority of cases. Few cases done with mask ventilation; obstructive respiratory pattern noted. - complication: during one case difficult ventilation via LMA requiring intubation; no reported issues with intubation
Pt 2 2y/o M	- Mosaic deletion of 13q14-13q21 - 90% cells affected	- macrocephaly - global hypotonia - developmental delay	Mallampati 1 vs 2	LMA used for most exams until 04/2014, then intermittent LMA vs mask ventilation depending on provider. No reported issues with mask ventilation
Pt 3 2y/o M	- Deletion of 13q3-13q21 - 100% cells affected	- global hypotonia - severe developmental delay - long narrow face - prominent jaw Small mouth - High palate	Mallampati 3	Uncomplicated mask ventilation
Pt 4 3y/o F	Unavailable	- Mild generalized hypotonia - down slanting palpebral fissures	Mallampati 2	LMA until 03/2011; then intermittent LMA vs mask ventilation depending on provider. No reported issues with mask ventilation.

S-513.**DEXMEDETOMIDINE ATTENUATES APOPTOSIS
INDUCED BY KETAMINE EXPOSURE IN FETAL RATS**

AUTHORS: Y. Lin, J. Li, M. Xiong, J. D. Eloy, V. Le, J. H. Ye, A. Bekker

AFFILIATION: Anesthesiology, Rutgers – New Jersey Medical School, Newark, NJ

INTRODUCTION: Ketamine anesthesia delivered to pregnant rats and monkeys has been shown to cause neuroapoptosis, learning and memory deficits in their offsprings^{1,2,3}. A recent study suggests that intravenous infusion of dexmedetomidine has anti-apoptotic and anti-inflammation effects in rats with intestinal ischemia⁴. The present study investigates whether intravenous dexmedetomidine premedication in pregnant rats can attenuate cerebral apoptosis in fetal rats exposed to ketamine anesthesia.

METHODS: With IACUC approval, 17 pregnant Sprague-Dawley rats on gestation day 18-20 were randomly divided into 4 groups. 6 dams were administered ketamine for 1 or 2 hours; 5 dams were administered dexmedetomidine for 1 hour followed by 2 hours of ketamine infusion; 3 dams were administered dexmedetomidine for 1 hour; 3 dams received no medication (controls). Ketamine or dexmedetomidine was administered to pregnant rats by intravenous infusion through tail vein catheters. Control pregnant rats had intravenous catheters inserted in the tail veins but received no infusion. The pregnant rats under ketamine induced general anesthesia were intubated and supported with controlled mechanical ventilation and 1 L/minute oxygen supply. Vital signs, including heart rate, arterial oxygen saturation, and pulse distension, were continuously monitored by throat pulse oximetry monitors (Harvard Apparatus, Holliston, MA). End-tidal CO₂ was continuously monitored by a CO₂ monitor (Datex Ohmeda, Louisville, KY). The temperature was maintained by a heating lamp and temperature controller (Harvard Apparatus, Holliston, MA). Cesarean sections were performed 1 hour after ketamine or dexmedetomidine infusion and fetal cerebral hemispheres were harvested. The cerebral tissue samples were store in -80°C and subjected to Western blot analysis to assess cleaved caspase-3 levels.

RESULTS AND MAJOR FINDINGS: The vital signs and end-tidal CO₂ monitoring indicated that the pregnant rats undergoing general anesthesia were stable and excluded hypoxia as a confounding factor. Ketamine anesthesia for 2 h, but not 1 h, increased cleaved caspase-3 levels in the fetal cerebra (control: 100 ± 30%; ketamine 1 h: 240 ± 33%; ketamine 2 h: 1312 ± 20 %. p < 0.001, ketamine 2h vs. control). The administration of 5 µg/kg/h intravenous infusion of dexmedetomidine for 1 hour attenuated the apoptotic effect resulting from ketamine anesthesia (p < 0.001, ketamine 2h vs. ketamine + dexmedetomidine). Dexmedetomidine alone did not affect the cleaved caspase-3 levels in the brain tissues of fetal rats.

CONCLUSIONS: These results indicate that maternal intravenous ketamine exposure activates apoptosis in fetal brains. Premedication with intravenous dexmedetomidine attenuates ketamine induced cerebral apoptosis in fetal rats.

REFERENCES:

1. Anesthesiology. 116(2):372-84, 2012
2. Science. 283(5398):70-4, 1999
3. Journal of Neuroscience. 23(3):876-82, 2003
4. Anesthesiology. 116: 1035-46, 2012

Resident Abstracts

Perioperative Anesthesia

S-514.**THE INCIDENCE, RISK FACTORS AND ADVERSE OUTCOMES OF ACUTE KIDNEY INJURY AFTER RADICAL CYSTECTOMY****AUTHORS:** J. Yu, J. Lim, K. Joung**AFFILIATION:** Anesthesiology and pain medicine, Asan Medical Center, Seoul, Korea, Republic of**PURPOSE:** Acute kidney injury (AKI) is a common complication after surgery. The AKI is known to increase morbidity and mortality of hospitalized patients. Radical cystectomy is a definitive treatment of high-grade invasive bladder cancer. However, there are little studies concerning AKI after the radical cystectomy. Therefore we examined the incidence, risk factors, and adverse outcomes of AKI after radical cystectomy.**METHODS:** After the approval from the Institutional Review Board of our institution, we retrospectively assessed 514 patients aged 20 years or over who underwent radical cystectomy between January 1, 2001 and December 31, 2011. AKI was defined and staged as serum creatinine concentration based on Risk, Injury, Failure, Loss of kidney function and End-stage kidney disease (RIFLE) criteria. Univariate and multivariable logistic regression analyses were conducted to evaluate the association between perioperative parameters and development of postoperative AKI. We also evaluated the association between AKI and the duration of hospital/intensive care unit stay.**RESULTS:** The overall incidence of AKI after radical cystectomy was 11.5% (59 of 514 patients). Multivariable logistic regression analysis demonstrated that independent risk factors of AKI after radical cystectomy were high body mass index (odds ratio = 1.097, $P = 0.037$) and long operation time (odds ratio = 1.003, $P = 0.043$). The duration of hospital stay was significantly longer in patients who had AKI after radical cystectomy, compared with patients with no AKI (36.9 ± 20.2 days vs 29.5 ± 10.2 days, $P = 0.007$).**CONCLUSIONS:** Our study suggests that the risk factors of AKI after radical cystectomy are high body mass index and long operation time. In addition, the AKI after radical cystectomy may be associated with the prolonged hospital stay.

S-515.**DEEP BRAIN STIMULATION UTILIZING DEXMEDETOMIDINE: A CLINICAL REPORT FROM THE UNIVERSITY OF MIAMI MILLER SCHOOL OF MEDICINE**

AUTHORS: D. B. Covington¹, Y. F. Rodriguez-Blanco², M. Degnan¹, B. V. Gallo³, J. R. Jagid⁴, T. M. Fuhrman⁵

AFFILIATION: ¹Anesthesiology, Jackson Memorial Hospital/ University of Miami Mill, Miami, FL, ²Anesthesiology, University of Miami Miller School of Medicine, Miami, FL, ³University of Miami School of Medicine, Miami, FL, ⁴Neurosurgery, University of Miami Miller School of Medicine, Miami, FL, ⁵Anesthesiology, Bay Pines VAHS, Bay Pines, FL

INTRODUCTION: Deep brain stimulation (DBS) is an increasingly utilized technique to treat symptoms of movement and psychiatric disorders.¹⁻⁵ The anesthetic technique remains challenging and "... it is clear that no simple anesthetic regimen exists."⁶

With its anxiolytic, sedative, and analgesic properties coupled with a short-half life and lack of respiratory depression, dexmedetomidine has ideal properties for DBS procedures. We conducted a retrospective review of the DBS procedures performed at our institution utilizing monitored anesthesia care (MAC) via dexmedetomidine infusion to report on the frequency and type of perioperative complications.

METHODS: After IRB approval, 78 DBS procedures involving 73 patients at the University of Miami Miller School of Medicine were retrospectively reviewed from 2009-11. All anesthetic records, nursing recovery notes, operative notes, and discharge summaries were reviewed. Patient demographics, current medications, indication for DBS, surgical location, and comorbid diagnoses were noted. Perioperative complications were also reviewed and defined per Khatib et al.⁷ All cases were performed with standard ASA monitors and via MAC with a dexmedetomidine infusion DBS placement.

RESULTS: 73 patients were studied - 47 male and 26 female. The average age was 67.4 8.7 years-old. 61 procedures (78.2%) were performed in patients with Parkinson's disease, and 17 procedures (21.8%) were performed for patients with essential tremors. The most common co-morbidities were hypertension (48.7%), cigarette smoking (26.9%), obesity (26.9%), coronary artery disease (16.7%), and diabetes (16.7%).

All cases utilized an intravenous infusion of dexmedetomidine during electrode implantation and assessment. The mean infusion dose of dexmedetomidine was 0.61mcg/kg/hr with a range of doses from 0.1 mcg/kg/hr to 1mcg/kg/hr. 16 cases (20.5%) utilized a loading dose of dexmedetomidine. 91% of cases utilized medications to manage intraoperative hypertension.

Two complications were noted in our review, resulting in a 2.6% complication rate. One patient became agitated intraoperatively, requested early termination, and only received a unilateral device, instead of the planned bilateral DBS. One cardiac complication involved refractory arterial hypertension, which required nifedipine and remifentanyl infusions to successfully complete the procedure. [See Table 1]

CONCLUSIONS: The anesthetic management for DBS remains challenging secondary to a variety of patient factors and unique surgical requirements. Previous research supports MAC with propofol and cited a complication rate per patient of 11.6%.⁷ The complication rate of 2.6% in this study augments previous support of dexmedetomidine via MAC for DBS as a safe and effective anesthetic option.⁸

REFERENCES:

1. N Am J Med Sci. 2014 Aug;6(8):359-69.
2. Neuron. 2005 Mar 3;45(5):651-660.
3. Neuropsychopharmacology. 2006 Nov;31(11):2384-93.
4. Cancer. 1986;57:1266-72.
5. Neuromodulation. 16(1):10-24.
6. Anesthesiol Clin. 2009 Sep;27(3):391-415.
7. J Neurosurg Anesthesiol 2008;20:36-40.
8. Anesth Analg. 2006;103:1224-28.

Table 1: Complication Type and Frequency

Complication	No. of Events	Complication Rate Per Patient
Respiratory	0	0%
Cardiac	1	1.3%
Neurologic	0	0%
Psychologic/psychiatric	0	0%
Patient-requested procedure termination	1	1.3%
Coughing/moaning/sneezing	0	0%
Total	2	2.6%

S-516.

WITHDRAWN.

S-517.

WITHDRAWN.

S-518.**ULTRASOUND AND PATIENT PARAMETERS AS POTENTIAL PREDICTORS OF DIFFICULT RADIAL ARTERY CATHETER INSERTION**

AUTHORS: M. Joseph¹, M. Tahir Janjua¹, N. Joshi², C. McNulty², E. Kilmartin¹, M. C. Torjman¹, J. Joseph¹

AFFILIATION: ¹Anesthesiology, Thomas Jefferson University, Philadelphia, PA, ²Anesthesiology, Sidney Kimmel Medical School, Philadelphia, PA

INTRODUCTION: Arterial catheters are commonly used for surgeries requiring continuous blood pressure monitoring and frequent blood sampling. Successful radial artery catheter (RAC) cannulation can be difficult and time consuming. The purpose of this study was to identify anatomic and clinical predictors of a difficult radial artery (RA) catheterization using high-resolution ultrasound and patient data.

METHODS: We performed an IRB approved, prospective observational study in 25 patients, in which 18 patients were analyzed, that required routine RAC placement prior to major general surgery. An experienced clinician inserted each 20 gauge polyurethane catheter (Arrow International; Reading, PA) in the OR using a palpation method. High resolution ultrasound examinations were performed using a SonoScape S-9, version 3.0.4.2 (SonoScape Co. Ltd., Shenzhen, China) immediately before insertion. A radiologist measured the AP diameter and lumen depth of the radial artery. Vital signs were recorded before and after RAC cannulation. The ease or difficulty of RAC placement was defined by the number of insertion attempts (# of forward passes) and the time to successful catheter insertion. The Difficult RAC insertion group (DG) was defined as 4 or more attempts and Easy RAC insertion group (EG) was defined as less than 4 attempts. Data were analyzed using the student t-test and Pearson correlation.

RESULTS: Patient characteristics at the time of RAC insertion were: age 60.8 ±12.1 years, BMI 28.1±7.5, HR 76.9±9.22 min⁻¹, systolic BP (SBP) 112.1±17.20 mm Hg, diastolic BP (DBP) 67.3±14.7 mm Hg, mean arterial BP (MAP) 78.1±14.9 mm Hg, RA diameter 1.97±0.46 mm, and RA depth 3.76±1.70 mm. BP did not significantly change during RAC insertion. The range of RAC insertion attempts was 1-32 with a median of 3 (IQR: 6.75). The DBP was significantly different between the EG and DG (n=8, mean 75.38±13.80 mm Hg; n=10, mean 60.9±11.88 mm Hg, P=0.0386, respectively). MAP was decreased in the DG 72.0± 12.85 vs EG 85.7 ±13.7 (p=0.055), while HR showed significant difference between the groups (EG 82.3±8.33min⁻¹, DG 72.6±7.50 min⁻¹, P=0.027). RAC insertion time was significantly different between the EG (3.0±2.96 min) and the DG (7.9±3.53 min, P=0.009). RA diameter, depth, and BMI were not correlated with the number of insertion attempts (R=0.235, R=0.198 and R=0.047, respectively).

CONCLUSIONS: Difficult RAC insertion may delay the start of surgery and lead to increased cost, especially in a high volume surgical setting. We found a negative correlation between HR and DBP at the time of RAC insertion with difficult RAC cannulation. Optimizing BP and HR while using palpation technique may help decrease the number of attempts for successful RAC placement and insertion time. The availability of high resolution US technology raises the question of whether its use could save time and effort for RAC placement. The study was limited by the small number of patients and variability of clinician experience with RAC insertion.

REFERENCES:

1. Current Anesthesia and Critical Care.1: 239-246. 1990.
2. Academic Emergency Medicine.13:1275-1279. 2006.

S-519.

EFFECTS OF INTRAOPERATIVE ESMOLOL INFUSION ON POSTOPERATIVE PAIN

AUTHORS: A. Gelineau, M. R. King, K. S. Ladha, T. A. Anderson

AFFILIATION: Anesthesia, Massachusetts General Hospital, Boston, MA

INTRODUCTION: Esmolol is an ultrashort beta-1 receptor antagonist that has been used to blunt the sympathetic response to perioperative stimuli. Esmolol has no known anesthetic or analgesic properties; however, recent studies have suggested that it may play a role in modulation of the pain response. We conducted a meta-analysis of the available data regarding the effect of intraoperative esmolol on postoperative opioid consumption.

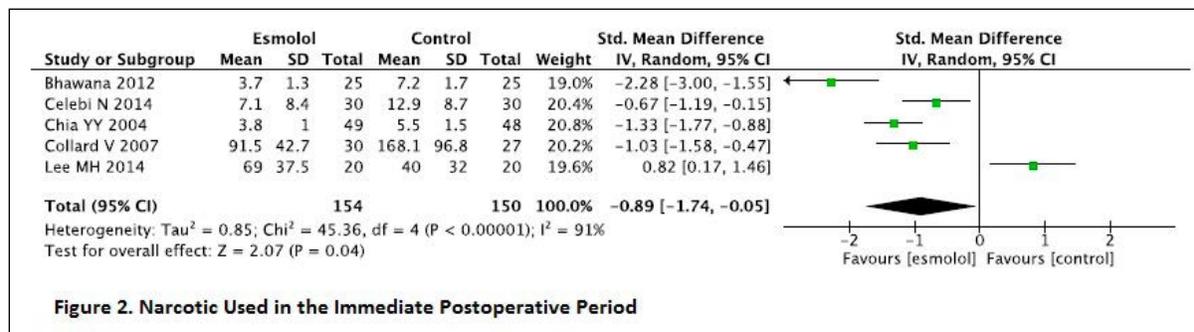
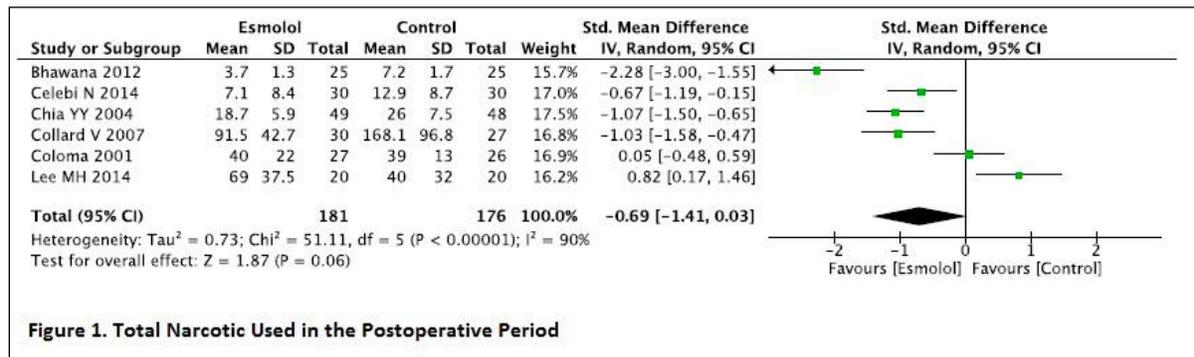
METHODS: A search of PubMed, Web of Science, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, pubget, and Embase using the terms “esmolol postoperative pain” and “esmolol pain” was conducted. The search results and “related publications” were screened for inclusion. Inclusion criteria were defined as: randomized, double blinded, placebo-controlled trials, written in English, reporting postoperative opioid consumption. Narcotic consumption in the immediate postoperative period (<4 hours) was also evaluated. If values were reported graphically, the computer program Plot Digitizer (available: <http://plotdigitizer.sourceforge.net/>) was used to estimate mean and standard deviation. Review Manager version 5.3 (The Nordic Cochrane Centre, Copanhagen, Denmark) was used to generate forest plots and standardized mean difference was calculated to determine effect size.

