



2011 Medical Student Anesthesia Research Fellowship Symposium

**Tuesday, October 18, 2011
2:30 – 5:30 PM
Room N226, McCormick Place
Chicago, IL**

Objective

The Medical Student Anesthesia Research Fellowship (MSARF) program provides support to both medical students and host departments for eight weeks of anesthesia-related research experience and is an element of FAER's commitment to attract scientific talent to academic anesthesiology. The symposium provides an opportunity for MSARF participants to present research findings from their MSARF experience.

Moderator: Paloma Toledo, MD, MPH

Dr. Toledo is a FAER Director and an obstetric anesthesiologist at Northwestern University in Chicago, IL. Following her obstetric anesthesia fellowship, she completed her Master's in Public Health and a postdoctoral fellowship in health services research. Her research interest centers around racial and ethnic disparities in the use of labor analgesia. She is a past-president of the ASA Resident Component and is currently a Director in the Society for Obstetric Anesthesia and Perinatology.

2011 MSARF Symposium Participants

Michael Alexander

Host Department: University of Chicago
Medical School: University of Illinois - Chicago

Gregory Amend

Host Department: UCSF Department of Anesthesia
Medical School: Stony Brook University School of Medicine

Mack Arroliga

Host Department: University of Pennsylvania School of Medicine
Medical School: Drexel University College of Medicine

Shyamal Asher

Host Department: University of Washington
Medical School: Alpert Medical School at Brown University

Christina Atiya

Host Department: UMDNJ-NJMS
Medical School: UMDNJ-NJMS

Alexander Badulak

Host Department: University of Colorado Denver
Medical School: University of Pennsylvania School of Medicine

Kiran Belani

Host Department: SUNY Downstate Medical Center
Medical School: University of Maryland School of Medicine

Adithya Bhat

Host Department: Washington University
Medical School: Case Western Reserve University School of Medicine

Jason Brustein

Host Department: State University of NY (SUNY) Stony Brook
Medical School: New York College of Osteopathic Medicine

Edwina Chang

Host Department: Children's Memorial Hospital
Medical School: University of Illinois at Chicago

Steven Constantino, Jr.

Host Department: Massachusetts General Hospital
Medical School: Tufts University School of Medicine

Johnathan Cyr

Host Department: Dartmouth-Hitchcock Medical Center
Medical School: Tufts University School of Medicine

Kevyn Davenport

Host Department: Yale University
Medical School: Loma Linda University School of Medicine

Luke Dong

Host Department: Medical University of South Carolina
Medical School: Medical University of South Carolina

Shiv Dua

Host Department: University of Pittsburgh
Medical School: George Washington University

Brian Ebert

Host Department: University of Utah
Medical School: Arizona College of Osteopathic Medicine/Midwestern University

Steven Engel

Host Department: University of Miami Miller School of Medicine
Medical School: University of Miami Miller School of Medicine

Jessica Fields

Host Department: Mount Sinai School of Medicine
Medical School: Mount Sinai School of Medicine

Karina Geronilla

Host Department: Medical University of South Carolina
Medical School: West Virginia University School of Medicine

Elizabeth Hong

Host Department: University of Michigan
Medical School: University of Michigan

Allison Janda

Host Department: Regents of the University of Michigan
Medical School: University of Michigan Medical School

Stephen Johnston

Host Department: Medical College of Wisconsin
Medical School: Medical College of Wisconsin

Sunchin Kim

Host Department: Mayo Clinic Rochester
Medical School: Wayne State University School of Medicine

Michael Kreger

Host Department: Vanderbilt University
Medical School: ETSU Quillen College of Medicine

Jennifer Lee

Host Department: Columbia University
Medical School: Harvard Medical School

Tong Liu

Host Department: State University of NY (SUNY) Stony Brook
Medical School: Warren Alpert Medical School of Brown University

Robert Marron

Host Department: UMDNJ-NJMS
Medical School: UMDNJ- New Jersey Medical School

Thomas Masterson

Host Department: University of Miami Miller School of Medicine
Medical School: University of Miami Miller School of Medicine

Maleeha Mohiuddin

Host Department: Northwestern University's Feinberg School of Medicine
Medical School: University of Missouri-Kansas City

Jennifer Mytar

Host Department: Texas Children's Hospital
Medical School: Touro University California

Darren Nabor

Host Department: Medical College of Wisconsin
Medical School: Medical College of Wisconsin

Meaghan Neill

Host Department: Vanderbilt University
Medical School: Medical University of South Carolina

Christopher Nguyen

Host Department: University of California Irvine
Medical School: University of California, Irvine

Jonathan Paul

Host Department: SUNY Downstate Medical Center
Medical School: New York College of Osteopathic Medicine

Marci Pepper

Host Department: Regents of the University of Michigan
Medical School: University of Michigan Medical School

Kasey Pierson

Host Department: Oregon Health & Science University
Medical School: University of Arizona College of Medicine - Phoenix

Naveen Reddy

Host Department: The Children's Hospital of Philadelphia
Medical School: New York University School of Medicine

Damoon Rejaei

Host Department: University of Wisconsin-Madison
Medical School: University of Vermont