RESULTS: Seventy-three papers were screened. Nine met criteria for inclusion. Of studies meeting inclusion criteria, three reported postoperative narcotic consumption as median with interquartile range and were excluded. Six reported cumulative opioid consumption as mean with standard deviation and were included in the meta-analysis (esmolol group 181 patients, control group 176 patients). There was a trend toward decreased postoperative narcotic use in the esmolol group (standard mean difference -0.69, 95%CI [-1.41, 0.03], p = 0.06), figure 1. Opioid consumption in the immediate postoperative period was evaluated in five of these studies (esmolol group 154 patients, control group 150 patients) and analysis showed a significantly lower total opioid consumption in the esmolol group (standard mean difference -0.89, 95% CI [-1.74, -0.05], p= 0.04), figure 2.

CONCLUSIONS: This meta-analysis of previously conducted randomized controlled trials on the perioperative use of esmolol shows that esmolol may have a large sparing effect on opioid consumption in the postoperative period. Notably, the three studies that were excluded all also showed a significantly lower postoperative narcotic need in the esmolol group.

REFERENCES:

- Br J Anaesth. 2004 Dec;93(6):799-805
- Anesth Analg. 2007 Nov;105(5):1255-62
- Indian J Anaesth. 2012 Nov;56(6):535-41
- Korean J Anesthesiol. 2014 Mar;66(3):222-9
- Anesth Analg. 2001 Feb;92(2):352-7
- Braz J Anesthesiol. 2014 Sep-Oct;64(5):343-9
- J Int Med Res. 2011;39(5):1861-9
- Can J Anaesth. 2012 May;59(5):442-8
- J Clin Anesth. 2013 Feb;25(1):36-41



S-520.

PREOPERATIVE DEXTROMETHORPHAN AS AN ADJUNCT FOR POST-OPERATIVE PAIN IN ADULTS: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

AUTHORS: M. R. King, A. Gelineau, K. S. Ladha, T. A. Anderson;

AFFILIATION: Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA.

INTRODUCTION: Dextromethorphan (DM) is an N-methyl-D-aspartate (NMDA) receptor antagonist that is most widely used as an ingredient in antitussives. Because of its low cost and favorable side effect profile, multiple studies have investigated its use as an adjunct for perioperative analgesia. Here we have performed a meta-analysis to determine whether the use of preoperative DM lowers perioperative opioid consumption and visual analog scale (VAS) pain scores.

METHODS: A systematic search was performed in PubMed, Web of Science, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, pubget, and Embase on May 4, 2014. The following search terms were used: (dextromethorphan) AND acute pain; (dextromethorphan) AND postoperative pain; (dextromethorphan) AND pain. Studies were included if they were randomized, double-blinded, placebo controlled trials written in English, performed on patients greater than 12 years. If there were multiple agents or test groups, only groups that received either

placebo or DM preoperatively were included. For comparison of opioid use, studies were included if they tracked total use of intravenous or intramuscular morphine, hydromorphone or meperidine over a 24 hour period. VAS score comparisons were performed within three time periods: from 0 to 1 hours, 4 to 6 hours, and at 24 hours post-operatively. If means and standard deviations for opioid consumption or VAS scores were reported graphically, the computer program Plot Digitalizer (available: <http://plotdigitizer.sourceforge.net/>) was used to estimate these values at the set time points. Review Manager version 5.3 (The Nordic Cochrane Centre, Copenhagen, Denmark) was used to generate forest plots and standardized mean difference was calculated to determine effect size.

RESULTS: Forty studies were found using the listed search terms; thirteen studies were either not written in English or performed in pediatric populations and were excluded, leaving 27 included studies. Nineteen studies reported opioid consumption at 24 hours, 14 studies reported VAS at 1 hour, 15 studies reported VAS at 4-6 hours, and 13 studies reported VAS at 24 hours. Opioid consumption (Figure 1) and VAS scores were significantly reduced in the DM groups in all comparisons (Table 1; $p < 0.0001$ for all comparisons).

DISCUSSION: This meta-analysis of previously conducted randomized control trials on the preoperative and perioperative use of dextromethorphan shows that DM has a large effect on postoperative opioid consumption at 24 hours and postoperative VAS scores at 1, 4-6, and 24 hours.

Table 1: Results of comparisons for opioid use and VAS scores at 0-1, 4-6, and 24 hours.

Comparison	DM n	Control n	Std mean difference	95% CI	p-value
Opioid use	522	537	-1.28	-1.87 to -0.70	$p < 0.0001$
VAS 0-1 hr	378	380	-1.79	-2.17 to -1.40	$p < 0.0001$
VAS 4-6 hrs	412	412	-0.99	-1.25 to -0.73	$p < 0.0001$
VAS 24 hrs	335	333	-1.23	-1.63 to -0.83	$p < 0.0001$

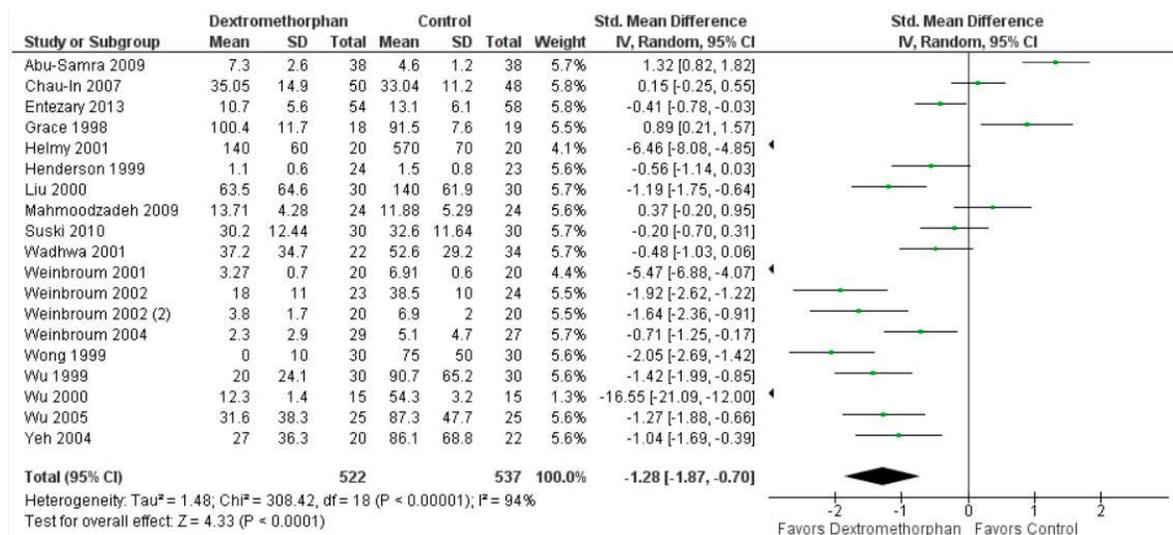


Figure 1: Forest plot of opioid consumption between DM and control groups

S-521.**SELF-REPORTED EXERCISE TOLERANCE AND PERIOPERATIVE MORBIDITY IN PULMONARY HYPERTENSION****AUTHORS:** A. C. Shah¹, A. Rooke¹, K. Ma², G. A. Van Norman¹**AFFILIATION:** ¹Anesthesiology & Pain Medicine, University of Washington, Seattle, WA, ²Surgical Outcomes Research Center, University of Washington, Seattle, WA**INTRODUCTION:** Patients with pulmonary hypertension (PHTN) presenting for elective surgery are at significantly higher risk for adverse perioperative outcomes, including increased hospital length of stay, right ventricular failure, cardiac arrhythmia, persistent postoperative hypoxemia, coronary ischemia and death.¹ The diagnosis of PHTN is based on costly echocardiographic examination and right heart catheterization and should be reserved for high risk patients. No studies have assessed the role of self-reported functional classification on PHTN severity stratification, and few studies have achieved a sufficiently large patient sample size.^{1,2} We evaluate the predictive value of self-reported exercise tolerance on echocardiogram findings, outcomes, and length of stay (LOS) after non-cardiac, non-obstetric surgery.**METHODS:** We queried the University of Washington AMALGA database for all PHTN seen in pre-operative anesthesia clinic for non-cardiac, non-obstetric procedures from April 2007 through September 2013. Inclusion criteria mandated an echocardiogram <1 year prior to the procedure and available patient-reported functional status (< or ≥ 4 METs). Univariate analyses were used to compare functional status with echocardiographic findings, complication rates, and length of stay (LOS). To date, we have collected information on 290 procedures in 178 PHTN patients (51.1% female, average age 61.8 +/- 14.4 years) with pre-operative evaluations and functional status (FS) classification, out of an estimated total of ~1500 patient charts.**RESULTS:** Poor self-reported exercise tolerance (FS < 4 METs; 94 patients/150 procedures) was associated with female gender (p=0.010), ASA class IV/V (p=0.05), as well as comorbidities including a history of ventricular dysrhythmias (p=0.003), DM (p<0.001), OSA (p=0.006) and CAD and prior PCI for CAD (p=0.004), lower baseline oxygen saturation on pulse oximetry (96.4% vs. 97.5%, p=0.010) and higher resting heart rates (79.4 vs. 72.7 bpm, p<0.001) Decreased left ventricular function was seen in a greater proportion of poor functional status patients (p=0.016). There was a statistically insignificant trend towards higher complication rates > 30 days post-hospital discharge in the FS < 4 METs subgroup (19.3% vs. 12.1%; p=0.108). Patients with FS < 4 METs had an insignificant trend towards hospital readmission >30 days after surgery (p=0.125), but demonstrated a greater LOS (9.01 +/- 16.7 vs. 5.39 +/- 8.37 days, p=0.026). In the entire cohort, three patients (1.7%) died more than 30 days after the procedure.**CONCLUSIONS:** Patient-reported functional status demonstrates associations with cardiopulmonary comorbidities and decreased left ventricular function in PHTN patients. Further data collection and multivariate analyses can help elucidate the role of reported exercise tolerance as an independent cost-effective predictor of cardiac function, post-operative complications and increased in-hospital care. Development of a risk stratification approach can guide decision-making regarding escalated diagnostic workup and management prior to surgery.**REFERENCES:**

1. Meyer S, McLaughlin VV, Seyfarth HJ, Bull TM, Vizza CD, Gomberg-Maitland M, Preston IR, Barberà JA, Hassoun PM, Halank M, Jaïs X, Nickel N, Hoeper MM, Humbert M. Outcomes of non-cardiac, non-obstetric surgery in patients with pulmonary arterial hypertension: results from an international prospective survey. *Eur Respir J.* 2013 Jun;41(6):1302-7
2. Ramakrishna G, Sprung J, Ravi BS, Chandrasekaran K, McGoon MD. Impact of pulmonary hypertension on the outcomes of noncardiac surgery: predictors of perioperative morbidity and mortality. *J Am Coll Cardiol.* 2005 May 17;45(10):1691-9

S-522.**HEMODYNAMIC IMPLICATIONS OF CARDIAC AUTONOMIC STATUS DURING ANESTHESIA INDUCTION IN PATIENTS WITH AND WITHOUT OBESITY**

AUTHORS: K. Anand¹, S. Ikramuddin², D. Walk³, M. Konia¹, E. Cingi¹, K. Sundarbose¹, I. Apostolidou¹

AFFILIATION: ¹Anesthesiology, University of Minnesota, Minneapolis, MN, ²Surgery, University of Minnesota, Minneapolis, MN, ³Neurology, University of Minnesota, Minneapolis, MN.

INTRODUCTION: Hemodynamic instability is a common complication during induction of general anesthesia (GA) and can lead to significant morbidity and mortality¹. Studies have shown that abnormalities of heart rate variability (HRV) place patients at higher risk of hemodynamic instability during GA². Obesity has been shown to be associated with sympathetic nervous system over activity and hence reduced HRV³. The objectives of the study were to analyze the association between various indices of ANS dysfunction and hypotension during standardized GA induction and the interaction effect between cardiac autonomic status and obesity on hemodynamic changes during GA induction. We hypothesized that the presence of abnormal indices of autonomic nervous system testing when associated with obesity increases the risk of hypotension during general anesthesia induction.

METHODOLOGY: We conducted a pilot prospective, observational study on 44 (25 with obesity and 19 without obesity) consecutive ASA I - III adult patients scheduled for elective surgery under standardized GA induction protocol. On the day of surgery, all consented participants underwent bedside autonomic nervous system (ANS) testing using a portable, noninvasive ANS monitor (ANX-3.0 Ansar, Philadelphia, PA). ANS indices included Total Spectral Power (TSP), Low frequency (Lf) and Respiratory frequency (Rf) variables of HRV during deep breathing, valsalva and standing. We analyzed the association between various indices of ANS dysfunction and hypotension (mean BP < 55 mmHg, systolic BP 20 mmHg from baseline) during anesthesia induction. Furthermore we explored the interaction effect between cardiac autonomic status and obesity on hemodynamic changes during anesthesia induction.

RESULTS: The average age of obese (46.5 years) vs. non-obese (45.7 years) was comparable. We found higher incidence of DM (24% vs. 0%), hypertension (28% vs. 0%) and greater ASA physical status in the obese patients vs. non-obese. Furthermore, several baseline HRV indices (TSP deep breathing, Lf deep breathing and Rfa deep breathing) were lower in the obese than the non-obese patients ($p < 0.05$) (Table 1). The incidence of hypotension during anesthesia induction between obese and non-obese patients was not significantly different (16.7% vs. 18.8% respectively). Neither the presence of an abnormal ANS measure nor obesity was associated with higher incidence of hypotension during general anesthesia induction.

CONCLUSION: In this pilot study, we found that hypotension during standardized anesthesia induction occurred with similar frequency in obese and non-obese population. The presence of an abnormal ANS measure using bedside monitor did not increase the risk of hypotension in obese patients. Further studies are needed to explore the significance of various degrees of ANS abnormalities in high-risk population perioperatively.

REFERENCES:

1. Anesth Analg (95); 2004:273-277.
2. Acta Anaesthesiol Scand (50); 2006:542-548.
3. Circulation (106); 2002:2533-2536.

Table 1: ANS indices significantly different between obese and the non- obese

ANS indices	Obese		p Value
	Yes	No	
Valsalva ratio	1.333±0.186	1.396±0.242	0.017
TSP deep breathing	2674.44± 2859.181	5394.632± 4608.159	0.020
Lf deep breathing	2213.8± 2388.249	4608.684± 3871.048	0.015
Rfa deep breathing	12.617± 16.796	31.392± 26.979	0.007

S-523.**ENHANCED RECOVERY AFTER SURGERY:
IMPLEMENTATION AND PRELIMINARY OUTCOMES FOR
COLORECTAL SURGERY AT A TERTIARY CARE CENTER****AUTHORS:** C. W. Shavit, J. Cheah, L. Chen**AFFILIATION:** Department of Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA**INTRODUCTION:** Enhanced Recovery After Surgery (ERAS) represents a multidisciplinary approach to standardize perioperative care and improve patient outcomes and hospital efficiency. ERAS pathways are directed to attenuate the surgical stress response, thereby enabling rapid recovery. Within the colorectal literature, ERAS protocols have been shown to reduce hospital length of stay (LOS) by 2.4 -2.5 days, with no difference in readmission or mortality.^{1,2,3}

We investigated the LOS, post-anesthesia care unit (PACU) time, pain scores, and frequency of adherence to ERAS protocol for colorectal surgery at a major tertiary care center.

METHODS: After CHR approval, data was collected for patients undergoing colorectal surgery after implementation of an ERAS pathway, from October 2013 to September 2014. These data were compared with those from a similar surgical cohort operated on in the year prior to the start of ERAS at our institution. The ERAS pathway protocolized adjunctive analgesics, regional anesthetic techniques, and rehabilitation goals (Table 1-2).

Student t-tests were performed to investigate potential differences in LOS, PACU recovery time, and pain scores on the visual analogue scale (VAS) from postoperative day (POD) 0-2. Adherence to the multimodal analgesia components of the ERAS protocol was also analyzed. Patients were considered to be adherent after receiving preoperative gabapentin that was continued till discharge, adjuvant pre-and postoperative acetaminophen, and a thoracic epidural infusion.

RESULTS: There were 453 patients in the pre-ERAS group and 133 in the ERAS group. The mean LOS in the pre-ERAS group was 9.6 days, and in the ERAS group it was 6.3 days (P=0.0018, SD= 11.8, 5.1). There were no differences in procedure length or the time to discharge from the PACU between the two groups. Postoperative VAS scores between the pre-ERAS and post-ERAS groups were 3.2 vs 1.9 on post-op day 0; 3.2 vs 2.3 on POD 1, and 3 vs 2.6 on POD 2, respectively (P= 0.0001, 0.0001, 0.108). Adherence to the ERAS protocol was 94.7% on POD 0; 97.6% on POD1; 86.3% on POD2.**CONCLUSIONS:** Our data show that implementation of an ERAS protocol for colorectal surgery is associated with a decreased LOS and pain scores. There was a significant reduction in VAS scores on POD 0 and POD 1; however no difference was observed by POD 2. This finding suggests that the analgesic benefits of the pathway are greatest during acute recovery.

Despite the involvement of multiple services in the execution of the ERAS pathway at our center, adherence to the approach to patient care was high, though adherence rates decreased throughout the post-operative course. This progressive decrease in adherence correlated with VAS score improvement and may suggest an associated relationship.

Further supporting prior evidence of successful ERAS programs for colorectal surgery: our integrative ERAS protocol, including multimodal analgesia, effectively reduced LOS and improved pain control for patients in the perioperative period.