Benjamin Roberts

Host Department: University of Alabama at Birmingham
Medical School: University of Alabama School of Medicine

Victoria Saites

Host Department: Thomas Jefferson University
Medical School: Thomas Jefferson University, Jefferson Medical College

Michael Schnetz

Host Department: Cleveland Clinic
Medical School: Case Western Reserve University School of Medicine

Christa Schueller

Host Department: Regents of the University of Michigan
Medical School: Wayne State University School of Medicine

Chirag Shah

Host Department: University of Colorado Denver
Medical School: Case Western Reserve University

Renuka Shenoy

Host Department: The Ohio State University - Medical Center
Medical School: Northeastern Ohio Universities College of Medicine

James Todaro

Host Department: Columbia University
Medical School: Columbia University, College of Physicians and Surgeons

Michael Topf

Host Department: University of Rochester
Medical School: University of Rochester School of Medicine and Dentistry

Janelle Tryjankowski

Host Department: Thomas Jefferson University
Medical School: Thomas Jefferson Medical College

Albert Tsai

Host Department: University of Pennsylvania School of Medicine
Medical School: University of Pennsylvania

Ajayram Ullal

Host Department: Montefiore Medical Center: The University Hospital for the Albert Einstein
College of Medicine
Medical School: Stony Brook University School of Medicine

Nathan Waldron

Host Department: Duke University Medical Center
Medical School: Duke University School of Medicine

Louise Wen

Host Department: Stanford University, Dept. of Anesthesia
Medical School: SUNY at Stony Brook

Keith Wirth

Host Department: University of Pittsburgh
Medical School: SUNY Downstate College of Medicine

Jocelyn Wong

Host Department: Stanford University, Dept. of Anesthesia
Medical School: Dartmouth Medical School

Patrick Wu

Host Department: University of Florida
Medical School: University of Virginia

Jennifer Yan

Host Department: Northwestern University's Feinberg School of Medicine
Medical School: University of Arizona College of Medicine

MSARF Symposium Poster Presentations

Student Name: Michael Alexander

Host Department: University of Chicago

Primary Mentor Name: Steven Roth, MD

Title of Research Project: Rodent Model of Perioperative Ischemic Optic Neuropathy

Introduction: Perioperative ischemic optic neuropathy (ION) is a rare condition resulting in blindness, with increased prevalence in spinal and cardiac surgery. The mechanisms of perioperative ION are not known although factors such as hypotension, hemodilution, and patient positioning have been present in many affected patients. An animal model is necessary to evaluate the mechanisms of perioperative ION in a controlled manner. The rat's optic nerve circulation is similar to the human, and may be suitable as a model.

Methods: Wistar rats were divided into groups of 4-6. In three groups, animals were head down tilted 70 degrees for 5 h. A control group was supine only. The head down tilted position approximates that in humans undergoing radical prostatectomy. One group was severely hemodiluted to hematocrit 20-25%. Another was moderately hemodiluted to 30-33%. The third was tilted but not hemodiluted. Blood was removed from a cannulated internal jugular vein and replaced using hydroxyethylstarch. Recovery was assessed two weeks later using electroretinography, and histological/immunohistochemical examination of retinal sections.

Results: With moderate hemodilution, the positive STR amplitude decreased about 50%. We found no TUNEL staining or histological changes in the retina or the optic nerve.

Conclusions: Moderate hemodilution and head-down tilt induced functional alterations in the retinal ganglion cells, which were not evident as neuronal injury on histological examination. The follow-up measurement period may be too early to demonstrate histological damage, but this model does appear to reflect retrograde functional changes in the RGCs, possibly due to ischemia in the optic nerve.

Student Name: Gregory Amend

Host Department: UCSF Department of Anesthesia

Primary Mentor Name: William L. Young, MD

Additional Mentors: Hua Su, MD, Espen J. Walker, PhD

Title of Research Project: Bevacizumab attenuates VEGF-induced cerebral angiogenesis in a dose-dependent manner

Background and Purpose: High vascular endothelial growth factor (VEGF) expression is part of the lesional phenotype of Hereditary Hemorrhagic Telangiectasia (HHT), an autosomal dominant inherited disorder associated with arteriovenous malformations (AVMs). Thus, VEGF is a potential target for therapeutic intervention. In this study we investigated whether anti-VEGF antibody could successfully reverse VEGF induced brain angiogenesis.

Methods: We injected an adeno-associated viral vector expressing human VEGF (AAV-VEGF, 2×10^9 genome copies) into the basal ganglia of eight week old C57BL/6 mice to induce brain angiogenesis. AAV-LacZ was used as a control vector. Six weeks later, Avastin® (rhuMab VEGF; bevacizumab) (1, 5, 10, and 15 mg/kg) was administered intraperitoneally every other day for 10 days. Herceptin (rhuMab HER2; Trastuzumab) was used as control treatment (n=6/group). GraphPad Prism (GraphPad Software, Inc., San Diego, U.S.A.) was used to obtain a dose-response curve and EC50.

Results: Compared with AAV-LacZ, injection of AAV-VEGF significantly increased vessel density (AAV-VEGF: $313 \pm 37/20X$ objective field vs. AAV-LacZ: 191 ± 41 ; $p < 0.001$). Mice treated with 5, 10, or 15 mg/kg bevacizumab had decreased vascular density compared to trastuzumab control (bevacizumab 5 mg/kg: 232 ± 50 , 10 mg/kg: 222 ± 22 , 15 mg/kg: 229 ± 42 ; trastuzumab 15 mg/kg: 313 ± 37 ; $p < 0.05$). Treatment with 1 mg/kg bevacizumab did not decrease vessel density compared to control (262 ± 46 , $p = 0.7$). Based on dose-response analysis, the EC50 of bevacizumab to inhibit brain angiogenesis was 1.06 mg/kg (95% CI: 0.36–3.10 mg/kg).

Conclusions: Bevacizumab inhibits VEGF-induced brain angiogenesis in a dose-dependent manner, suggesting that bevacizumab could be used to inhibit brain lesion progress of HHT patients.

Student Name: Mack Arroliga

Host Department: University of Pennsylvania School of Medicine

Primary Mentor Name: Roderic G. Eckenhoff, MD

Additional Mentors: Maryellen F. Eckenhoff, PhD

Title of Research Project: The Effect of Propofol and Surgery in Murine Alzheimer's Pathogenesis

Introduction: Recent findings suggesting that surgery increases the risk of cognitive decline among the elderly together with the growing body of in vitro, cell and animal evidence suggesting involvement of anesthetics on Alzheimer pathogenesis, call for further evaluation of the interaction between surgical care and Alzheimer neuropathology. Most animal work in this field is conducted with isoflurane only, and without surgery, rendering the results of limited clinical relevance. Here, we study mice with a more relevant peri-operative experience.

Methods: Triple transgenic Alzheimer (3xTgAD) mice, aged 8-12 months, were exposed to air alone (n= 9), 250 mg/kg propofol alone (n=12), or propofol plus cecal ligation and excision surgery (n=12). Morris water maze (MWM) behavioral testing was performed starting 3 weeks later, including reference memory learning, probe memory testing, swim speed, and rotorod. The MWM will be repeated 3 months post-operatively in the same animals. The brains will be examined with ELISA and Luminex assays and sectioned for immunohistochemical analysis with biomarkers for Alzheimer's disease and inflammation.

Results: Cognitive testing, 3 weeks postoperatively, revealed that surgery under propofol anesthesia had a trend towards poorer performance on both learning and memory tests (P= 0.06). The propofol only group had no significant effect on either cognitive tests. There was no effect of either anesthesia or surgery on motor function as reflected by swim speed and rotorod testing. Behavioral testing at 3 months postoperative will be available at the time of the symposium.

Student Name: Shyamal Asher

Host Department: University of Washington

Primary Mentor Name: Monica Vavilala, MD

Additional Mentors: Deepak Sharma, MD

Title of Research Project: Survival Advantage and PaO₂ Threshold in Severe Traumatic Brain Injury

Introduction: Traumatic Brain Injury (TBI) is a leading cause of death and disability in the United States. Secondary insults such as hypoxemia are known to adversely affect outcomes after TBI. However, the effect of high PaO₂ on TBI outcomes is controversial. The main aim of this study was to identify the optimal PaO₂ range early after severe TBI.

Methods: A retrospective study was conducted. A total of 193 adult patients with severe TBI met eligibility criteria. Data abstracted included patient level characteristics and laboratory data including PaO₂, PaCO₂ and hematocrit recorded within the first 72 hours after admission.

Results: The crude and adjusted effects of 50 mmHg incremental PaO₂ thresholds during the first 72 hours on discharge survival were examined. A PaO₂ greater than 250 mmHg (68%) was associated with discharge survival (AOR 8.8; 95% CI 1.8 – 43.2) in patients with severe TBI. This relationship between PaO₂ thresholds and survival was sustained until a PaO₂ threshold of 450 mmHg (AOR 3.3; 95% CI 1.5 – 7.5). The prevalence of hypoxemia was 24% and was associated with discharge mortality (Survival AOR 0.46; 95% CI 0.22 – 0.95).

Conclusion: A PaO₂ threshold of greater than 250 mmHg during the first 72 hours after injury was associated with improved all-cause survival advantage in patients with severe TBI, independent of hypocarbia or hypercarbia. While most patients had at least one PaO₂ greater than 250 mmHg during the first 72 hours, in-hospital hypoxemia was common.

Student Name: Christina Atiya
Host Department: UMDNJ-NJMS
Primary Mentor Name: Vasanti Tilak, MD
Additional Mentors: Catherine Schoenberg, BSN, CCRC
Title of Research Project: Does the administration of preoperative midazolam assist in maintaining blood glucose norms in the non-diabetic patient during the perioperative period?

Background: In patients undergoing surgery, serum glucose levels may rise in response to intraoperative stress. Perioperative hyperglycemia has been associated with post-operative complications. In an exploratory study by this PI for predictors of perioperative hyperglycemia in non-diabetic patients, an unexpected relationship was found between preoperative administration of midazolam, an anxiolytic benzodiazepine, and glucose levels. We hypothesize that in non-diabetic patients undergoing hernia repair, the pre-operative administration of midazolam will attenuate a hyperglycemic response to psychological stress.