REFERENCES:

1. Disease Colon and Rectum 2013; 56(5): 667-678
2. Clin Nutr 2010 Aug;29 (4):434-440.
3. Anesth Analg 2014;118:1052-61

S-523 • continued

ANESTHESIA		SURGERY		NURSING		PATIENT	
DAYS B4	PREPARE	Phone Consult: deliver instructions via MyChart or mail.	Informed Consent. Enter pre-op orders			Enroll in MyChart	
			Hand out brochure				
DOS. PRE-OP	ANALGESICS	Pre-Op Warming, PIV, Crystalloid @ 30 ml/hr	No bowel prep for right, transverse, colectomy	Please complete Pre-Op RN checklist 45 minutes prior to OR start time, then Green Light.	Nothing by mouth for eight hours before surgery except for a Boost Breeze completed 2 hours before coming to hospital		
	POPNY	Gabapentin 600mg once Acetaminophen 1000mg once Diclofenac (if eGFR>60) 100mg once Scopolamine 1.5mg TD once Age < 60 years	Nothing by mouth for eight hours before surgery except for a Boost Breeze completed 2 hours before coming to hospital.	Apply Warming Blanket to patient. Teach IS. IV Placed. Crystalloid started at 30ml/hr. Gabapentin 600, APAP 1000, Diclofenac given once with water (<100ml). Antiemetics may also be ordered.	Risks of surgery and anesthesia will be discussed. You will sign a consent for the procedure, and discuss the possibility of receiving blood products. If there is any chance you might be pregnant, please discuss with surgery and anesthesia		
REGI ONAL		30 minutes before start time, complete anesthesia assessment, go to Block Room, and place Thoracic Epidural placed at T8-10	Consent checked, Site Marking, and 24-hr H&P completed 40 minutes before OR start time.				
INTRA-OP	SCIP-VTE	Heparin 5000units SQ X 1 after epidural placement	If on steroids, ask for Hydrocortisone 100mg IV x 1				
		Orogastric tube to low intermittent suction.					
		Fluids: NTE 2L unless EBL>300ml,					
	SCIP-10	Patient temperature must not drop below 36.0 C.					
	SCIP-Inf-1,2	Antibiotic: Ertapenem 1 gram IV x 1					
MEDS		Opioid of Choice: Hydromorphone or Morphine. Titrate to RR 12bpm at time of extubation.					
		If Opioid-Tolerant, continue their opioid regimen intra-op. Start ketamine load and infusion. 0.2 mg/kg x 1. Then 2 mcg/kg/min.					
	POPNY	Dexamethasone 4mg IV x 1 after induction Metoclopramide 10mg IV X 1. Unless contraindicated. Ondansetron 4mg IV x 1					
REGI ONAL		Thoracic Epidural 0.0625% Ropi + Fentanyl 2 mcg/ml @ 8 ml/hr Bilateral TAP Block. 20ml of Ropi 0.2%. Done prior to prep & drape.					
PACU	MEDICATION	Order opioid of Choice: Hydromorphone or Morphine. May start PCA. Order Antiemetics		Hydromorphone or Morphine IV PRN Titrate to RR 10bpm Thoracic Epidural 0.0625% Ropi + Fentanyl 2 mcg/ml @ 8 ml/hr			
	REGI ONAL	Thoracic Epidural 0.0625% Ropi + Fentanyl 2 mcg/ml @ 8 ml/hr					
FLOOR/ICU POD 0	MEDICATIONS	Gabapentin 600mg PO QHS		Vital Signs q 4H, I&O shift, weight daily, surgical incision care abdomen,	Out of bed ad lib		
		Acetaminophen 1000mg IV q6H		Ambulation: OOB ad lib	Incentive Spirometry x15 q 1H		
		Toradol (if eGFR>60) 15mg IV q6H		Incentive Spirometry x15 q 1H			
		If Opioid-Tolerant, continue ketamine infusion 2 mcg/kg/min and maintain daily opioid req. PCA HM 0.2/10/0		Foley Catheter to gravity. DVT Proph: Heparin 5ku SQ TID			
	REGI ONAL	Thoracic Epidural 0.0625% Ropi + Fentanyl 2 mcg/ml @ 8 ml/hr		Clears. Gum chewing ok.	Clears. Gum chewing ok.		
FLOOR/ICU POD 1	MEDICATIONS	Gabapentin 600mg PO QHS	Famotidine	Vital Signs q 4H, I&O shift, weight daily, surgical incision care abdomen,	Walking 5 times a day. At least first time with nurse.		
		Acetaminophen 1000mg IV/PO q6H	Labs: CBC, Cr, BUN	Ambulation: OOB to chair (3hrs) BID Ambulation 5 x per day	Incentive Spirometry x15 q 1H		
		Toradol OR 15mg IV q6H Diclofenac (eGFR) 50mg PO TID		Incentive Spirometry x15 q 1H			
		If Opioid-Tolerant, continue ketamine infusion 2 mcg/kg/min and maintain daily opioid req. PCA HM 0.2/10/0		Remove Foley Catheter in AM DVT Proph: Heparin 5ku SQ TID			
	REGI ONAL	Thoracic Epidural 0.0625% Ropi + Fentanyl 2 mcg/ml @ 8 ml/hr		Advance to Soft Diet. Gum chewing ok.			
FLOOR/ICU POD 2	MEDICATIONS	Gabapentin 600mg PO QHS	Famotidine	Vital Signs q 4H, I&O shift, weight daily, surgical incision care abdomen,	Walking 5 times a day. At least first time with nurse.		
		Acetaminophen 1000mg IV/PO q6H	Nutrition Consultation	Ambulation: OOB to chair (3hrs) BID Ambulation 5 x per day	Incentive Spirometry x15 q 1H		
		Toradol OR 15mg IV q6H Diclofenac (eGFR) 50mg PO TID	Hold 6AM Heparin dose	Incentive Spirometry x15 q 1H			
		If Opioid-Tolerant, continue ketamine infusion 2 mcg/kg/min If Opioid-Tolerant, continue their daily opioid requirement.		DVT Proph: Heparin 5ku SQ TID			
	REGI ONAL	STOP epidural infusion at 6AM. Catheter to be removed at 8AM.		Advance to Regular Diet	Advance to Regular Diet		

Resident Abstracts

Regional Anesthesia

S-524.**BILATERAL LOWER EXTREMITY BLOCKS FOR ABOVE THE KNEE AMPUTATIONS IN PATIENT WITH GANGRENE AND MULTIPLE CO-MORBIDITIES****AUTHORS:** J. Rivera¹, J. J. Gonzalez²**AFFILIATION:** ¹Anesthesiology, Montefiore Medical Center, Bronx, NY, ²Anesthesiology, Cleveland Clinic, Cleveland, OH

INTRODUCTION: Patients with multiple comorbidities are common in vascular surgery and cannot often be optimized for necessary procedures. Peripheral nerve blockades provided the desired conditions for amputation surgery with hemodynamic stability but are limited by local anesthetic toxicity concerns if large doses are needed. With above the knee amputation (AKA) a significant dose is necessary.

We describe a patient receiving bilateral AKA for gangrene that benefited from sequential blockade using long and short acting local anesthetics.

CASE REPORT: A 59 year old female (152cm, 62.1kg) with history of DM, ESRD, PVD, CAD, Pulmonary HTN, AS(AVA 0.95 cm²) and systolic CHF with ejection fraction of 30% with MI within 30 days on aspirin and clopidogrel who urgently needed bilateral AKA. A discussion was held with the surgeon for possible staging due to the local anesthetic dose needed for bilateral AKA. The surgeon said that both legs were infected and there was a concern for sepsis.

After an arterial line was placed, bilateral US guided intraneural popliteal blocks using 0.375% 20cc with 2mg dexamethasone on each side and femoral nerve blocks using mepivacaine 1.5% 20cc and 2mg dexamethasone were placed. After 90 minutes, a 1:1 mixture of Chloroprocaine 3% and mepivacaine 1.5% 1:1 used for bilateral obturator (anterior and posterior division) and lateral femoral cutaneous nerve blocks using 10cc of mixture at each site. A total of 4mg of midazolam and 25mcg fentanyl were used for sedation in this apprehensive patient.

The surgery began without any sensation on incision yet had discomfort on deep muscle incision in the inner right thigh which resolved with titration of 50 mg of ketamine. Additional intraop medications included 2mg midazolam and titration of 100 mcg of fentanyl at closing. In the PACU, the patient was comfortable and required 75mcg fentanyl for analgesia.

Bilateral nerve block for AKA requires a significant amount of local anesthetic that may not be tolerated in patients, especially with cardiac conditions. We decided to space the placement of the blocks to decrease total peak dose. We also decided to use longer acting bupivacaine and intermediate mepivacaine with dexamethasone on the nerve blocks to the more important nerves (femoral and sciatic nerves). After time for the initial absorption of the first bolus to resolve, we used mepivacaine mixed with short acting, safer chloroprocaine just prior to incision. Only partial blockade of the right obturator was obtained but was able to be rescued with titration of analgesic.

CONCLUSION: We were able to safely perform this procedure by using intraneural injection, timing the placement of nerve block and using a shorter local anesthetic with better safety profile. Due to the history of recent MI, pulmonary HTN and aortic stenosis, it was best to avoid general anesthesia and spinal anesthesia.

REFERENCES:

- Feldman HS. Toxicity of local anesthetic agents. In: Rice, SA, Fish KJ, eds. *Anesthetic Toxicity*. New York, NY: Raven Press 1994.
- Kalichman, MW. Physiologic mechanisms by which local anesthetics may cause injury to nerve and spinal cord. *Reg Anesth*. 1993;18(6 Suppl):448-452

S-525.**PARASACRAL SCIATIC NERVE BLOCK VERSUS LABATT SCIATIC NERVE BLOCK FOR HIP ARTHROSCOPY****AUTHORS:** B. Kornblatt, J. D. Jaffe, D. Henshaw, R. Weller**AFFILIATION:** Anesthesiology, Wake Forest Baptist Hospital, Winston-Salem, NC

INTRODUCTION: Hip arthroscopy is performed as a minimally invasive approach to treating hip injuries¹. Surgical incisions, muscle spasms and tissue distention can contribute to postoperative pain in patients undergoing this procedure². Multiple therapies to address postoperative pain in this cohort of patients³ have been studied, including neuraxial analgesia^{7,8}, peripheral nerve blockade, systemic opioids, benzodiazepines, and non-opioid pharmacotherapies. We hypothesized that the more proximal parasacral approach to sciatic nerve blockade would provide superior postoperative pain control compared to Labat-approach sciatic nerve blockade when combined with a lumbar plexus block for patients undergoing hip arthroscopy. Primary outcome was 24 hour opioid consumption and secondary outcomes were pain scores in the PACU.

METHODS: After approval by the institution's internal review board, a retrospective chart review was performed of 140 patients, ages of 18 to 75, who underwent unilateral hip arthroscopy and received either a parasacral sciatic nerve block^{4,5} or a Labatt trans-gluteal sciatic nerve block^{4,6} for postoperative analgesia. All patients received a lumbar plexus block as part of their analgesic regimen⁹. Data collected and analyzed consisted of: demographic data, data related to regional anesthesia procedures, total opioid administered in the post anesthesia recovery room (PACU) and over the first 24 hours following PACU discharge, pain scores preoperatively and for the first 24 hours postoperatively. Opioid consumption and pain scores were compared between the two groups using Wilcoxon Rank-Sum tests.

RESULTS: All nerve blocks were performed with the same local anesthetic solution along with general anesthesia. Opioid administration was not significantly different between the two groups in the PACU and in the first 24 hours postoperatively. Additionally, median pain scores in PACU and over the 24 hour period following PACU discharge were similar for both groups of patients.

CONCLUSIONS: Parasacral and Labatt trans-gluteal sciatic nerve blocks, when combined with lumbar plexus blockade, provided patients with similar postoperative analgesia following hip arthroscopy. No significant differences were discovered between the two approaches to sciatic nerve blockade. Further research is indicated for elucidating the potential long term benefits of a regional anesthetic technique for the provision of postoperative analgesia in patients who present for hip arthroscopy.

REFERENCES:

1. *Anesthesia & Analgesia* 2012;115:968-72
2. *J Clin Anesth* 2008;20:462-5
3. *Am J Sports Med* November 2003;31:1020-1037
4. *Miller's Anesthesia* 2005,52, p 1639-1674
5. Gaertner, Elizabeth, MD. "Parasacral Nerve Block." *The Journal Of The New York School Of Regional Anesthesia*(2006)
6. "Transgluteal/Anterior Approach." NYSORA. New York School Of Regional Anesthesia, n.d. Web. 23 Jul. 2013
7. *Anesthesiology* 2000;93:115-21
8. *Br J Anaesth* 2008;101:750-60
9. *Anesthesia&Analgesia* 2002;94:1606-13

S-526.**QUANTIFICATION OF VENOUS PRESSURES DURING INTRAVENOUS REGIONAL ANESTHESIA**

AUTHORS: B. Farhang¹, A. Lesiak², D. Ianno³, A. Shafritz⁴, C. Viscomi³

AFFILIATION: ¹Anesthesiology, University of Vermont FAHC, Colchester, VT, ²Orthopedic, University of Vermont FAHC, Colchester, VT, ³Anesthesiology, University of Vermont FAHC, Burlington, VT, ⁴Orthopedic, University of Vermont FAHC, Burlington, VT

INTRODUCTION: Intravenous Regional Anesthesia (IVRA) is utilized for upper extremity surgery. Higher tourniquet pressures and longer inflation time increase the risk of soft tissue injury. We investigated the duration and magnitude of elevated venous pressure during IVRA to assess the possibility of safely lowering the tourniquet pressure during surgery.

MATERIALS & METHODS: After IRB approval and informed consent, 20 adult patients scheduled for distal upper extremity surgery were studied. Two IV catheters were placed in the surgical arm: the hand for IVRA, and the antecubital fossa, which had a digital pressure transducer for monitoring venous pressure. The limb was elevated, exsanguinated with an Esmarch bandage, and then an upper arm tourniquet was inflated to 300 mm Hg. Local anesthetic (LA) was injected over two minutes (40cc in females, 50cc in males). Venous pressure was recorded prior to injection and every 30 seconds after injection of LA for twenty minutes or until the completion of surgery.

RESULTS: All 20 subjects completed the study without complication. Group demographics were equivalent. No associations were discovered between venous pressures and systemic blood pressure, patients' height, BMI, or age. The mean tourniquet time was 21 minutes (range 16.5-41.5 minutes). Mean peak venous pressure was 75 mmHg, occurring at 1.5 minutes following LA injection. Peak venous pressure was 340 mmHg in one patient and lasted for less than 30 seconds. Mean venous pressure fell below systolic blood pressure after 4.5 minutes in all cases except one. This patient had elevated venous pressures (153-248 mmHg) for 24 of 25 minutes of tourniquet time exceeding systolic blood pressure by 30-130 mmHg. It took 11.5 minutes (range 0-20 minutes) for the mean venous pressure to fall below and remain below 40 mmHg.

CONCLUSIONS: Tourniquet pressures during IVRA are critical in the prevention of LA toxicity. We found that the mean peak venous pressure was below systolic blood pressure in only 14 of the 20 subjects, and the peak injection pressure exceeded 300 mmHg in one patient. Another patient's venous pressure remained above systolic blood pressure for 24 of 25 minutes of tourniquet time. Current precautions to prevent LA toxicity may be insufficient in some patients and attempts to lower tourniquet pressures to just above systolic blood pressures soon after IVRA injection may result in toxicity.

REFERENCES:

1. Bier A. A new method for local anaesthesia in extremities. *Annal Surg* 1908;48:780-781.
2. Brown EM, McGriff JT, Malinowski RW. Intravenous regional anaesthesia (Bier block): review of 20 years' experience. *Can J Anaesth* 1989;36:307-310.
3. Chan VW, Peng PWH, Kaszas Z, Middleton WJ, Muni R, Anastakis DG, et al. A comparative study of general anaesthesia, intravenous regional anaesthesia, and axillary block for outpatient hand surgery: clinical outcome and cost analysis. *Anesth Analg* 2001;93:1181-1184.
4. El-Hassan KM, Hutton P, Black AM. Venous pressure and arm volume changes during simulated Bier's block. *Anaesthesia*. 1984 Mar;39(3):229-35.
5. Finnegan BA, Bukht D, Strunin L. Venous pressures in simulated Bier's block. *Anaesthesia*. 1984 Nov;39(11):1149-50.
6. Grice SC, Morell RC, Balestrieri FJ, Stump DA, Howard G. Intravenous regional anaesthesia: evaluation and prevention of leakage under the tourniquet. *Anesthesiology*. 1986 Sep;65(3):316-20.
7. Noordin S, McEwen JA, Kragh JF Jr, Eisen A, Masri BA. Surgical tourniquets in orthopaedics. *J Bone Joint Surg Am*. 2009 Dec;91(12):2958-67.
8. Oragui E, Parsons A, White T, Longo UG, Khan WS. Tourniquet use in upper limb surgery. *Hand*. 2011;6: 165-173.
9. Wakai A, Winter DC, Street JT, Redmond PH. Pneumatic Tourniquets in Extremity Surgery. *J Am Acad Orthop Surg*. 2001;9:345-51.

Resident Abstracts

Sleep Medicine

S-527.

SEMI-UPRIGHT POSITION DURING SLEEP PREVENTS POSTOPERATIVE WORSENING OF APNEA HYPOPNEA INDEX IN PATIENTS WITH SUPINE-RELATED OBSTRUCTIVE SLEEP APNEA (OSA)

AUTHORS: M. Singh¹, A. Yadollahi², P. Liao¹, W. Kang¹, S. Islam¹, F. Chung¹

AFFILIATION: ¹Department of Anesthesia, Toronto Western Hospital, University Health Network, Toronto, ON, Canada, ²Sleep Research Laboratory, University Health Network-Toronto Rehabilitation Institute, Toronto Rehabilitation Institute, Toronto, ON, Canada

BACKGROUND: The severity of obstructive sleep apnea (OSA) has been shown to increase postoperatively.¹ Elevated head position has been used in management of OSA in the general population,² but not postoperatively. In this pilot trial, we hypothesized that use of a semi-upright position versus a non-elevated position will prevent postoperative worsening of OSA in patients undergoing non-cardiac surgeries.

METHODS: Following research ethics board (REB) approval, adult patients (>18 years), ASA I-IV, undergoing elective inpatient surgery, were consented to undergo a home portable polysomnography (PSG). Patients with OSA (AHI >5 events/h), were randomized into Group E (semi-sitting position, 45 degrees incline), or control group C (no head-end elevation). The bed angle was measured by using in-built bed-angle indicator or a goniometer, at the beginning and end of night. All patients were monitored for three postoperative nights using oximetry and underwent a PSG on postoperative night 2 (N2) or night 3 (N3). Primary outcome was postoperative AHI. Subgroup analysis was performed for patients with supine-related OSA (sr-OSA) defined as preoperative overall AHI > 5 events/h, and supine AHI more than two times the non-supine AHI.³ ANCOVA analysis was used to compare change of AHI from baseline between two groups.