Methods: In a prospective, single-blinded (subject only) study, subjects were randomized into a midazolam group (M) and a placebo group (P). Exclusion criteria include patients whose pre-operative blood glucose > 110 mg/dL. 10 minutes before entering the OR, Group M received 1-2.5 mg IV midazolam and Group P received 2 cc of normal saline. All patients completed the State Trait Anxiety Inventory for Adults (Form Y-1 and Y-2) pre-operatively to quantify the levels of current “state anxiety” and long-term anxiety. Blood glucose levels were measured 30 minutes post-induction. In the PACU, pain scores and glucose were drawn twice. 7 subjects have currently been enrolled with a target of 60.

Power Analysis: A sample size estimation of 30 per group is based on effect change of 30%, probability of significance (?) of 0.05, power of the test (1-?) of 80% and dropout rate of 10%. Data will be presented as % number and mean ± standard deviation. Data analysis will be performed by statistical software. A p value <0.05 will be considered statistically significant.

Student Name: Alexander Badulak
Host Department: University of Colorado Denver
Primary Mentor Name: Holger K. Eltzschig, MD, PhD
Additional Mentors: Almut Grenz, MD, PhD
Title of Research Project: Oxygen-Sensing Prolylhydroxylases (PHDs) in Acute Kidney Injury

During renal ischemia, shifts in the metabolic supply to demand ratio – particularly for oxygen – result in severe tissue hypoxia. Cellular responses to hypoxia are regulated by oxygen-sensing enzymes that coordinate transcriptional responses to hypoxia. Central among these enzymes are three oxygen-sensing prolyl hydroxylases (PHD1-3). Limited oxygen availability results in inhibition of PHDs with subsequent stabilization of hypoxia-inducible factors (HIFs), initiating a transcriptionally-regulated response that re-programs cells for hypoxia adaptation. We hypothesize that genetic deletion or pharmacologic inhibition of PHDs mediates kidney protection from ischemia.

Gene targeted mice for PHD1, 2 and 3 (PHD1^{-/-}, PHD2^{+/-}, PHD3^{-/-}) were studied in an ischemic model of acute kidney injury (AKI), utilizing a hanging weight system. Renal function was determined by FITC-labeled inulin clearance, serum creatinine, renal cytokine levels, renal myeloperoxidase (MPO), histology and TUNEL staining.

We first treated C57/BL6 mice with a PHD inhibitor (dimethyloxallyl glycine, DMOG) before renal ischemia. Mice with DMOG treatment showed attenuated kidney injury following renal ischemia, with smaller decreases in GFR and increases in serum creatinine reduced. Inflammatory cytokines (TNF-alpha, IL-6) and neutrophil infiltration (MPO) were attenuated in DMOG treated mice. Further studies in gene-targeted mice for PHD1, 2 or 3 showed a selective phenotype in Phd1^{-/-} mice with remarkable protection from ischemic AKI. GFR was tremendously improved, serum creatinine significantly lower and histological damage attenuated.

Thus, we identified a selective phenotype in Phd1^{-/-} mice with improved renal function following AKI due to ischemia. PHD inhibitors may be novel therapeutic agents in the treatment of AKI.

Student Name: Kiran Belani

Host Department: SUNY Downstate Medical Center

Primary Mentor Name: Tigran Sukiasyan, MD

Additional Mentors: Vitaly Kotlyar, MD and Galina Borodulina, MD

Title of Research Project: Does nitrous oxide decrease sevoflurane inhalation induction time in children? A prospective, controlled, randomized and blinded study.

There is a commonly held belief that the addition of nitrous oxide (N₂O) increases the speed of sevoflurane inhalation induction. However, numerous studies in adults and animals do not support this. Currently, the choice of the inhalation induction technique is at the discretion of the anesthesiologist. Two of the inhalation induction techniques, 8 Vol.% sevoflurane in 100% oxygen and 8 Vol.% sevoflurane in variable ratios of oxygen/N₂O, are widely accepted and considered safe in children. Since the previous studies conducted in the pediatric population have shown conflicting results, our ongoing study tests the effect of N₂O on time of inhalation induction with sevoflurane in children ages 1-5 years. Patients were randomized to one of two groups, 8 Vol.% sevoflurane in 30% oxygen/70% N₂O (Group 1) or 8 Vol.% sevoflurane in 100% oxygen (Group 2) by a non-blinded researcher; the mask induction and assessment was performed by a blinded attending anesthesiologist. Times to eyelash reflex loss and complete immobilization were recorded. For the preliminary sample of n = 25 recruited (n=13 in Group 1, n=12 in Group 2), we report no statistically significant difference in induction times between the two groups, suggesting that N₂O may not appreciably reduce induction time in children. The study will be continued to reach the final sample size of n = 80. At that point, if no difference in induction times is found, we will conclude that N₂O can be eliminated from the routine induction regimen in children.