RESULTS: Eighty-three OSA patients undergoing mainly orthopedic and general surgeries were randomized (Group P: 41; Group C: 42). There was no difference in baseline demographics and comorbidities between two groups. Forty-six patients (Group P: 25; Group C: 21) completed PSG on postoperative N2/N3. The AHI and oxygen desaturation index (ODI) increased postoperatively within the groups, indicating worsening of severity of OSA (Table 1). Intention-to-treat analysis showed no significant difference was observed in AHI or ODI on postoperative N2 or N3 between two groups (p >0.05) (Table 1). Subgroups analysis showed that patients classified as sr-OSA (n=12) had a significantly lower AHI postoperatively in the semi-sitting position than those who were not (n=34), (p<0.05). (Figure 1)

CONCLUSION: This pilot trial demonstrated feasibility of use of semi-sitting position amongst OSA patients postoperatively. Patients with supine-related OSA versus non-supine related OSA had a significantly lower AHI postoperatively in the semi-sitting position. Future trials with sufficient power are needed to establish this relationship further.

REFERENCES:

1. Anesthesiology. 2014; 120: 287-98;
2. Am Rev Respir Dis. 1986; 133; 662-6;
3. Sleep Med Rev. 2014; 18: 7-17.

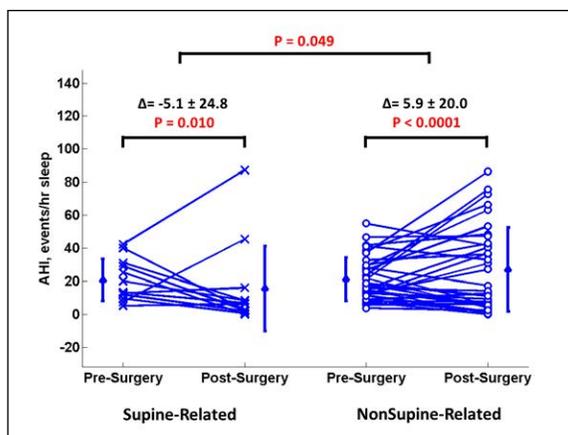


Figure 1. The effect of semi-upright body position on the apnea-hypopnea index (AHI) in patients with supine-related OSA (n=12), compared with patients with no supine-related OSA (n=34). The postoperative AHI decreased significantly in patients with supine-related OSA compared those without (P<0.05).

Table 1. Effect of semi-sitting position on various sleep related parameters compared to the supine position (Control).

Variable	Supine (n=25)			Semi sitting (n=21)			Between Group (P-value)
	Pre-Surgery	Post-Surgery	Within group (P-value)	Pre-Surgery	Post-Surgery	Within group (P-value)	
AHI	20.2±14	25.0±26	0.001	22.0±11	22.9±27	<0.001	0.741
ODI	21.8±13	25.0±23	0.001	22.0±13	24.5±26	<0.001	0.281

AHI: Apnea-hypopnea Index, RDI: Respiratory disturbance Index, ODI: Oxygen desaturation index.

Resident Abstracts

Technology,
Computing and Simulation,
Equipment Monitoring

S-528.**BLOOD VOLUMES CONTAINED WITHIN SURGICAL SPONGES AT THE END OF SURGERY****AUTHORS:** G. Konig¹, A. Hosford², S. Satish², J. Waters¹**AFFILIATION:** ¹Anesthesiology, University of Pittsburgh Medical Center, Pittsburgh, PA, ²Gauss Surgical, Los Altos, CA.**INTRODUCTION:** When making estimates of intraoperative blood loss, the anesthesiologist must estimate the amount of blood contained within suction canisters, surgical sponges, surgical drapes, and on the operating room floor. Quantitative measurements of the blood contained within surgical sponges are rarely made. The objective of this study was to make quantitative measures of the volume of blood contained within surgical sponges at the end of common surgical procedures.**METHODS:** Prospective cohort study of the Hb content of surgical sponges. Consecutive cesarean section (C/S), abdominal (GI), hysterectomy, liver resections, and total hip replacement (ortho) surgeries were enrolled. Total blood volume contained within each sponge used during the surgical case was measured and totaled for the surgical case using a previously validated visual-algorithm system^{1,2}. Cases were grouped by type, and reported as mean, standard deviation (SD), median, 25th percentile, 75th percentile, and interquartile range (IQR).**RESULTS:** A total of 68 surgical cases were enrolled (30 C/S, 12 GI, 7 hysterectomy, 7 liver, 12 ortho). The mean volume of blood for c/s were 369mL, SD 198mL, median 312mL (245mL, 454mL, IQR 209mL). The mean volume of blood for GI cases were 205mL, SD 202mL, median 121mL (57mL, 287mL, IQR 231mL). The mean volume of blood for hysterectomies were 102mL, SD 62mL, median 112 (55mL, 144mL, IQR 89mL). The mean volume of blood for liver resections were 426mL, SD 275mL, median 460mL (229mL, 534mL, IQR 305mL). The mean volume of blood for total hip replacements were 84mL, SD 112mL, median 53mL (40mL, 65mL, IQR 25mL).**CONCLUSIONS:** There is a significant amount of blood contained within surgical sponges at the end of surgery in many common surgical procedures. An accurate estimated blood loss for the surgery should include a measure of the blood contained within the surgical sponges removed from the field.**REFERENCES:**

1. Anesth Analg. 2014 Sep;119(3):595-600
2. Anesth Analg. 2014 Sep;119(3):588-94

S-529.

**ACQUISITION OF BASIC AND RESCUE
TRANSESOPHAGEAL ECHOCARDIOGRAPHY SKILLS
AND KNOWLEDGE BY NOVICE ANESTHESIOLOGY
RESIDENTS USING HIGH-FIDELITY SIMULATION**

AUTHORS: D. P. Kirby, L. A. Sueda, R. Fagley, J. D. Helman, C. Hoaglan, F. Salinas

AFFILIATION: Anesthesiology, Virginia Mason Medical Center, Seattle, WA

INTRODUCTION: Simulation-based medical education has proven to be beneficial to trainees; it provides a controlled environment that fosters proficiency in team communication, acquisition of procedural skills, and strengthening of clinical knowledge^{1,2,3}. Mannequin-based transesophageal echocardiography (TEE) simulators are powerful teaching tools that can play a major role in resident education. TEE simulators allow for a standardized approach to teaching normal anatomy and common pathology in addition to providing trainees with the opportunity to increase their manual dexterity skills^{4,5}. Bose et al⁶ demonstrated enhanced cognitive skill acquisition of basic TEE concepts after simulation training. Ferrero et al⁷ showed that, after a single, 45-minute training session, simulation-trained residents outperformed their traditionally trained counterparts in obtaining quality echocardiographic images when tested on actual patients. The current study was undertaken to test the hypothesis that a 5-week, TEE-simulation training program would be more effective at facilitating resident learning of basic and rescue TEE skills, both cognitive and technical, when compared to traditional lectures.

METHODS: To minimize exposure to prior TEE training, this study was designed to include only first year anesthesiology (CA-1) residents and will be conducted over the course of two years to enable sufficient statistical powering. To date, nine TEE-naïve CA-1 residents have participated in the study. Each was randomly assigned to either the simulation or the traditional lecture group. Over the course of five weeks, both groups received five sixty-minute training sessions that followed the National Board of Echocardiography’s content outline for basic TEE. Each participant took a written pre-test prior to the commencement of the sessions as well as a written and practical skills test after the conclusion of the sessions.

RESULTS: For power purposes, inferential statistical analyses are being postponed until study completion. The raw data and descriptive statistics from the cognitive skills test can be found in Tables 1 and 2, respectively. A visual representation of the raw data acquired from the technical skills tests for the traditional and simulation groups can be found in Figures 1 and 2, respectively.

CONCLUSIONS: Given the limited sample size at this stage of our study, it would be imprudent to make any broad generalizations. With this caveat in mind, it is safe to say that the preliminary data are hinting at a trend towards better performance in the simulation group on both the written cognitive and the practical skills tests. If supported by further data, this trend argues in favor of incorporating more simulation-based training exercises into residency training rather than more conventional lectures.

REFERENCES:

1. Anesthesiology 205; 103: 241-248.
2. Anesthesiology 2010; 112: 202-211.
3. Anesth Analg 2012; 114: 626-633.
4. J Cardiothorac Vasc Anesth 2011; 25: 177-181.
5. J Cardiothorac Vasc Anesth 2009; 23: 544-548.
6. J Cardiothorac Vasc Anesth 2011; 25: 212-215.
7. Anesthesiology 2014; 120: 149-159.

Table 1. Cognitive skills test raw scores (#correct out of 30 questions).

		PRE-TEST	POST-TEST
		*CA1-1	14
SIMULATION GROUP	CA1-3	16	16
	CA1-5	16	18
	CA1-7	15	15
	CA1-9	15	19
	CA1-2	15	13
TRADITIONAL GROUP	CA1-4	13	13
	CA1-6	13	14
	CA1-8	11	9

*CA1= Clinical Anesthesiology Year 1

Table 2. Descriptive statistics of cognitive skills test performance.

	PRE-TEST			POST-TEST		
	MEAN	S.D.	VAR	MEAN	S.D.	VAR.
COMBINED	14.22	1.64	2.69	15.56	4.07	16.53
SIMULATION	15.20	0.84	0.70	18.20	3.11	9.70
TRADITIONAL	13.00	1.63	2.67	12.25	2.22	4.92

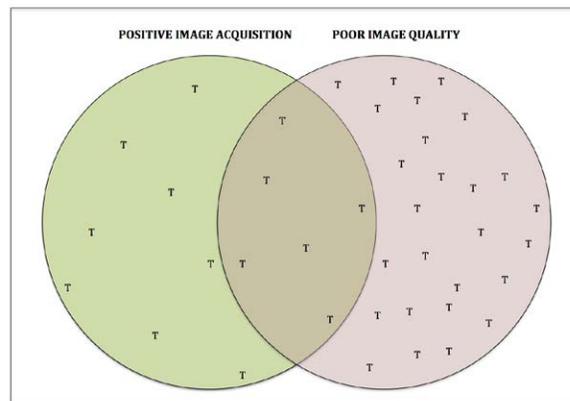


Figure 1. Venn diagram representing the raw data results of the Traditional (T) Group’s TEE skills test (n=4; TEE views x 10).

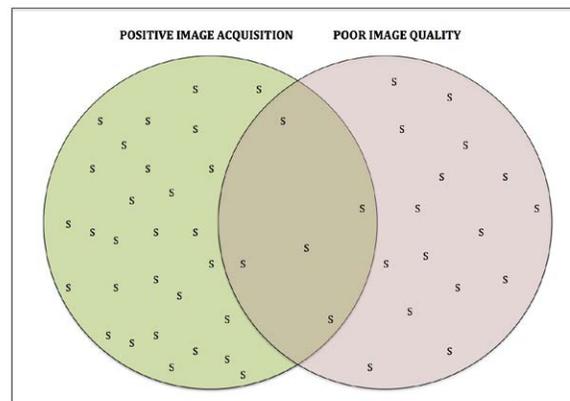


Figure 2. Venn diagram representing the raw data results of the Simulation (S) Group’s TEE skills test (n=5; TEE views x 10).

S-530.**PROCESS IMPROVEMENTS FOR TIMELY INITIATION OF EPIDURAL INFUSION FOR POST-OPERATIVE PAIN CONTROL****AUTHORS:** A. C. Shah, M. McGauvran, B. Nair, L. Bollag**AFFILIATION:** Anesthesiology & Pain Medicine, University of Washington, Seattle, WA

INTRODUCTION: Preoperative epidural catheters placed for post-operative pain management are often started only after the end of surgery. Consequences of delayed epidural initiation include increased post surgical pain and prolonged recovery room time, and it is thus recommended that continued infusions for post-operative pain management be started early on during surgery.¹ A baseline audit of patients in our institution receiving pre-operative epidurals revealed that the infusions were started pre or intra-operatively only 57% of the time. We describe process enhancements through pharmacy-based interventions and electronic alerts to improve compliance in starting epidural infusion prior to end of surgery.

METHODS: A comprehensive review of pharmacy and equipment supplies and locations was performed and a number of institution-specific changes were made to the epidural infusion workflow including alterations to how the processing and delivering of the infusions as well as making epidural infusion equipment easier to access. Additionally, we used an Anesthesia Information Management System (AIMS)-based decision support system called Smart Anesthesia Manager (SAM), to institute a computer reminder system to encourage the timely initiation of post-operative pain control epidurals. In order to assess the above changes, anesthesia provider placing epidural catheters were encouraged to fill out a short survey. This survey served as a documentation of post-operative patient-reported pain scores. Survey data was collected during the pre-intervention (9/22/14 to 10/30/14) and post-intervention phase (10/31/14 to 12/11/14). Obstetric cases were excluded from the study.

RESULTS: 65 survey sheets were collected, 39 before and 23 after the intervention. Pre-intervention, 27/39 (=69%) epidural infusions were started pre or intra-operatively. Post-intervention, 21/23 (91%) epidural infusions were started pre or intra-operatively, representing a modest increase in initiation rate (p=0.06).

Averaged maximum PACU pain scores were 5.7 +/- 3.6 (timely initiation) compared to 7.2 +/- 4.0 (late initiation); p=0.26. Averaged observed pain scores at the time of recovery room departure were 3.0 +/- 2.3 (timely initiation) compared to 4.5 +/- 2.5 (late initiation); p=0.06.

CONCLUSION: The pharmacy-based process intervention and electronic alerts produced a 22% increase in timely initiation of epidurals either pre or intra-operatively. This also coincided with a slight decrease in post-operative pain scores, especially at the end of recovery room stay. Further data collection is needed to truly ascertain the significance of earlier epidural initiation on the post-operative recovery room course.

REFERENCES:

1. Andreae MH, Andreae DA. Local anaesthetics and regional anaesthesia for preventing chronic pain after surgery. The Cochrane database of systematic reviews 2012;10:CD007105.

S-531.

ASSESSMENT OF RIGHT VENTRICULAR FUNCTION USING FLOTRAC/VIGILEO CARDIAC OUTPUT MONITOR

AUTHORS: K. Kassel, S. R. Musuku, S. Pani;

AFFILIATION: Anesthesiology, Albany Medical Center, Albany, NY

BACKGROUND: Left ventricular function is assessed using different cardiac output (CO) monitors in the operating rooms. They may be intermittent or continuous devices. Transesophageal echocardiography (TEE) is an intermittent method and Swan-Ganz is a continuous method. FloTrac Edward’s continuous CO monitor is also used to continuously monitor CO, SV. In addition this device displays stroke volume variation (SVV) in percentage (Normal SVV<12%). SVV is an indicator of preload, the higher the number the lower the preload of the patient. Presently this device is designed for the high pressure arterial system.

On the other hand the right ventricular (RV) function monitoring is not routinely performed. Monitoring RV function may be important in cardiac cases especially in severe biventricular dysfunction, pulmonary hypertension and left ventricular assist device insertion. We intended to continuously monitor and quantify the right ventricular function using the FloTrac EV1000 cardiac output monitor. In our study the FloTrac Transducer is connected to the pulmonary artery line to analyze the pulmonary artery trace to display CO, SV and SVV.

PURPOSE: The primary purpose of this study is to obtain proof of concept that CO, SV and SVV can be accurately and reliably measured in the low pressure right ventricular track using the FloTrac EV1000, designed for the high pressure left ventricular track.

This preliminary study has an IRB approval and consented by the patients. The FloTrac data generated was not used for managing patients.

METHODS: Ten adult patients under general anesthesia scheduled for elective cardiac surgery requiring pulmonary arterial catheter, mechanical ventilation using set tidal volume (6-7mL/kg) and respiratory rate (12-14/min) as standard of care, were studied. No additional interventions were performed as a part of the study. The FloTrac pressure transducer was connected to the pulmonary artery line on the Swan Ganz catheter and the Edwards EV1000 monitor was calibrated. The data collected included Cardiac Output, Stroke Volume, and Stroke Volume variation from the EV1000 monitor display. An average of over 300 readings per subject as the FloTrac records readings every 20 seconds. Although Cardiac Index, Stroke Volume Index and Vascular Resistance were also displayed, these parameters are not included in this report.

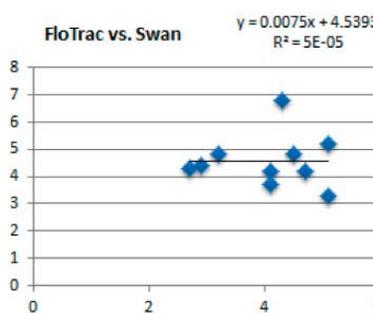
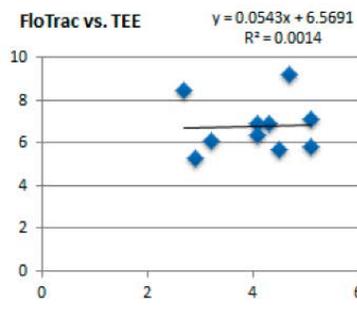
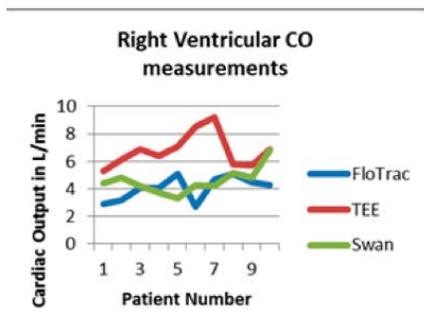
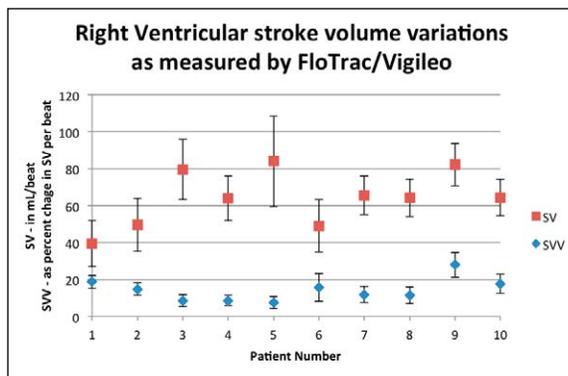
RESULTS AND DISCUSSION: The Cardiac Output (CO), Stroke volume (SV) and stroke volume variation (SVV) values for the right ventricle as obtained from the FloTrac/Vigileo system are presented in Table 1 and Figure 1. Ranges for these values from the right ventricles were: 2.9 - 5.1 L/Min, 39.5 - 84.0 ml/beat and 7.5 - 27.9%, respectively. The SVV values were generally inversely related to the SV values. Stroke volume variation (SVV) is an indicator of preload when connected to arterial trace. Although no right ventricular SVV values have been reported in the literature, it may be important to note from the figure that the SVV varies inversely with the stroke volume and cardiac output. This may be a better preload indicator than when the FloTrac transducer is connected to the arterial trace.