Student Name: Adithya Bhat

Host Department: Washington University

Primary Mentor Name: Peter Nagele, MD

Title of Research Project: Myocardial Ischemia After Electroconvulsive Therapy

Background: Electroconvulsive therapy (ECT) is very commonly used to treat patients with severe major depression to gain an immediate improvement in their depressive symptoms. ECT involves the administration of a strong electrical current to the head of the patient and usually requires brief general anesthesia. The strong electrical current used in ECT initiates a generalized seizure in the patient that lasts for a few minutes. In spite of general anesthesia, ECT causes a major stress response in the patient and myocardial infarctions as well as myocardial damage after ECT have been reported¹⁻⁷. However, only scant data exist that systematically aimed to investigate the risk of myocardial ischemia after ECT.

Methods: A blood sample and EKG were obtained before and after an ECT treatment in patients electively scheduled for ECT. Samples were obtained from 3 ECT visits from each patient. To measure the extent of a potential myocardial injury, ultra-sensitive plasma troponin was measured, and the EKG interrogated for signs of myocardial ischemia.

Results: Preliminary results from 19 patients show that ECT was not associated with myocardial injury. The majority of patients had no detectable ultra-sensitive troponin in their blood (limit of detection < 3 pg/mL) and no ischemic changes in the EKG. In patients with a measureable baseline troponin, no change was observed after ECT.

Conclusions: Evidence from these preliminary data indicate that ECT is not associated with myocardial injury.

Student Name: Jason Brustein

Host Department: State University of NY (SUNY) Stony Brook

Primary Mentor Name: Zvi C. Jacob, MD

Additional Mentors: Helene D. Benveniste, MD, PhD, Peter S. Glass, M.B., Ch.B, FFA (SA), Christopher Biel, B.S.

Title of Research Project: A comparison between two active heating devices during administration of general anesthesia: The Bair Hugger Convection device versus the Koala resistive mattress device.

Introduction: Hypothermia is a potential side effect of general anesthesia that may lead to greater blood loss, infections, and longer hospitalization. Hypothermia occurs because general anesthetics inhibit thermoregulatory control, which

results in redistribution of body heat. This rapid core-to-peripheral transfer of heat causes most patients to become hypothermic. Recently, a new resistive mattress (Koala) was introduced as an alternative heating device for surgical procedures. We compared the effectiveness of the Bair hugger and Koala devices in the prevention of hypothermia in patients undergoing <2hrs surgical procedures.

Methods: After receiving IRB approval, 55 patients were randomized to receive body warming during surgery via either the Bairhugger or Koala. Intra-operatively, the ambient room temperature and nasopharyngeal temperatures were recorded in 5 minute intervals until extubation. We compared the lowest core temperature maintained by both devices during surgery and the total heat maintained (“Average Remaining Heat” (ARH)).

Results: The results demonstrated that the mean lowest core temperature (LCT) was significantly less than 35.5°C for both groups. Therefore, both patient groups became hypothermic by definition. Additionally, the statistical analysis demonstrated that the ARH of the Bair Hugger group was significantly higher than that of the Koala group (p=0.038), suggesting that the former is more efficient in maintaining a higher temperature in the patients.

Conclusions: Our preliminary data suggests that the Bairhugger outperforms the Koala in maintaining body temperature in the ambulatory setting. However, neither device adequately maintains normothermia in the acceptable range of 35.5°C or greater.

Student Name: Edwina Chang

Host Department: Children's Memorial Hospital

Primary Mentor Name: Santhanam Suresh, MD

Additional Mentors: Narasimhan Jagannathan, MD

Title of Research Project: Prospective, randomized comparison of the LMA-Unique™ and LMA-Supreme™ in children

Background: The LMA-Supreme™ is a new laryngeal mask airway with structural modifications that allow for improved airway seal pressure and aero-digestive separation when compared to the LMA-Unique™. There have been numerous studies evaluating the safety and efficacy of the LMA-Supreme in adults, but there have been no studies to date analyzing the performance of the LMA-Supreme in children. Therefore, we conducted a prospective, randomized comparison of the LMA-Supreme and LMA-Unique in order to assess the efficacy of the device in children.

Methods: Fifty children (ASA I-III) undergoing elective surgery were randomly assigned to receive either a size 2 LMA-Unique or size 2 LMA-Supreme for airway management. The primary outcome measure was oropharyngeal leak pressure (OLP). Secondary outcome measures included ease of insertion, time to device placement, incidence of gastric insufflations, ease of gastric tube placement, fiberoptic examination, airway stability and perioperative complications.

Results: Ease of device insertion, number of insertion attempts, fiberoptic grade and airway stability were similar between the two devices. However, OLP was higher (19.08 vs 15.60 cmH₂O, p<0.001) for the LMA-Supreme when compared to the LMA-Unique. Furthermore, incidence of gastric insufflation was higher (6 vs 0 patients, p<0.01) for the LMA-Unique. Placement of the gastric tube for the LMA-Supreme was successful in all children.

Conclusions: In anesthetized children not receiving neuromuscular blockade, the LMA-Supreme is associated with a higher OLP and less gastric insufflation versus the LMA-Unique. The LMA-Supreme performs similarly to the LMA-Unique in regards to ease of insertion, fiberoptic position and airway stability.

Student Name: Steven Constantino, Jr.