Right ventricular CO and SV obtained by this FloTrac method may not be compared to the other modalities like the TEE and Swan-Ganz catheter used in the operating room. TEE measurements are intermittent and Swan-Ganz catheter is a continuous cardiac output monitoring. In addition Swan-Ganz has a lag time of at least 60 seconds to display the cardiac output. In our preliminary observation, we found no correlation between the three different modalities. The comparison and correlation are shown in the figure 2.

CONCLUSION: The FloTrac pressure transducer can monitor right ventricular CO and SV from the pulmonary artery trace. SVV varies inversely with the stroke volume even when FloTrac is used to analyze the pulmonary artery trace. The FloTrac measurements may not be comparable to the other measurements obtained using the TEE or the Swan-Ganz catheter.

REFERENCES:

1. Edwards Life sciences: <http://www.edwards.com/Pages/Default.aspx>
2. <http://www.edwards.com/products/mininvasive/pages/flotracsensor.aspx>



Resident Abstracts

Trauma

S-532.**ONE CASE OF CONTRAST-ENHANCED POSTMORTEM COMPUTED TOMOGRAPHY IN WHICH CONTRAST MEDIA WAS ADMINISTERED THROUGH A BONE MARROW LINE****AUTHORS:** M. Tada, K. Tateoka, E. Ijiri, K. Hayashi**AFFILIATION:** Anesthesia, Nayoro city general hospital, Nayoro, Japan.**INTRODUCTION:** In the area of emergency medical care, it is hard to establish an intravenous line for severe cases such as cardio-respiratory arrest. The bone marrow puncture allows establishing an intravenous line as well as safe, simple administer of drugs for all ages. In the case of trauma death, it is possible to posthumously perform computed tomography (CT) to investigate the cause of death.

We hereby report our hospital's case of contrast-enhanced postmortem CT (CEPMCT) where contrast media was injected from a bone marrow line.

METHODS: A 70s-year-old male patient was transferred to the emergency department. He was crushed during work in a plastic greenhouse in April, 2014 by the house which collapsed with snowy heaviness. His family discovered the patient who fell down with the head bent forward and requested emergency help.

The emergency rescue team upon arrival confirmed the condition was cardiopulmonary arrest. With securing the intravenous line proving difficult, We simply secured the bone marrow line with the right tibial tuberosity. Continuing cardiopulmonary resuscitation and injecting epinephrine (total 3mg) with no reaction, we confirmed his death. The parents consented to performance of CEPMCT with which we investigate a cause of death. While injecting a contrast media from the bone marrow line the chest compressions was performed for 2 minutes at a 100 times/min(a total of 200 times), and the CT scanned.

RESULTS: Only the right-sided vessels(for example; Pulmonary artery) were enhanced. But the left-sided vessels(for example; ascending aorta) were not enhanced as we expected. Without the findings of the CEPMCT scan the cause of death was considered to be suffocation by thoraco-abdominal compression from the presence of ecchymosis of palpebral conjunctiva and the information from the scene.**CONCLUSIONS:** We performed securing of intravenous infusion line with the marrow needle for a cardiopulmonary arrest case and we performed CEPMCT with injecting contrast media from the marrow line because we investigate the cause of death. We could not enhance the left-sided vessel but the right-sided vessel, so it suggested that we are able to perform CEPMCT with injecting contrast media from the marrow line.

At the present we are allowed to secure the intravenous line with the marrow needle for all age groups. When we can not secure the intravenous line from peripheral vessel, we can secure more and more the marrow line, so we can increasingly perform CEPMCT with the marrow line. Therefore it is necessary to maintain it to enforce good contrasting PMCT of the precision.

It was found that CEPMCT was possible even with administration of the contrast media from the bone marrow lines. It suggests that it is possible to expand the diagnostic range by developing image capturing conditions such as chest compression and so on.

REFERENCES

SpringerPlus 2:663 2013

Best Medically Challenging Case

Liver

MC-102.

REFRACTORY HYPOTENSION DURING SURGERY CAUSED BY SEPTIC SHOCK AND HEPATIC CYST COMPRESSION ON RIGHT ATRIUM IN A WOMAN WITH POLYCYSTIC KIDNEY DISEASE

AUTHORS: J. Tan, H. R. Abdullah

AFFILIATION: Department of Anaesthesiology, Singapore General Hospital, Singapore, Singapore

ABSTRACT: A lady with Polycystic kidney and liver disease underwent an Open fenestration of infected hepatic cysts. Intra-operatively, she became severely hypotensive and did not improve despite aggressive resuscitation with multiple vasopressors, suggesting vasoplegic syndrome from septic shock. Intra-operative transthoracic echocardiography (TTE) also revealed a large hepatic cyst compressing on the right atrium (RA), severely reducing venous return and aggravating the hypotension. This report demonstrates 1) the early recognition and management of a decompensated fixed cardiac output obstruction caused by massive hepatic cysts and 2) the management of vasoplegic syndrome including the use of Methylene blue (MB).

A 64 year old ASA status II lady with Polycystic kidney and liver disease underwent an Open fenestration of infected hepatic cysts. Pre-operative TTE and computed tomography (CT) (Fig.1) showed a few hepatic cysts adjacent to the RA but not causing significant compression on it. As soon as the infected cysts were infiltrated (Fig.2), she turned severely hypotensive from massive bacteremia, requiring multiple vasopressors to support her blood pressure (Fig. 3,4). Focused intra-operative TTE was done and revealed a poorly

filled heart with empty ventricles, due to an unknown hypoechoic structure that was compressing on the RA throughout the cardiac cycle (Fig. 5). This lesion eventually turned out to be a large hepatic cyst that was invaginating into the right hemidiaphragm. As surgical removal of that cyst was deemed too high risk, careful co-ordination was made with the surgeons to minimize compression on the RA at all times intra-operatively. Surgery was completed with the patient transferred to the Surgical Intensive Care Unit (SICU) on multiple vasopressor support. Post-operatively, intravenous MB was administered. In addition, with removal of the other cysts, the remaining liver was now allowed to descend in the abdominal cavity, relieving the compression on the heart. These factors resulted in improved hemodynamics and reduced vasopressor requirements. The patient was transferred out of the SICU the following day.

Hepatic cysts are known to cause caval compression and gastric/duodenal obstruction¹⁻⁴. However, reports of compressive effects by hepatic cysts on the heart have been scarce. This case emphasizes the importance of pre-operative assessment tools in identifying potential intra-operative complications, especially in cases of grossly altered anatomy. Pre-operative TTE findings allowed us to pinpoint a compounding factor for hypotension (right atrial compression by cysts) apart from sepsis induced vasoplegia. This was pivotal in formulating early strategies to minimize the compressive effects on the heart. Potential benefits of using transesophageal versus transthoracic echocardiography in this particular case were also discussed. Finally, the successful use of MB in Vasoplegic syndrome is demonstrated. As a potent inhibitor of guanylate cyclase, MB decreases cyclic GMP and vascular smooth muscle relaxation, resulting in improved hemodynamic outcomes⁵⁻⁸.



Figure 1

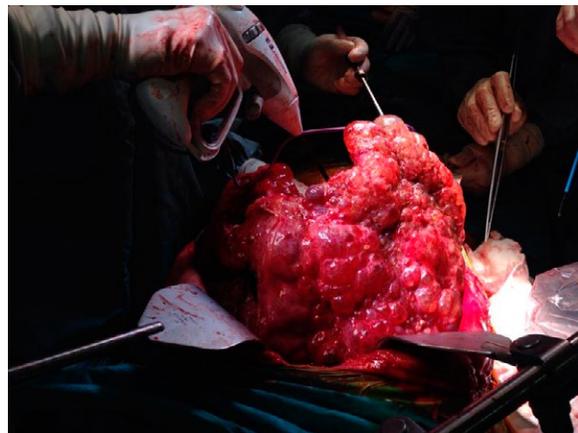


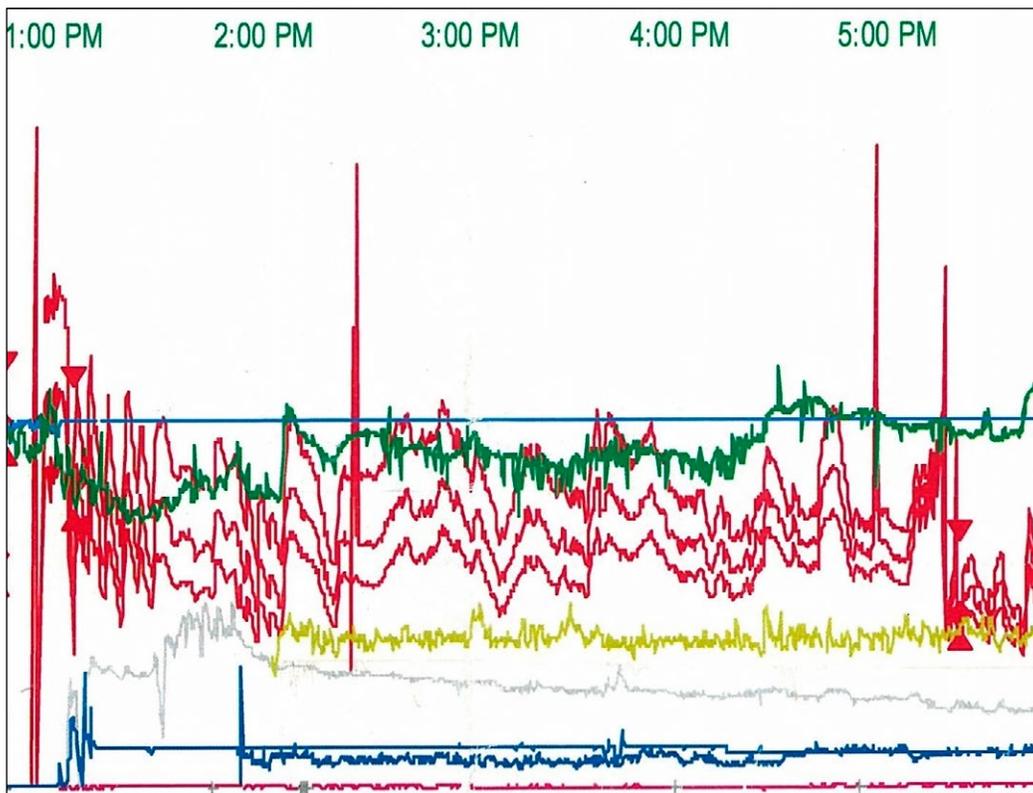
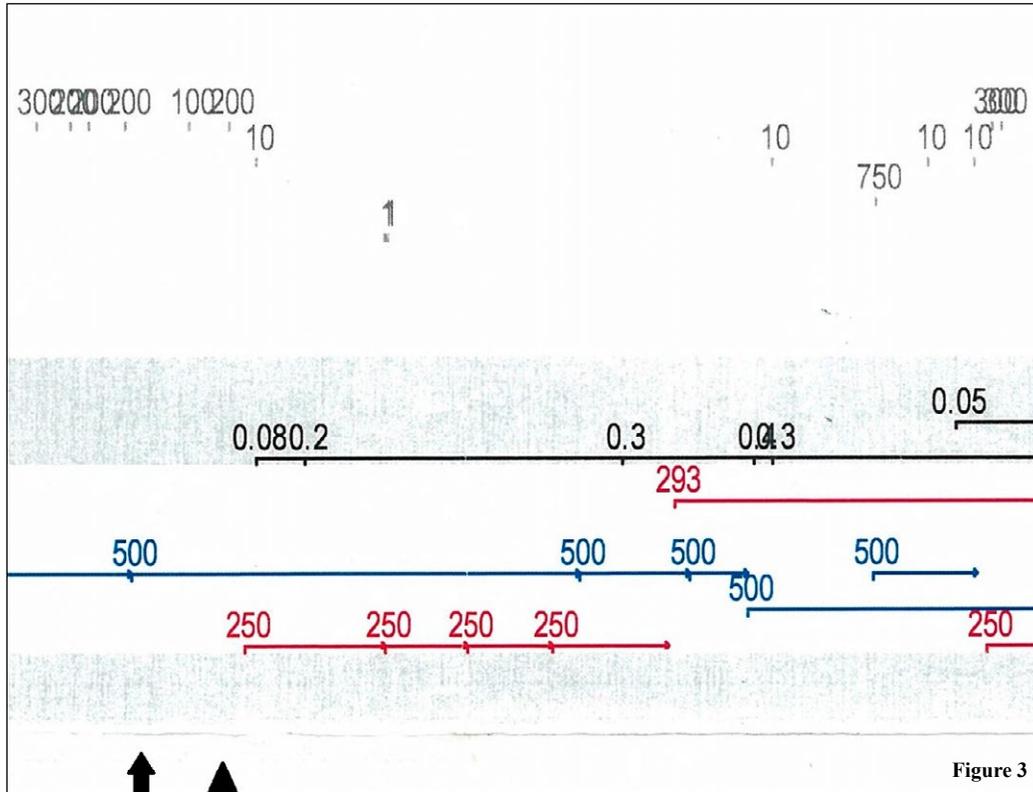
Figure 2



Figure 5

MC-102 • CONTINUED ON NEXT PAGE

MC-102 • continued



A

Abbasiazari, Mohammad S-228
 Abcejo, Arney S. S-485
 Abdullah, Hairil R. S-11
 Abernathy, James S-256
 Abitbol, Nathalie S-458
 Abramson, David S-512
 Abrons, Ron S-19
 Abuelkasem, Ezeldeen S-434
 Ackerman, Michael J. S-78
 Adachi, Yushi U. S-159
 Adams, Clayton S-446
 Adiutori, Lisa M. S-12
 Adler, Joel S-303
 Admon, Dror S-260
 Afonso, Anoushka S-512
 Aerni, Michelle R. S-455
 Afifi, Sherif S-479
 Agarwal, Shvetank S-55
 Agarwala, Aalok S-298
 Agarwala, Aalok V. S-506
 Aikawa, Katsuhiko S-332
 Akahori, Takahiko S-356
 Akeju, Oluwaseun S-195, S-282
 Akimoto, Yoshihiro S-54
 Akintoye, Emmanuel S-57, S-58
 Akiyama, Daiji S-71
 Akutsu, Reika S-269
 Albert, Mazin T. S-460
 Alexander, Jason S-293
 Alexander, John S-443
 Alexander, John C. S-233
 Alfonso, Jeimy S-218
 Allain, Michael D. S-163, S-172
 Allard, Rene S-499
 Allen, John S-280
 Al Madhoun, Waleed S-373
 Aluyen, Julius N. S-472
 Alvis, Bret D. S-13
 Ames, David S-192
 Amlong, Corey A. S-39
 An, Steven S-89
 Anand, Krithika S-522
 Anderson, Thomas A.
 S-506, S-519, S-520
 Andrews, Gerald S-377
 Andropoulos, Dean B. S-52

Ansermino, J Mark S-355, S-357
 Aoyagi, Mitsuo S-2
 Aoyama, Tomohiro S-40
 Apostolidou, Ioanna S-522
 Appelstein, Alexis S-51
 Applegate, Patricia S-377
 Applegate, Richard S-377,
 S-482, S-486
 Arakida, Masako S-291
 Arao, Masayuki S-207
 Ardon, Alberto S-338
 Armour, Trygve S-401
 Armstrong, J N. S-179, S-188
 Armstrong, Ryden S-179, S-188
 Asher, Yogen S-471
 Aslakson, Rebecca A. S-309
 Aslam, Hina S-418
 Attaallah, Ahmed S-241
 Auerbach, Andrew D. S-510
 Ayers, Andrew L. S-372
 Aziz, Michael S-19

B

Baba, Hiroshi S-199, S-277
 Babar Melik, Emine S-234
 Bach, Richard S-122
 Badugu, Sainath S-91
 Baek, Chong-Wha S-229
 Bahadur, Sachin S-26, S-55
 Bai, Xiaowen S-160, S-175,
 S-285, S-81, S-87
 Bai, Yaowu S-23, S-3
 Bain, James R. S-83
 Baker, G Ross S-144
 Balikai, Chandrappa S-51
 Balzer, Felix S-103, S-410
 Bamba, Keiko S-199
 Banerjee, Arna S-14
 Banik, Ratan S-261
 Banks, Matthew S-180
 Banta, James S-403
 Barbara, David W. S-407
 Bardia, Amit S-402
 Barnes, Brian M. S-83
 Barnett, Andrew S-482
 Barnhart, Margaret S-486
 Barros, Guilherme A. S-231
 Barrowman, Nicholas S-373

Bayman, Emine S-138, S-19
 Beach, Michael S-412
 Beattie, Scott S-313
 Beck-Schimmer, Beatrice
 S-190, S-76
 Beebe, David S-114
 Behrend, Travis L. S-407
 Beilin, Yaakov S-406
 Bekker, Alex S-288, S-513
 Belani, Kumar S-114
 Benitez Lopez, Julio S-456
 Bennett, Christopher L. S-252,
 S-358, S-359, S-371, S-372
 Bennett, Mark S-241
 Bennici, Lesley S-308
 Bensalem-Owen, Meriem S-151
 Benuzillo, Jose S-266
 Benzon, Honorio T. S-333
 Benzon, Hubert A. S-333
 Berger, Miles S-165
 Bergese, Sergio S-488
 Berggreen, Astrid E. S-74
 Berkowitz, Dan E. S-89
 Berman, Jeffrey M. S-95
 Bernhard, Michael S-382
 Besser, Stefanie S-177
 Biddle, Chuck S-132
 Bilbily, Matthew S-238
 Binder, Helen S-260
 Binder, Jeffrey S-173
 Bitarafan, Sara S-336
 Black, Ian S-286
 Blech, Daniel J. S-163, S-172
 Blennow, Kaj S-192
 Blitz, Daina S-322
 Blitz, Jeanna S-308, S-315
 Blobner, Manfred S-414
 Blomeyer, Christoph S-65
 Bloom, Marc S-238
 Bloom, Marc J. S-152
 Bohman, John K. S-15
 Bohorquez, Jorge S-358, S-359
 Bollag, Laurent S-530
 Bong, Choon L. S-280, S-281
 Bonnet, Francis S-230
 Bonney, Iwona S-262
 Bonvini, John M. S-76
 Boretsky, Karen S-319, S-336