Host Department: Massachusetts General Hospital

Primary Mentor Name: Dr. Jianren Mao

Title of Research Project: The Role of Traditional Pain Management Techniques in Patients with Critical Limb Ischemia

Rest pain represents a significant morbidity in patients suffering from critical limb ischemia. While revascularization and amputation are the mainstay treatments for this condition and typically eliminate symptoms, not all patients are candidates for these procedures. Current modalities of managing rest pain symptoms include palliative medications, such as opiates, local anesthetics, GABA analogues, and NMDA antagonists, and treatments, including spinal cord stimulation, sympathectomy, and electroanalgesia. This poster will review the efficacy of the available pain management treatments and considers possible directions for future studies.

Student Name: Johnathan Cyr

Host Department: Dartmouth-Hitchcock Medical Center

Primary Mentor Name: Joseph Cravero, MD

Title of Research Project: Awake vs. Sedated Voiding Cystourethrogram Studies in Children – A Multicentered Evaluation of Outcomes

Introduction: Vesicoureteral reflux (VUR) is a common pathology in pediatric patients, and the accepted gold standard for diagnosing VUR is the voiding cystourethrogram (VCUG). While hundreds of thousands of VCUGs are performed each year across the United States, there is currently disagreement over the proper sedation/anesthesia to use for these procedures in children. Questions remain about how sedation may psychologically impact the child. In order to lend some clarity to the issue of sedation for VCUGs, we conducted an observational study whereby we compared deep sedation, minimal sedation, and unsedated VCUGs using a multicentered methodology.

Methods: After IRB approval and informed parental consent, children who were scheduled to undergo VCUG at Dartmouth-Hitchcock Medical Center (DHMC) and Connecticut Children's Medical Center (CCMC) were enrolled in the study. Inclusion criteria included age between 2-9 years, no allergy to anesthetics, signed parental consent, and good general health. No changes were made in the technique for providing sedation for VCUGs. Common practice at DHMC is to use mask induction with potent inhaled agents, followed by IV propofol deep sedation. Common practice at CCMC is to perform VCUGs with either no sedation or with oral midazolam. Outcomes of child personality, parental state anxiety, induction compliance, and post-hospital behavior changes were assessed using validated questionnaires and were compared between children undergoing VCUG using no sedation, minimal sedation with midazolam, and deep sedation with propofol.

Student Name: Kevyn Davenport

Host Department: Yale University

Primary Mentor Name: Chao Ma, MD

Title of Research Project: A Novel Mechanism Underlying Neurogenic Inflammation in a Murine Model of Collagen Antibody Induced Rheumatoid Arthritis

Rheumatoid arthritis (RA) is a chronic inflammatory disease accompanied by significant pain and hyperalgesia in the joints affected. An inappropriate immune response against self-antigens (e.g., type II collagen) in the joint is believed to be vital to the development of RA and recent studies also indicate a potential role for neurogenic inflammation. However, it is unclear how neurogenic inflammation is triggered in RA and whether it may be related to the autoimmune response. In this study, a model of collagen antibody induced arthritis (CAIA) was produced by injecting a C57BL/6 mouse with a cocktail of monoclonal antibodies against type II collagen. Behavioral tests indicated mechanical and heat hyperalgesia and decreased weight-bearing threshold in the hindpaw at 3-10 days post-injection, accompanied by a significant increase in the RA score. In vivo electrophysiological recordings from the dorsal root ganglion (DRG) neurons revealed spontaneous action potentials and decreased threshold to mechanical stimuli in C-nociceptive sensory neurons innervating the hindpaw. Immunofluorescent staining showed that the high-affinity activating receptor for IgG immune complex, Fc γ RI, is expressed in the mouse DRG neurons co-expressing substance P (SP) and Calcitonin gene-related peptide

(CGRP) – the peptides critically involved in neurogenic inflammation. Based on these results, we propose that nociceptive DRG neurons expressing Fc γ RI are directly activated by the IgG immune complex formed by autoantibody and self-antigen in RA, therefore triggering the release of SP and CGRP. This novel mechanism may underlie the neurogenic inflammation in RA and contribute to the development of joint pain and hyperalgesia.

Student Name: Luke Dong

Host Department: Medical University of South Carolina

Primary Mentor Name: Scott T. Reeves, MD

Additional Mentors: Jeffery J. Borckardt, PhD

Title of Research Project: Analgesic effects of two sessions of postoperative left prefrontal cortex repetitive transcranial magnetic stimulation.

BACKGROUND: Recent preliminary trials found that a single postoperative 20 minute repetitive transcranial magnetic stimulation (rTMS) treatment over the left prefrontal cortex was associated with a significant reduction in postoperative patient-controlled morphine use. This study sought to reproduce these results and to determine the value of adding a second rTMS treatment 4 hours after surgery on postoperative opioid use and postoperative pain.

METHODS: One hundred twelve participants who underwent gastric bypass surgery completed this study. Participants received two 20-minute treatments of Real or Sham postoperative rTMS. Each participant was randomized double-blind to one of four study groups for the two treatments (Real-Real, Sham-Real, Real-Sham, or Sham-Sham). Patient-controlled hydromorphone pump usage was tracked throughout each participant's postoperative hospital stay.

RESULTS: There were no differences among groups with respect to the mean total PCA (mg) hydromorphone use ($F(3,111)=2.32$, ns) nor to the cumulative PCA usage curve slopes during the 36-hour post-operative period ($F(1,111)=0.12$, ns) before or after controlling for chronic opioid-use status.

CONCLUSIONS: The results of this study failed to reproduce the analgesic effect of rTMS in a postoperative setting seen in previous studies. Total PCA opioid use and cumulative PCA usage curve slopes were comparable among randomized groups. The addition of a second treatment also failed to have a positive analgesic effect. Future studies should be geared toward better understanding variables that might influence TMS effects on pain perception in the perioperative setting and a dose-finding study seems warranted given the previous successful trials of TMS for post-operative pain management.

Student Name: Shiv Dua

Host Department: University of Pittsburgh

Primary Mentor Name: Michael S. Gold, PhD

Additional Mentors: Yi Zhu, Ferenc Gyulai, MD

Title of Research Project: Tyrosine Kinase Activity Contributes to the Inflammation-Induced Shift in Spinal GABA-A Receptor Signaling in the Rat

Persistent inflammation drives a shift in spinal γ -aminobutyric acid receptor type A (GABA-A) signaling such that application of the GABA-A receptor selective agonist muscimol, exacerbates inflammatory hypersensitivity. Preliminary in vitro data suggest an increase in GABA-A current underlies this shift. Furthermore, the increase in GABA-A current appears to be mediated by a relative increase in tyrosine kinase (TK) activity. Thus, the present study was designed to begin to determine the extent that these in vitro observations are manifest in vivo. Rats were randomized to one of four groups defined by the presence of persistent inflammation and the administration of a TK inhibitor. Mechanical nociceptive threshold (threshold) was determined before and 20 min after intrathecal administration of active (genistein) or inactive (genistone) TK inhibitor. All rats then received an intrathecal injection of muscimol. Threshold was determined 10 min later. There was no significant influence of genistein on threshold in naïve or inflamed rats. However, there was a significant interaction between inflammation and TK inhibitor on the response to muscimol: muscimol elevated threshold in the absence of inflammation and TK inhibitor, decreased threshold in the presence of inflammation but absence of TK inhibitor, and increased threshold in the presence of inflammation and TK inhibitor. Given our recent results suggesting that the inflammation-induced shift in signaling confers a deleterious impact to GABA-A receptor preferring general

anesthetics, the results of the present study suggest a novel strategy with which to minimize the potential for deleterious consequences associated with the use of such anesthetics.

Student Name: Brian Ebert

Host Department: University of Utah

Primary Mentor Name: Harriet Hopf, MD

Additional Mentors: Sean Runnels, MD

Title of Research Project: Does the UU Butyrylcholinesterase genotype predict a normal clinical and biochemical response to succinylcholine? A Model for Personalized Medicine in Anesthesia

Introduction: Personalized Medicine tailors treatment to genetic makeup, but has been little implemented in anesthesiology. Butyrylcholinesterase (BChE), a plasma cholinesterase, metabolizes succinylcholine. The presence of abnormal variants (A, S, K, etc.) results in prolonged neuromuscular blockade (NMB): moderate (20-40 min.) in ~1:300 individuals and profound (2-8 hrs.) in ~1:3000. Prediction of succinylcholine duration from an individual's genome would be a model for development of personalized medicine in anesthesiology. As a first step, we therefore examined whether a UU (normal) BChE genotype predicts a normal clinical and biochemical response.

Methods: With IRB approval and informed consent, we enrolled 50 (of 200 planned) ASA 1-2 subjects undergoing GA with intubation. Blood was collected prior to giving succinylcholine (1 mg/kg). Dibucaine Number (DN), activity (U/L) and genotype were measured. NMB duration was measured using acceleromyography. DN, activity and genotype were correlated with NMB duration.

Results: To date, 18/33 (55%) samples are UU. Median (range) NMB duration for UU was 8.0 (4 - 13.75) min. and for UA (UAK) was 13.9 (6 - 14) min. DN was 85 for all UU samples, and lower for all other samples. BChE activity was 3763-6693 U/L and did not predict UU status.

Conclusions: NMB duration for the UU genotype is consistent. DN of 85 is highly predictive of UU genotype. Activity is a poor predictor. Only 55% (18/33) of our samples were UU (82% were UU, UUK, or UK, despite a cited rated of 96%). Future volunteer studies will evaluate rare genotypes.

Student Name: Steven Engel

Host Department: University of Miami Miller School of Medicine

Primary Mentor Name: Kenneth Proctor, MD

Additional Mentors: Chad Thorson, MD

Title of Research Project: BIS vs. RASS

In the inpatient critical care setting, both over and undersedation are common problems that lead to unfavorable outcomes. Oversedated patients are at risk for increased days on the ventilator, prolonged hospital stays, and infections. Patients who are inadequately sedated may require physical restraints due to attempts at self-extubation and/or removal of invasive catheters. Numerous methods exist to measure the extent of sedation, and subjective sedation scales, including RASS (Richmond Agitation and Sedation Scale), are the most commonly used. Subjective scales require frequent nursing observations of patient's reactivity to stimuli. Scores range from +4 in a combative patient to -5 in an unarousable state. An objective tool for measuring sedation is the Bispectral Index (BIS), which is an objective number based on EEG and EMG-derived parameters. A score of 100 corresponds to a fully functional awake patient, whereas 0 corresponds to a brain dead patient. BIS has traditionally been used for tracking sedation in the operating room, but recent studies have shown that BIS scores in the ICU correlate with subjective sedation scales. In this study, intubated trauma patients in the ICU are randomly assigned to sedative monitoring with BIS or RASS. Sedative drugs are titrated to maintain a BIS score of 60 to 80, or a RASS score of 0 to -2. The hypothesis is that a BIS-driven sedation will result in lower sedative drug use, which may also lead to shorter ventilation time, less ICU associated infection, and decreased lengths of stay.