- Borges, Juliana S-85
 Bosco, Joseph S-22
 Bosnjak, Zeljko S-285
 Bosnjak, Zeljko J. S-160,
 S-175, S-73, S-81, S-87
 Bosshart, Daniel S-322
 Bouchacourt, Juan P. S-360
 Boyd, Gwendolyn S-259
 Boyle, Walter S-122
 Boysen, Philip G. S-425, S-427
 Brambrink, Ansgar M.
 S-181, S-19
 Brandom, Barbara S-300
 Brayonov, Jordan S-250
 Braz, Leandro G. S-82
 Breen, Leah F. S-363
 Breen, Peter H. S-363
 Bridges, John F. S-309
 Brodie, Sonia M. S-355, S-357
 Brovender, Andrea S-144
 Brown, Anthony R. S-475
 Brown, Daniel S-255
 Brown, Emery N. S-195, S-282
 Brown, Michael J. S-141
 Burkle, Christopher S-205
 Butala, Parag S-64
 Butterworth, John F. S-132
 Buvanendran, Asokumar S-328
 Byon, Hyojin S-350
- C**
 Candiotti, Keith S-218,
 S-354, S-361
 Canfield, Scott S-81
 Cannesson, Maxime S-150
 Carr, Kevin S-108
 Carson, Linda S-345
 Carson, Sharon S-254
 Carvalho, Ana Lygia R. S-82
 Castresana, Manuel R.
 S-26, S-55, S-438
 Cates, David S-500
 Cattano, Davide S-19
 Chambers-Little, Terry-Ann S-271
 Chan, Cliburn S-80
 Chaichana, Khan K. S-463
 Chandralekha, . S-197
 Chandrasoma, Janak T. S-153
- Chang, Avian S-114
 Chang, Joyce S-416, S-484
 Chau, Destiny S-225
 Chau, Destiny F. S-151
 Chaudhry, Mohammad S-93
 Chaudhuri, Kallol S-477
 Chaudhuri, Swapna S-477
 Cheah, Jonathan S-523
 Chee, Won S-9
 Chen, Chia-Wen S-166
 Chen, Grace S-214
 Chen, Kuen-Bao S-166
 Chen, Lee-lynn S-523
 Cheung, Chi Wai S-215
 Chew, Sophia S-20
 Chidambaran, Vidya S-274
 Chima, Navraj S. S-508
 Cho, Ahreum S-237
 Cho, Jin Sun S-53
 Cho, Sungsam S-156
 Choe, Won joo S-276
 Choi, Eunsu S-24, S-341
 Choi, Geun-Joo S-229
 Choi, Woo J. S-53
 Choi, Yong Seon S-331
 Chortkoff, Ben S. S-459
 Choukalas, Chris S-104
 Christie, Kari S-131
 Christopher, Nancy A. S-355
 Chu, Larry F. S-153
 Chua, Lester S-124
 Chung, Frances S-314,
 S-347, S-348, S-527
 Chung, Sookja K. S-215
 Chyu, Darrick S-419
 Cibula, Jean E. S-151
 Cingi, Elif S-522
 Clendenen, Nathan S-326
 Clendenen, Steven R. S-326
 Cobas, Miguel S-440, S-441
 Colon, Jimmie E. S-474
 Conway, Charles S-50
 Cooley, Jennifer A. S-255
 Correa, Denis S-314
 Cotte, Juan S-505
 Cotugno, Richard S-290
 Couch, Sharon C. S-453, S-474
 Covington, Derek B. S-456, S-515
- Craft, Robert M. S-417
 Cropsey, Chris L. S-366
 Cross, Richard C. S-259
 Cuadrado, Fernando F. S-174
 Cuff, Germaine S-118,
 S-152, S-22, S-238
 Curry, Timothy B. S-141
 Czosnyka, Marek S-113
- D**
 Dabir, Shideh S-228
 Dagal, Arman S-94
 Danninger, Thomas S-346
 D'Armiento, Jeanine S-107
 Das, Kumuda C. S-312
 Daste, Laurie S-425, S-427
 Davis, Verda A. S-488
 Day, Michael S-22
 DeAngelis, Vincent S-419
 Deb, Chameli S-11
 DeBord Smith, Ann S-303
 Degnan, Meredith S-515
 Delaney, Daniel S-345
 Delson, Nathan S-140
 DeMaria, Samuel S-147, S-149
 Demos, Harry A. S-325
 Denny, John T. S-419, S-93, S-445
 De Oliveira, Gildasio S. S-235
 Dering, Andrew S-161
 Desai, Ronak S-342
 Devine, Scott S-304
 De Vry, Derek J. S-67
 Dexter, Franklin S-369
 Deyo, Donald S-117
 Dhillon, Sabrina S-401
 Diachun, Carol Ann B. S-129
 Dighe, Shruthi S-411
 DiLorenzo, Amy S-129,
 S-130, S-131, S-429
 Ding, Chao S-220
 Ding, Lili S-273
 Dissen, Gregory A. S-181
 Do, Sang-hwan S-24, S-341
 Dodd, Sarah E. S-415, S-495
 Dong, Tony S-91
 Dong, Yuanlin S-185
 Dority, Jeremy S. S-429
 Dorotta, Ihab S-377

Dorsey, David S-94
 Dowling, Oonagh S-322
 Downs, Levi S-345
 Dubovoy, Arkadiy S-132
 Dudaryk, Roman S-252, S-358,
 S-359, S-371, S-372, S-456
 Duggan, Elizabeth W. S-247
 Duma, Andreas S-50
 Dumbarton, Tristan C. S-422
 Dumont, Guy S-357
 Dwarakanath, Sanjay
 S-26, S-438, S-439
 Dworkin, Robert S-265

E

Edelman, Guy S-12
 Edstedt Bonamy, Anna-Karin
 S-289
 Egashira, Takashi S-18
 Egi, Moritoki S-90
 Eguchi, Satoru S-194
 Ehrenfeld, Jesse M.
 S-135, S-143, S-310
 Eichenbaum, Kenneth D. S-321
 Eikermann, Matthias S-414
 Eisler, Lisa S-287
 Ekundayo, Desiree S-12
 El Dib, Regina S-231, S-82
 El Hadidy, Abla S. S-374
 Eloy, Jean D. S-513
 Elsharydah, Ahmad S-223
 Emerick, Trent D. S-148
 Engar, Thomas W. S-430
 Epstein, Richard H. S-368, S-369
 Ercole, Ari S-113
 Eriksson, Lars I. S-289
 Eskander, Jonathan S-505
 Evans, Abigail S-163
 Evans, Tyler L. S-438, S-439
 Evered, Lisbeth A. S-192
 Eversole, Daniel S-262

F

Fagley, R. Eliot S-529
 Fahy, Brenda G. S-151
 Faircloth, Amanda S-132
 Farah, Nizam S-422
 Farhang, Borzoo S-526

Farney, Robert S-314
 Fee, Christopher S-97
 Feierman, Dennis E. S-321
 Feiner, John S-511
 Felts, Lara S-504
 Ferschl, Marla S-492, S-511
 Fidler, Jonathan A. S-191
 Fidler, Richard L. S-380
 Fields, Kara S-346
 Firth, Paul S-282
 Fischler, Kenneth E. S-403
 Fiskum, Gary S-383
 Ford, Brent S-379
 Fortier, Christopher S-256
 Fowler, Leslie C. S-14, S-143
 Fragneto, Regina S-130, S-131
 Frank, Anja S-65
 Freeman, Jenny S-264
 Friedrich, Tammy S-106
 Friend, Alexander S-286
 Fuhrman, Thomas M. S-515, S-8
 Fujimoto, Kazuhiro S-435
 Fujimura, Naoyuki S-284
 Fujino, Yuji S-109,
 S-337, S-63, S-70
 Fujiwara, Yoshihiro S-356
 Fujiyoshi, Tetsuhiro S-370
 Fukuda, Yoko S-299
 Fukusaki, Makoto S-18
 Funai, Yusuke S-217

G

Gaffney, Vandy S-439
 Galinkin, Jeffrey S-501
 Gallo, Bruno V. S-515
 Gan, Tong S-23, S-3, S-45
 Gan, Tong J. S-330
 Gandhi, Sweeta D. S-67
 Ganem, Eliana M. S-231
 Gao, Lei S-113
 Garbee, Courtney S-433
 Garcia, Paul S. S-191
 Gasanova, Irina S-233, S-455
 Gaudet, John G. S-475
 Ge, Zhi-Dong S-175, S-73
 Geevarghese, Sunil K. S-128
 Geiger, Timothy S-310
 Gelb, Adrian S-484

Gelber, Katherine S-418
 Gelineau, Amanda S-519, S-520
 Geller, Melissa A. S-345
 Gencorelli, Frank S-353
 Generoso, Jose R. S-380
 George, Edward S-263, S-264
 George, Khristine S-373
 Gerhardt, Greg A. S-488
 Germond, Liane S-453
 Gerzanich, Vladimir S-124
 Gharibjanians, Nareg S-457
 Ghebre, Rahel S-345
 Gilron, Ian S-265, S-499
 Ginter, Brooke S-429
 Gipson, Keith S-62
 Girard, Timothy D. S-128
 Glatz, Pia S-289
 Glenn, Eric S-505
 Glick, David S-163, S-172
 Godwin, Noah S-403
 Goldberg, Andrew S-147, S-149
 Goldberg, Michael S-342
 Goldenberg, Neil S-11
 Goldstein, Sheldon S-444,
 S-452, S-458
 Gomez, Karla I. S-218
 Gonzalez, Antonio S-200
 Gonzalez, Justo J. S-524
 Gorges, Matthias S-355, S-357
 Gorlin, Andrew S-447, S-448
 Goto, Takahisa S-275
 Goucher, Haley C. S-428, S-471
 Govender, Denira S-253
 Govindan, Kalyani S-279
 Grady, Sean S-180
 Granath, Fredrik N. S-289
 Grande, jon W. S-251
 Gratch, David S-368
 Gravenstein, Nikolaus S-193
 Gray, Kashaine S-411
 Greengrass, Roy A. S-338
 Greilich, Philip E. S-266
 Grignola, Juan C. S-360
 Gross, Jeffrey S-62
 Guglielminotti, Jean S-203, S-206
 Guo, Yaqiu S-220
 Gupta, Anita S-224
 Gupta, Anupriya S-262

Gupta, Piyush M. S-321
Gusakov, Oleg S-451
Guru, Pramod K. S-106

H

Habicher, Marit S-103, S-410
Hackney, Christopher W. S-325
Hackworth, Robert J. S-489
Hagihira, Satoshi S-37, S-432
Hall, Dennis S-245
Hamada, Keiko S-86
Hamada, Toshihiko S-362
Han, Xue S-421
Hanawa, Kazumi S-302
Hanawa, Takehisa S-302
Hand, William R. S-256, S-317
Hanidziar, Dusan S-478
Hannegan, Lisa S-484
Hansen, Daniel S-490
Hara, Tetsuya S-156,
S-18, S-327, S-71
Harambasic, Zlatan S-424
Haramura, Yoko S-86
Harshman, Scott S-498
Hashiba, Eiji S-99
Hashiguchi, Saori S-299
Hashimoto, Tomoki S-178
Hashimoto, Toshikazu S-332
Hassan, Zaki-Udin S-429
Hassani, Ataollah A. S-251
Hastings, Randolph H. S-140
Hathaway, Jessica S-412
Hattori, Seiji S-232
Hawthorne, M. Frederick S-41
Hay, Karen L. S-486
Hayabuchi, Mitsuyo S-362
Hayabuchi, Yoshiro S-362
Hayashi, Kentaro S-532
Hayashi, Yukio S-70
Hayhurst, Christina J. S-121
Haynes-Henson, Kimberley K.
S-500
Hazama, Keita S-404
He, Zhaoping S-15
Head, Brian S-170
Heifets, Boris D. S-186
Heim, Markus S-414
Heinze, Hermann S-74

Helman, James D. S-529
Helyes, Zsuzsanna S-110
Hemauer, Sarah S-421
Hemingway, Maureen W. S-349
Henshaw, Daryl S-525
Herasevich, Vitaly S-92
Heringlake, Matthias S-74
Hernandez Torres, Vivian S-323
Hester, Doug S-13
Hidaka, Hidekuni S-301
Higgins, Michael S-13
Higgs, Maureen M. S-489
Hill, Steven S-266
Hilmi, Ibtesam A. S-433, S-434
Hino, Hirofumi S-207
Hippard, Helena K. S-279
Hirano, Kumi S-38
Hirasaki, Yuji S-86
Hirata, Naoyuki S-376
Hirayama, Miwa S-207
Hirooka, Keiko S-158
Hirota, Kazuyoshi S-334, S-99
Hirrlinger, Johannes S-177
Hirsch, Jan S-380
Ho, Shung-Tai S-47
Hoaglan, Carli S-529
Hoang, Stanley S-437
Hoefnagel, Amie L. S-497, S-442
Hoelzer, Bryan S-495
Hoffer, Darryl N. S-499
Hoka, Sumio S-370
Hokamura, Kazuya S-1
Holley, Katherine S-250
Hong, Caron M. S-124
Hong, Suk H. S-223
Hori, Daijiro S-89
Horikoshi, Yuta S-30, S-37, S-432
Hosford, Andrew S-528
Hossfeld, Bjoern S-382
Hou, Ching-Cheng S-47
Housey, Michelle S-161
Howard, Diantha S-286
Hoyt, Matthew J. S-412
Hsiung, Robert S-430
Hu, Ling Qun S-400
Hua, Yi S-292
Huang, Chun-Jen S-115
Huang, Joshua S-238

Huang, Thomas S-68
Huang, Xiang S-16
Huang, YuGuang S-209
Hubbard, Jeffrey B. S-68
Hudetz, Anthony S-173
Hudetz, Judith A. S-67
Hughes, Christopher G.
S-121, S-128
Hull, Matthew S-259
Hulsmann, Swen S-177
Humeidan, Michelle L. S-488
Humphries, Colin S-173
Hung, Ching-Hsia S-214
Hur, Min S-155
Hussein, Mohamed M. S-374
Hussey, Patrick S-138
Hutchins, Jacob S-345
Hyder, Joseph A. S-303, S-407

I

Ianno, Daniel S-526
Ianov, Igor S-465
Ichikawa, Junko S-56
Ichimaru, Tatsuro S-291
Ichinomiya, Taiga S-327
Ide, Yasuo S-30
Igarashi, Kotaro S-72
Ihara, Naho S-299
Iida, Hiroki S-375
Iijima, Takehiko S-189, S-54
Iijima, Tetsuya S-302
Ijiri, Eriko S-532
Ikeda, Keita S-364, S-365
Ikeshita, Kazutoshi S-4
Ikramuddin, Sayeed S-522
Imada, Tatsuyuki S-109,
S-337, S-63
Imai, Hidekazu S-277
Imamura, Toshikatsu S-432
Imao, Yuriko S-199
Inagaki, manami S-46, S-48
Inagaki, Yasuyoshi S-160
Ing, Caleb S-287
Ingoglia, Michael S-481
Inoue, Tomio S-189
Iohom, Gabriella S-324
Iqbal, Zafar S-67
Irikoma, Shingo S-198

Irwin, Michael S-154, S-34
Ishibashi, Katsuhiko S-269
Ishigaki, Sayaka S-35, S-49
Ishii, Hiroyuki S-6
Ishii, Kenzo S-100, S-301
Ishii, Nanako S-31
Ishikawa, Kazuyoshi S-219
Ishiyama, Yu S-31
Ishizaki, Hironori S-18
Islam, Shadman S-527
Itakura, Sayako S-35
Ivie, Ryan S-293
Iwasaki, Hiroshi S-111, S-72
Iwasaki, Tatsuo S-90
Iwata, Hideki S-194
Iwata, Hiroki S-101
Iwata, Shihoko S-86

J

Jachna, Bozena S-402
Jacob, Adam S-205, S-323
Jacobsohn, Eric S-253
Jaffe, Jonathan D. S-525
Jagid, Jonathan R. S-515
Jain, Sudheer S-152, S-238
Jainandunsing, Jayant S-402
Jalisatgi, Satish S-41
James, Michael L. S-165
Jan, Thomas S-245, S-419, S-93
Jaschinski, Thomas S-230
Jenkins, Andrew S-191
Jensen, Erik S-251
Jerman, Jonathan S-290
Jespersgaard, Cathrine S-196
Jiao, York S-62
Joffe, Aaron S-94
Johnson, Stephen S-181
Jones, John S-290
Jones, Stephanie S-129
Joseph, Jeffrey S-518
Joseph, Mark S-518
Joseph, Thomas T. S-405
Josephs, Sean A. S-413
Joshi, Girish P. S-230, S-233,
S-234, S-443, S-455
Joshi, Nisarg S-518
Joung, Kyoung-Woon S-514
Jovanovic, Dubravka S-8

Jung, Chul-Woo S-155
Jung, Yong-Hoon S-229

K

Kabytaev, Kuanysh S-41
Kahana, Madelyn S-271
Kain, Zeev S-150
Kajdi, Marie-Elisabeth S-190
Kakinuma, Yuta S-60, S-79
Kaku, Ryuji S-210
Kallidaikurichi Srinivasa,
Karthikeyan S-324
Kamata, Kotoe S-158
Kamibayashi, Takahiko S-63
Kamijo, Ryutaro S-189
Kaminaga, Satomi S-194
Kamiya, Takefumi S-6
Kamiya, Yoshinori S-199
Kanamori, Rie S-297
Kanaya, Ayana S-49
Kanazawa, Tomoyuki S-90
Kanda, Hirotosugu S-72
Kang, Fang S-16
Kang, Hyun S-229
Kang, Mia S-95
Kang, Weimin S-527
Karan, Suzanne S-129
Karashima, Yuuji S-370
Karkouti, Keyvan S-313
Kashiwagi, Yuta S-111
Kashyap, Rahul S-15
Kassel, Kareem S-531
Kasuya, Yusuke S-6
Kataoka, Hanae S-54
Kato, Hiromi S-38
Kato, Takasumi S-38
Katoh, Takasumi S-1,
S-101, S-105
Katori, Nobuyuki S-60, S-79
Katsumi, Norifumi S-435
Kawaguchi, Jun S-17
Kawahito, Shinji S-40
Kawai, Yusuke S-221
Kawakami, Hayato S-54
Kawakami, Junichi S-38
Kawamae, Kaneyuki S-352
Kawano, Takashi S-194
Kawasaki, Sho S-284

Kawase, Hirokazu S-168
Kawashima, Shingo S-1, S-101
Kaye, Jeffrey A. S-169
Kedarisetty, Suraj S-140
Keeyapaj, Worasak S-463
Keledjian, Kaspar S-124
Kendale, Samir S-152,
S-308, S-315
Kennedy, Tara S-449, S-470
Kennington, Konrad S-459
Kereliuk, Stephanie M. S-253
Kereskai, László S-110
Kersten, Judy S-73
Khan, Muzna S-117, S-379
Kibler, Kathleen K. S-52
Kiernan, Colleen S-244
Kikuchi, Toshihiro S-294
Kilmartin, Elaine S-518
Kim, Byung Gook S-24
Kim, Dong-Ho S-155
Kim, Eun Soo S-307
Kim, Hae Kyu S-307
Kim, Helen S-510
Kim, Hyunzu S-350
Kim, Ji Yeon S-276
Kim, Jin Tae S-167
Kim, Jinhee S-329
Kim, Jun Hyun S-276
Kim, Jung S-152
Kim, Kyung-woo S-276
Kim, Kyung-tae S-276
Kim, Michael S-501
Kim, Mihwa S-42
Kim, Minjae S-318
Kim, Myounghwa S-331
Kim, Sun S-335
Kim, Tae Kyun S-307
Kimura, Tetsuro S-1, S-101
King, Adam B. S-310
King, John S-489
King, Michael R. S-519, S-520
Kingeter, Adam S-421
Kinoshita, Hiroyuki S-356
Kinoshita, Masako S-210
Kinsky, Michael S-117, S-379
Kirby, Dennis P. S-529
Kirksey, Meghan S-346
Kitahata, Hiroshi S-40

- Kitamura, Akira S-37
 Kitayama, Masato S-334
 Kline, Richard P. S-174
 Klopovic, Cindy S-380
 Knapp, Kathleen E. S-447
 Kobayashi, Kensuke S-101
 Kobayashi, Shunji S-31
 Kobayashi, Yoshiro S-164
 Koch, Jennifer L. S-355
 Kocz, Remek S-251
 Kodaka, Mitsuharu S-56
 Kodama, Mitsuyoshi S-170
 Koht, Antoun S-466
 Kohyama, Tomoki S-102
 Koitabashi, Toshiya S-17
 Komasawa, Nobuyasu S-10
 Komayama, Noriaki S-158
 Komori, Makiko S-56
 Kondo, Izumi S-86
 Konia, Mojca Remskar S-522
 Konig, Gerhardt S-528
 Konno, Ayumi S-189
 Kopec, Michael S-50
 Kor, Daryl J. S-141, S-15, S-255
 Kornblatt, Benjamin S-525
 Koshika, Kyotaro S-17
 Kotani, Mariko S-102
 Koyama, Yusuke S-301
 Kracke, George S-41
 Kramer, George S-117, S-379
 Kraus, Molly S-448
 Krause, Bryan M. S-180
 Krazit, Stephen T. S-223
 Kreiling, Sabine S-12
 Kroin, Jeffrey S. S-328
 Kronenfeld, Mark S-321
 Kueffer, Peter S-41
 Kuhn, Sonja Jolanda S-76
 Kumar, Vikas S-26, S-438, S-439
 Kundumani-Sridharan, Venkatesh S-312
 Kunisawa, Takayuki S-72
 Kuo, Yu-Cheng S-166
 Kuratani, Norifumi S-269
 Kuroda, Kosuke S-120
 Kurokawa, Satoshi S-61
 Kurzweil, Vanessa S-298
 Kushikata, Tetsuya S-99
 Kuwabara, Atsushi S-178
L
 Ladd, Diane S-262
 Ladha, Karim S. S-519, S-520
 Lai, Brian S-496
 Lai, Taryn S-157
 Landy, David S-403
 Landy, Noah S-403
 Langdon, James R. S-417
 Langford, Karin M. S-255
 Lapko, Natalia S-91
 Latif, Rana S-131
 Latoures, Renee S-380
 Laudanski, Krzysztof S-91
 Law, Lawrence Siu-Chun S-23, S-3, S-45
 Lawton, Michael S-484
 Le, Vanny S-513
 Leavitt, Olga S. S-400
 Lecours, Mylene S-484
 Lee, Allison S-204
 Lee, Angela C. S-469
 Lee, Chanhung S-484
 Lee, Daniel E. S-129
 Lee, Dowon S-237, S-307
 Lee, Eun-A S-237
 Lee, HT S-42
 Lee, Jae W. S-178
 Lee, Jae Hoon S-331
 Lee, Ji-Hyun S-167
 Lee, Jiwon S-142, S-155
 Lee, Johanna M. S-195, S-282
 Lee, Jung-Man S-155
 Lee, Justin S-409
 Lee, Peter S-324
 Lee, Sharon S-460
 Lehmann, Christian S-422
 Leng, Orsolya S-110
 Leone, Bruce S-316
 Lerner, Adam S-411
 Lesiak, Alex S-526
 Lessa, Marcos S-85
 Leung, Jacqueline M. S-257
 Li, Chi-Yuan S-166
 Li, Guohua S-203, S-206, S-318
 Li, Haobo S-154, S-34
 Li, Husong S-437, S-450, S-472
 Li, Jing S-288, S-513
 Li, Juan S-16
 Li, Suobei S-84
 Li, Tianzuo S-242, S-330
 Li, Yanru S-242
 Li, Zhitao S-33
 Li, Zhongmin S-408
 Liang, Mingyu S-87
 Liao, Peter S-347, S-348, S-527
 Lim, Jinwook S-514
 Lima, Vinicius S. S-231
 Lin, Na S-242
 Lin, Wei-Yong S-166
 Lin, Yichun S-513
 Liou, Jing-Yang S-43
 Lipsitz, Stuart S-303
 Liu, Chang Amber S-461
 Liu, Hong S-408
 Liu, Hsin-Ping S-166
 Liu, Jia S-178
 Liu, Peiyu S-34
 Liu, Weiling S-20
 Liu, Yanan S-160, S-175, S-285, S-73
 Ljungqvist, Olle S-508
 Lo, Elaine A. S-45
 Lo, Sansan S-469
 Lofgreen, Seth S-501
 Loftus, Randy W. S-509
 Logvinov, Ilana I. S-133
 Lopez, Mathew J. S-442
 Lotz, Christopher S-65, S-69
 Loughnane, Frank S-324
 Low, Sarah A. S-213, S-493
 Lowlaavar, Nasim S-355
 Loyd, Gary E. S-249
 Lubarsky, David S-353, S-361
 Ludwin, Danielle S-475
 Lukens, Margaret F. S-131, S-225, S-429
 Luo, Xin S-215
 Lyden, Elizabeth S-500
 Lynch, Thomas S-309
 Lynde, Grant C. S-507
 Lyons, Andrew B. S-431
 Lytle, Francis T. S-415

M

- Ma, Kevin S-521
Ma, Qing S-306, S-80, S-83
Ma, Yan S-346
Macaluso, Kyle S-436
Machina, Matt S-313
MacIver, Bruce S-186
Mackay, Emily S-449, S-470
MacNabb, C. Marshall S-263
Maduram, David T. S-283
Maeda, Akihiko S-109,
S-337, S-63
Maekawa, Takuji S-156
Magee, Glenn S-304
Maguire, David S-368
Maguire, David P. S-369
Mahmood, Feroze
S-57, S-58, S-68
Mahmoud, Maher F. S-374
Majima, Masataka S-112
Makinde, Rachelle S-234
Makino, Hiroshi S-1, S-101
Maloney, Lauren S-136
Maltby, Jeffery R. S-508
Maniker, Robert S-293
Mann, David S-279
Mantilla, Carlos B. S-323
Manvar, Ankur M. S-494
Marcantonio, Edward S-411
Marchand, James S-208
Marienau, Mary S. S-78
Marino, Joseph S-322
Martin, Archer S-480
Martin, Lauren D. S-181
Martynyuk, Anatoly S-193
Maruta, Toyooki S-122
Maruyama, Naoko S-31
Maruyama, Takashi S-158
Mashour, George A. S-161
Masui, Kenichi S-49
Mathew, Joseph S-165
Mathews, Donald M.
S-250, S-286, S-424
Matsubara, Sachie S-54
Matsuda, Hiromi S-112
Matsukawa, Takashi S-302
Matsuki, Yuka S-44
Matsumoto, Yu S-109,
S-337, S-63
Matsuoka, Yoshikazu S-210
Mattek, Nora C. S-169
Matthes, Kai S-319, S-336
Matyal, Robina S-57, S-58, S-68
Mauermann, William S-407
Mavarez, Ana C. S-218
Maxan, Alexander S-422
McBride, Devin S-482
McBroom, Mandy S-266
McCarthy, Robert J. S-333, S-400
McCarty, Kelsey S-298, S-506
McCaskey, Kyle S-465
McClain, Robert L. S-338
McCollum, Katelyn S-290
McConville, Sarah S-459
McDonagh, David S-165
McDonnell, Conor S-144
McEvoy, Matthew D.
S-135, S-14, S-143,
S-310, S-317, S-366
McFadyen, Grant S-153
McGauvran, Michelle S-530
McGovern, David S-479
McNeer, Richard R. S-252,
S-358, S-359, S-371, S-372
McNulty, Christopher S-518
McQuillan, Jay S-122
McSwain, Julie R. S-325
Measom, Reuel S-490
Mecozzi, Sandro S-39
Mehta, Neeraj S-315
Melendez, Jose S-501
Mementsoudis, Stavros S-346
Meng, Marie-Louise S-200, S-204
Merchant, Richard N.
S-357, S-508
Meyers, Kelly S-241
Meyers, Sasha S-254
Mezger, Viktor S-103, S-410
Mickus, Gregory J. S-133, S-480
Mieda, Tsutomu S-30, S-37
Miller, Bruce S-161
Miller, Judith S-309
Miller, Timothy S-23, S-3
Mimuro, Soichiro S-105
Minami, Kimito S-375
Minami, Toshiaki S-10
Mincer, Joshua S. S-405
Mine, Tomoko S-344
Minehart, Rebecca D. S-349
Mishra, Pragnyadipta S-452
Mita, Naoji S-40
Mitchell, Derek S-497
Mitchell, John D. S-58,
S-129, S-57
Miyakawa, Hidetoshi S-207
Miyake, Yu S-49
Miyamoto, Yasunori S-356
Miyao, Hideki S-54
Miyasho, Koji S-100
Mizogami, Maki S-362, S-44
Mizoue, Ryoichi S-168
Modolo, Marilia P. S-82
Modolo, Norma Sueli P. S-82
Moguilevitch, Marina S-51
Mohiuddin, Adil M. S-93
Mongan, Paul S-316
Montoya-Gacharna, Jose S-64
Moorthy, Ganesh S. S-52
Moreno Duarte, Ingrid S-414
Morgan, Sharon S-445
Mori, Shuji S-120
Mori, Takashi S-217
Morimatsu, Hiroshi S-100,
S-116, S-120, S-125,
S-168, S-210, S-90
Morimoto, Masaaki S-31
Morioka, Nobutada S-158, S-291
Morisaki, Hiroshi
S-299, S-60, S-79
Moriyama, Kiyoshi S-102
Moriyama, Kumi S-137
Morohashi, Toru S-35
Morrisey, Jeremiah S-122
Moss, Jimmy L. S-338
Motoyasu, Akira S-137
Mueller, Jeffrey T. S-255
Munguba, Gustavo S-403
Murad, Hani S-440, S-441
Muragaki, Yoshihiro S-158
Murase, Yoriko S-275
Murata, Hiroaki S-327
Murchison, Charles F. S-169
Murlin, Edyta B. S-191

Murphy, Glenn S. S-304
Musuku, Sridhar R. S-531, S-460
Muto, Noriko S-210

N

Nader, Nader D. S-251
Nadler, Jacob S-165
Nafiu, Olubukola S-268, S-278
Nagai, Mirei S-291, S-297, S-6
Nagappa, Mahesh S-314,
S-347, S-348
Nagaro, Takumi S-248
Nagasaka, Hiroshi S-30,
S-37, S-432
Nagele, Peter S-50
Nagoshi, Makoto S-367
Nair, Bala S-530
Nair, Singh S-271, S-335, S-51
Nakaigawa, Naoko S-232
Nakajima, Emi S-302
Nakamura, Emi S-356
Nakamura, Koji S-162
Nakamura, Ryu S-116, S-125
Nakamura, Shiro S-189
Nakamura, Tina S-30, S-37
Nakane, Masaki S-352
Nakata, Yoshinori S-139
Nakatsuka, Hideki S-404
Nakayama, Hideto S-432
Nanayakkara, Rajika S-408
Nantais, Jordan S-422
Narine, Venod S-315
Nash, Abigail S-191
Nedeff, Nicholas S-371
Neff, Mary S-161
Neff, Thomas A. S-76
Neira, Victor M. S-373
Nelson, Ariana S-333
Nelson, Christina L. S-417
Neuburger, Peter J. S-118
Newman, Nicole L. S-218
Ng, Victor S-468
Ngai, Lynn S-153
Nguyen, Dung S-130
Nguyen, Louis L. S-303
Nie, James S-186
Nimma, Sindhuja S-225
Nishi, Masatoshi S-5

Nishibori, Masahiro S-120
Nishihara, Isao S-10
Nishikawa, Kiyonobu S-217
Nishimura, Akiko S-189
Nishimura, Daisuke S-299
Nishizawa, Shuya S-30
Niwa, Hidetomo S-334
Nizamuddin, Junaid S-201
Nobuhara, Eisuke S-344
Noguchi, Kevin K. S-181
Nolan, Kevin S-373
Nomura, Minoru S-4, S-86
Norman, Brett C. S-128
Northern, Theresa S-425, S-427
Numata, Yuuki S-219
Nuttall, Gregory A. S-255, S-78

O

Obara, Soichiro S-269
Obata, Hideaki S-216
Obata, Yurie S-362
Ocampo-Salazar, Andres S-93
Ochiai, Ryoichi S-98
O'Connor, Michael S-163, S-172
O'Connor, Patrick S-172
Odefey, Amy S-424
Odo, Nadine S-292
Ogami, Keiko S-327
Ogino, Yuichi S-162, S-216
Oguchi, Katsuji S-46, S-48
Ogunkua, Olutoyosi S-234
Ogunnaike, Babatunde
S-233, S-234
Ogura, Takahiro S-35, S-49
O'Hara, Brian S-14
Ohashi, Nobuko S-277
Ojalvo, Katherine J. S-255
Okamoto, Hirotosugu S-112, S-184
Okamura, Keiko S-56
Okitsu, Kenta S-109, S-337
Oliver, William C. S-78
Olney, John S-181
Olsen, David S-205
Olsen, Emily A. S-181
Olson, Jessica S-73, S-81, S-87
Olson, Moses S-377
Olutoyin, Olutoye S-279
Omar, Sohaila H. S-374

Omiya, Hiroki S-210
Omori, Emiko S-116, S-125
O'Neal, Jason S-411
Ono, Kazumi S-100, S-301
Onuki, Kazuyuki S-37
Orhurhu, Vwaire J. S-57, S-58
Osato, Shinnosuke S-31
Oszkiel, Hanna S-91
Otake, Hiroshi S-139
Otsuka, Ryo S-40
Ottesen, Alex S-108
Ouchi, Takashi S-17
Overdyk, Frank S-322
Owais, Khurram S-57, S-58, S-68
Owens, Brianne M. S-504
Ozaki, Makoto S-158, S-291,
S-297, S-6, S-61, S-86

P

Paarmann, Hauke S-74
Paek, Gene S-459
Page, Christopher S-136
Pagel, Paul S. S-67
Pages, Elaine M. S-453
Pai, Jason S-234
Pai, Sher-Lu S-133
Paisansathan, Chanannait S-487
Pak, Song Hyon S-465
Palaniappan, Dhamodaran S-409
Pancaro, Carlo S-208
Pandharipande, Pratik S-421
Pandharipande, Pratik P. S-128
Pani, Saroj S-531
Park, Sun-Gyoo S-229
Park, Yong-Hee S-229
Parks, Colby L. S-39
Parlow, Joel S-499
Parsa, Tahereh S-228
Parveen, Divya S-253
Parviz, Yalda S-228
Pasternak, Jeffrey S-485
Patel, Anuradha S-288
Patel, Arpan S-333
Patel, Arpit N. S-93
Patel, Hetal M. S-509
Patel, Mayur B. S-128
Patel, Piyush S-170
Patel, Rita M. S-148

- Patel, Samir K. S-428
Patterson, Kathleen M. S-67
Patterson, Steven E. S-114
Paugh, Theron A. S-52
Pavone, Kara J. S-195, S-282
Pearce, Robert A. S-39
Pearn, Matthew L. S-170
Pedersen, Nancy L. S-289
Pehar, Mario S-179, S-188
Pelligrino, Dale A. S-487
Pena, Joseph J. S-475
Penick, Emily S-449
Perkins, William S-485
Perouansky, Misha S-39
Peters, John J. S-213
Peters, Julia C. S-509
Peters, Matthew S. S-266
Petruša, Emil R. S-349
Phitayakorn, Roy S-349
Pian-Smith, May C. S-349
Pickering, Brian S-92
Picton, Paul S-161
Piehl, Estee S-153
Pintér, Erika S-110
Pinyavat, Teeda S-283
Podd, Bradley S-433
Podgoreanu, Mihai V.
S-306, S-80, S-83
Ponnusamy, Vikram S-165
Potosky, Ryan S-238
Puentes, Dyanet S-193
Pugliesi, Felipe S-82
Purdon, Patrick S-195, S-282
Purugganan, Ron S-254
- Q**
Qazzaz, Munir S-179, S-188
Qi, Feng S-220
Qiu, Qiu S-215
Quan, Ashley S-483, S-468
Quinn, John P. S-110
Quinn, Joseph F. S-169
Quinones, Quintin J. S-80, S-83
Qureshi, Sana S-261
- R**
Rabinovich, Annette S-118
Rabizadeh, Iman S-403
Radwan, Khaldia G. S-374
Rahlfs, Thomas S-146
Rahman, Pariza S-320, S-7
Rakic, Andrei S-494, S-498
Ramachandran, Rashmi S-197
Ramaswamy, Priya S-478
Rana, Sarosh S-201
Ranganathan, Pavithra S-241
Rangavajjula, Ashwin S-496
Rao, Roshni S-234
Raphael, Darren R. S-150
Rasmussen, Lars S. S-196
Raval, Ronak N. S-486
Ray, Andrew L. S-96
Raz, Aeyal S-180
Reardon, Jessica S-309
Rebel, Annette S-130,
S-131, S-429
Reddy, Arundathi S-225
Reddy, Shamantha G. S-261
Regan, Patricia R. S-247
Reilly, Aimee C. S-462
Reimer, Graham S-286
Restin, Tanja S-190
Rewari, Vimi S-197
Riazi, Sheila S-300
Ribeiro Marques, Nicole
S-117, S-379
Rico Mora, David S-354
Rico Mora, David A. S-361
Riffenburgh, Robert S-489
Rifkin-Graboi, Anne S-280
Riley, Jeffrey B. S-106
Rim, June H. S-64
Rinehart, Joseph S-150
Ring, Laurence S-107
Ring, Steve S-266
Ritchie, Michael K. S-241
Ritchie, Rosalind S-225
Riva, Juan S-360
Rivera, Josue S-524
Rivera, Joy S-256
Rizvi, Batool S-257
Rodes, Meghan E. S-235
Rodriguez, Isadora S. S-82
Rodriguez, Luis I. S-353,
S-354, S-361
Rodriguez, Michelle S-108
Rodriguez-Blanco, Yiliam F.
S-218, S-515
Roewer, Norbert S-65, S-69
Rojas, Camila R. S-258
Rojas, Constanza I. S-258
Rollins, Mark S-492, S-468
Rooke, Alec S-521
Roquemore, Joyce S-146
Rosenbaum, Abraham S-363
Rosenberg, Andrew D. S-152
Rosenfeld, David S-448
Rosinia, Francis S-505
Ross, Patrick S-367
Rotchel, Sepehr S-473
Rothman, Brian S. S-143
Rozner, Marc A. S-259
Ruan, Wei S-84
Ruiz, Joseph R. S-146, S-254
Russo, Lori S-152
Rye, David B. S-191
- S**
Saberito, Darlene W. S-321
Sadhasivam, Senthilkumar
S-273, S-274
Safi, Tarang S-444
Saito, Junichi S-99
Saito, Shigeru S-162, S-216
Saito, Tomoyuki S-20
Saito, Yoji S-344
Sakai, Akiko S-327
Sakai, Tetsuro S-148
Sakuma, Shiori S-61
Sakura, Shinichi S-344
Sakurai, Hiroki S-232
Sakuyama, Yasuyuki
S-291, S-297
Salek, David S-316
Salinas, Francis S-529
Salter, Michael S-379
Salter, Mike S-117
Samuelson, Stefan T.
S-147, S-149
Sandberg, Warren S-135,
S-143, S-310
Sander, Michael S-103, S-410
Sandin, Rolf H. S-289

- Sanghavi, Devang S-106
 Santhanam, Lakshmi S-89
 Saraf, Rabya S-68
 Satish, Siddarth S-528
 Sato, Keita S-61
 Sato, Nobukazu S-98
 Sato, Sachiko S-168
 Sato, Shigehito S-1, S-101, S-105, S-38
 Sayal, Puneet S-349
 Schaller, Stefan J. S-414
 Schears, Gregory J. S-106
 Schell, Randall M. S-129, S-130
 Schenning, Katie J. S-169
 Scherrer, Gregory S-213, S-493
 Schläpfer, Martin S-190, S-76
 Schonberger, Robert B. S-62
 Schroeder, Darrell R. S-323
 Schroeder, Henrike S-74
 Schultz, Gretchen A. S-413
 Schumann, Roman S-262
 Schuster, Anne S-309
 Schwab, Cassidy S-436
 Scott, Barbara S-490
 Scott, David A. S-192
 Segal, Eran S-260
 Segal, Scott S-208
 Seidman, Peggy A. S-136
 Seifi, Ali S-108
 Seino, Yusuke S-61
 Semenova, Janet S-290
 Serita, Ryohei S-17
 Seshadri, Sonya S-140
 Setoguchi, Hidekazu S-370
 Seubert, Christoph S-193
 Sevryugina, Yulia S-41
 Shafritz, Adam S-526
 Shah, Aalap C. S-521, S-530
 Shahul, Sajid S-201
 Shalabi, Ahmed S-257
 Shaikh, Shaheen S-462
 Shانهchi, Maryam S-351
 Shanks, Amy S-161
 Shaparin, Naum S-271
 Sharma, Beamy S. S-315
 Sharma, Bharat S-186
 Shavit, Candace W. S-523
 Shawari, Nivin S-422
 Shea, Erica R. S-96, S-416, S-97
 Shekane, Paul S-315
 Shen, Le S-209
 Shetty, Naveen S-335
 Shibata, Itsuko S-156, S-71
 Shibata, Sho C. S-109, S-337, S-63
 Shido, Akemi S-344
 Shigemi, Hiroko S-362
 Shigemi, Kenji S-44, S-362
 Shimabukuro, David S-416, S-96
 Shimabukuro, David W. S-97
 Shimizu, Hiroko S-116, S-125
 Shimizu, Kazuyoshi S-90
 Shinohara, Yosuke S-352
 Shiraishi, Saki S-156
 Shirasaka, Wataru S-4
 Shirozu, Kazuhiro S-370
 Shleffer, Pnina S-260
 Shoham, Marny S-315
 Shotwell, Matthew S. S-421
 Shworak, Nicholas W. S-509
 Silbert, Brendan S-192
 Silkey, Beryl S-504
 Simard, J. Marc S-124
 Sinclair, David S-361
 Singer, Lewis S-271
 Singh, Christopher S-238
 Singh, Harpreet S-114
 Singh, Mandeep S-527
 Singh, Neeta S-197
 Singhal, Deepak S-197
 Singhal, Neil R. S-290
 Sinskey, Jina S-492, S-511
 Skelley, Jason S-259
 Slee, April S-430
 Sloan, Paul A. S-131, S-225
 Smielewski, Peter S-113
 Smiley, Richard M. S-200, S-204
 Smith, Daryl I. S-497, S-442
 Smith, Michael P. S-80, S-83
 Smith, Shannon M. S-265, S-499
 Smith, Wendy S-484
 Smul, Thorsten M. S-65, S-69
 Sobol, Julia S-293
 Sohn, Hye-min S-329
 Soliman, George S-338
 Soliman, Sameer S-482, S-486
 Solina, Alann S-419
 Somei, Masayuki S-46, S-48
 Soriano, Sulpicio S-461
 Sra, Simranjit S. S-114
 Staats, Janet S-80
 Staeuble, Christiane S-414
 Starnes, Joseph R. S-135
 Stein, David E. S-304
 Steinmetz, Jacob S-196
 Steppan, Jochen S-89
 Stevens, Caroline S-146
 Stewart, Melissa K. S-244
 St. Jacques, Paul S-13
 Stoll, William D. S-317
 Stotts, James G. S-104
 Stumpner, Jan S-65, S-69
 Stundner, Ottokar S-346
 Subramaniam, Balachundhar S-411
 Subramanian, Arun S-415
 Sueda, Lila A. S-529
 Suemasa, Mika S-414
 Sugimine, Satomi S-216
 Sugimoto, Masahiro S-221
 Sugiura, Takahiro S-164
 Sugiyama, Yoko S-375
 Sullivan, Mary C. S-96, S-97, S-416
 Sun, Lena S-283
 Sun, Liting S-215
 Sun, Ming S-287
 Sun, Yanxia S-330
 Sundarbose, Kaminibose S-522
 Sunshine, Jacob S-94
 Suresh, Preetham S-473
 Sutton, Caitlin D. S-507
 Suzuki, Akihiro S-111
 Suzuki, Takahiro S-221
 Sviggum, Hans S-205
 Syed, Naweed I. S-179, S-188
 Szolcsányi, János S-110
- T**
 Tachibana, Shunsuke S-376
 Tada, Masahiro S-532
 Taenzer, Andreas S-286
 Tahir Janjua, Muhammad Salman S-518

- Tai, Wai L. S-215
Takaenoki, Yumiko S-35
Takahashi, Toru S-116, S-125
Takaishi, Kazumi S-40
Takamatsu, Misako S-199
Takanishi, Atsuo S-6
Takarada, Junko S-232
Takasusuki, Toshifumi S-219
Takechi, Kenichi S-248
Takeda, Yoshimasa S-168
Takemoto, Steve S-104
Talmor, Daniel S-411
Tamura, Takeshi S-70
Tan, Crystal S-506
Tan, Jens S-146, S-254
Tan, Josephine S. S-280, S-281
Tan, Mingjuan S-23
Tanaka, Noriaki S-38
Tang, Chaoliang S-16
Tang, Jiping S-482
Tani, Yoshiyuki S-4
Taniguchi, Arata S-210
Taniguchi, Yoshie S-66
Tanioka, Nohito S-116, S-125
Tateda, Takeshi S-207
Tateoka, Kazuyoshi S-532
Tateosian, Vahe S-457
Tatsumi, Shinichi S-10
Tatsuya, Yamada S-137
Tawfik, Vivianne L. S-493
Tayler, Ezekiel S-481
Taylor, Justin S-259
Templonuevo, Mark S-254
Terada, Takahiro S-297
Terada, Takashi S-98
Terao, Yoshiaki S-18
Terekhov, Maxim S-310
Terzakis, Kristina S-282
Testai, Fernando S-487
Thelen, Brendan J. S-500
Thiele, Robert H. S-364, S-365
Thomas, Shawn S-451
Thompson, Jennifer L. S-121
Threatt, Anthony L. S-366
Ti, Lian Kah S-20
Tian, Guogang S-34
Tian, Yi S-34
Tickoo, Mayanka S-402
Tien, Michael S-323
Tinch, Brian S-461
Ting, Chien-Kun S-36, S-43
Tischer-Zeitz, Tobias S-65, S-69
Toda, Yuichiro S-90
Todd, Michael S-19
Toderis, Liat S-260
Tokuda, Kentaro S-370
Toledo, Paloma S-428
Tomita, Akiko S-435
Tomlin, Jeffrey S-489
Toriyama, Sumiko S-4
Torjman, Marc C. S-518
Torres, David S-258
Tosun, Cigdem S-124
Toy, Serkan S-504
Toyama, Yuki S-111, S-72
Traynor, Andrea J. S-153
Treggiari, Miriam S-94
Tricinella, Anthony S-266
Triakha, Anjan S-197
Trotti, Lynn M. S-191
Truong, Sarah S-408
Tsai, Mitchell S-424
Tsai, Pei-Shan S-115
Tse, James S-93, S-445
Tseng, Kenneth S. S-406
Tsou, Mei-Yung S-36, S-43
Tsuchiya, Hironori S-44
Tsuji, Chikako S-18
Tsuji, Mayumi S-46, S-48
Tsuneyoshi, Isao S-122
Tsuruno, Kodai S-31
Tu, Weifeng S-33
Tucker, William B. S-39
Tuckwell, Hannah S-268, S-278
Tuman, Kenneth S-328
Turk, Dennis S-265
Turnbull, John S-483
Twaroski, Danielle S-160, S-175, S-285, S-81
- U**
Uchimoto, Kazuhiro S-275
Uchiyama, Akinori S-70
Ueda, Kenichi S-138
Ueta, Kazuyoshi S-70
Um, Michael H. S-377
Umemura, Kazuo S-1
Uno, Toshihiro S-291, S-297
Urrego, Daniela S-179, S-188
Ursomanno, Patricia S-118
Ushio, Haruka S-370
Ushiyama, Akira S-54
- V**
Vadhera, Rakesh B. S-437, S-472
Valenzuela, Bernardita P. S-258
Vallejo, Manuel S-241
Vandeventer, Alix S-506
VanGordon, Monika S-41
van Heusden, Klaske S-357
Van Norman, Gail A. S-521
Van Straten, John S-443
Vasilopoulos, Terrie S-151
Vealey, Ryan J. S-466
Venkatasubramanian, Raja S-273, S-274
Vera, Arnaldo R. S-440, S-441
Vetri, Francesco S-487
Villafranca, Alexander J. S-253
Vinks, Alexander S-273, S-274
Viscomi, Christopher S-526
Viscusi, Eugene S-496
Visnjevac, Ognjen S-251
Vivek, Kumar S-51
Vogel, Rachel Isaksson S-345
von Heymann, Christian S-410
von Kriegenberg, Katrina M. S-477
Voogd, Sarah C. S-78
Voralu, Kirtanaa S-224
Voscopoulos, Christopher S-263, S-264
Vydyanathan, Amaresh S-335
- W**
Wada, Kosuke S-164
Wagner, Gebhard S-157, S-418
Wagner, Deborah S-52
Wagner, Heather M. S-78
Wagner, Robin L. S-163, S-172
Waisel, David S-319
Wakaizumi, Kenta S-299
Wake, Hidenori S-120
Wakeam, Elliot S-303

- Walk, David S-522
Walker, James S-504
Wall, Melanie S-318
Wallace, Arthur S-104
Walls, Sara S-14
Walters, Robin S-259
Wamsley, Brian S-489
Wanderer, Jonathan P.
S-135, S-143, S-310
Wang, Dong S-493
Wang, Shen-Chih S-36
Wang, Wayne S-445
Wang, Yan S-220
Warltier, David C. S-73
Warren, Julio S-8
Warren, Stephen S-64
Wasnick, John S-312
Watanabe, Yuichi S-139
Watcha, Mehernoor F. S-279
Waters, Jonathan S-528
Watkins-Pitchford, John M. S-305
Weavind, Liza M. S-244, S-421
Weigel, Wade A. S-431
Weiss, Matthew S-309
Weller, Robert S-525
Werneid, Kristian S-300
Wen, Tony S. S-472
West, Nicholas C. S-355, S-357
Wetzel, Randall C. S-367
Weyker, Paul D. S-97
White, William D. S-165
Whitlock, Elizabeth L. S-510
Whiting, Christopher S-450
Whittington, Robert S-418
Wie, Christopher S-448
Wilder, Nicole S. S-52
Wilhelm, Armand E. S-475
Wilkerson, Carlos S-470
Williams, Mark R. S-265
Williams, Robert S-286
Williamson, Amber S-290
Wilson, Gregory A. S-323
Wilson, Sylvia H. S-325
Wittwer, Erica D. S-92
Wolf, Bethany J. S-325
Wolf, Francis A. S-247
Wong, Cynthia A. S-428, S-466
Wong, David T. S-11
- Wong, Jean S-314, S-347
Wu, Songwei S-292
- X**
Xia, Zhengyuan S-154,
S-215, S-34
Xie, Zhongcong S-185
Xiong, Ming S-288, S-513
Xu, Bo S-33
Xu, Changqing S-193
Xu, Fenglian S-179, S-188
Xu, Hao-Liang S-487
Xu, Junmei S-34, S-84
- Y**
Yadollahi, Azadeh S-527
Yagi, Tatsuya S-38
Yakoshi, Chihiro S-334
Yamada, Atushi S-189
Yamaguchi, Shigeki S-219
Yamakage, Michiaki S-376
Yamamoto, Eiichiro S-297
Yamamoto, Kunihiko S-72
Yamanaka, Daiki S-194
Yamanishi, Yuichiro S-30
Yamaoka, Masakazu S-116, S-125
Yamasaki, Hiroyuki S-217
Yamashita, Tomoyuki S-4
Yamazaki, Haruyuki S-164
Yan, Yasheng S-160, S-175,
S-285, S-73, S-81, S-87
Yanez, Norbert D. S-94
Yang, Relin S-440
Yang, Yushi S-256
Yang, Yuxiao S-351
Yano, Takeshi S-122
Yao, Weifeng S-154
Yasuda, Atsushi S-463
Yasuda, Yoshitaka S-356
Yasumura, Rie S-164
Yazdani, Shiraz S-446
Ye, Jiang H. S-288, S-513
Ye, Jingying S-242
Yeap, Yar Luan S-142
Yeh, Joseph S. S-308
Yen, Constanza S-258
Yeo, Angela S. S-281
- Ying, Hao S-379
Yogo, Hisanori S-239
Yokokawa, Sumire S-61
Yokomichi, Hiroshi S-302
Yokoyama, Masataka S-194
Yoo, Daniel S-346
Yoo, Young-Chul S-53
Yorozu, Tomoko S-102, S-137
Yoshimura, Tatusya S-139
Yoshino, Jun S-284
Yoshioka, Hiroe S-164
Yoshitomi, Osamu S-156, S-71
Youssef, Maha A. S-374
Youssef, Maha I. S-374
Yu, Jihion S-514
Yufune, Shinya S-35
Yuzaki, Michisuke S-275
- Z**
Zach, Kristen S-136
Zaja, Ivan S-285, S-81
Zecca, Massimiliano S-6
Zhang, Bingxi S-242
Zhang, Jiaqiang S-193
Zhang, John S-482, S-486
Zhang, Xiaoguang S-257
Zhang, Xue S-273, S-274
Zhang, Yanping S-218
Zhang, Yiyang S-185
Zhang, Yuguan S-209
Zhang, Zhiquan S-306, S-83
Zheng, Xiwen S-163, S-172
Zhou, Juan S-422
Zimering, Jeffrey H. S-185
Zininberg, Elena S-512
Zorumski, Charles F. S-50
Zuppa, Athena F. S-52