Student Name: Jessica Fields

Host Department: Mount Sinai School of Medicine

Primary Mentor Name: Leila Hosseinian, MD

Additional Mentors: David Reich, MD and Ira Hofer, MD

Title of Research Project: Using a Mathematical Model to Predict Daily Cardiothoracic Intensive Care Unit Census

Background: The occupancy of the cardiothoracic intensive care unit (CTICU) represents an important rate-limiting process in many institutions' cardiac surgical case volume. Resulting case cancellation leads to increased lengths of hospital stay and undesirable disruption of day-of-admission surgery. There is a lack of systems for modeling and prediction of CTICU occupancy.

Methods: We are currently collecting data in an IRB-approved retrospective chart review of CTICU for a recent 12-month interval. Variables to be assessed for predictive value include: (prior to ICU admission) age, gender, race, heart failure status, kidney disease, diabetes mellitus, lung disease, use of vasopressors/inotropes, post-cardiopulmonary bypass left ventricular ejection fraction, surgical procedure performed, urgency of surgery, and transfusion data. ICU variables include daily creatinine, PaO₂:FiO₂, cardiac rhythm, use of vasopressors/inotropes, delirium assessment, lactate, pulmonary artery pressure, hemoglobin level, and transfusion requirements. The statistical methods include queuing theory and competing risk models to assess the likelihood of daily transfer or demise for each ICU patient.

Results: Data analysis is in progress. They will be presented at the ASA Annual Meeting.

Discussion: Existing literature focuses on predicting ICU length of stay at ICU admission using tools, such as SOFA and APACHE II. These tools do not account for the different mechanisms of ICU discharge, such as clinical improvement or death. The current investigation is directed towards daily prediction of likelihood that a patient will vacate an ICU bed.

Student Name: Karina Geronilla

Host Department: Medical University of South Carolina

Primary Mentor Name: Alan Finley, MD

Additional Mentors: Peggy Edgerton, RN, BSN, Jeffery Borckardt, PhD

Title of Research Project: Preoperative Prothrombin Time as a Predictor of Postoperative Bleeding in Patients Undergoing Left Ventricular Assist Device Placement

Background: Left ventricular assist device (LVAD) implantation in end-stage heart failure patients is frequently associated with perioperative bleeding complications, which are a major cause of morbidity. Preoperative identification of high-risk patients may lead to better risk stratification and optimization of coagulation status prior to surgery.

Methods: We conducted a retrospective chart review of patients who underwent LVAD implantation at MUSC from April 2009 to July 2011. We reviewed preoperative anticoagulation medications and vitamin K, coagulation values, blood transfusions, and bleeding or thrombotic complications. Twenty-seven LVAD patients were divided into normal preoperative PT (n=12) and prolonged preoperative PT (n=15) groups.

Results: Prolonged preoperative PT was associated with elevated total chest tube, wound drainage, and JP tube output on POD1 (p=0.023) and POD1-POD7 (p=0.020), as well as delayed chest closure (p=0.042). Increased utilization of postoperative blood products was observed in prolonged PT groups (13.6 units in prolonged PT group vs 5.7 units in normal PT group), but was not statistically significant.

Conclusions: Increased preoperative PT is associated with increased postoperative chest tube output and delayed chest closure. Larger sample sizes are needed to evaluate if patients with prolonged preoperative PT values require increased postoperative blood transfusions. Elevated PT signifies a decrease in hepatic synthesis of coagulation factors secondary to passive congestion and hepatic ischemia from chronic heart failure. Knowledge gained by identifying patients at risk for perioperative bleeding complications may allow clinicians to implement interventions preoperatively to improve hepatic synthetic function through use of inotropic support and/or vitamin K repletion.

Student Name: Elizabeth Hong
Host Department: University of Michigan
Primary Mentor Name: Chad Brummett, MD
Additional Mentors: Ralph Lydic, PhD
Title of Research Project: Perineural Dexmedetomidine Added to Ropivacaine for Sciatic Nerve Block in Rats Prolongs the Duration of Analgesia by Blocking the Hyperpolarization-activated Cation Current

Background: The current study was designed to test the hypothesis that the increased duration of analgesia caused by adding dexmedetomidine to local anesthetic results from blockade of the hyperpolarization-activated cation (I_h) current.

Methods: In this randomized, blinded, controlled study, the analgesic effects of peripheral nerve blocks using 0.5% ropivacaine alone or 0.5% ropivacaine plus dexmedetomidine (34 mcM or 6 mcg/kg) were assessed with or without the pretreatment of alpha1- and alpha2-adrenoceptor antagonists (prazosin and idazoxan, respectively) and antagonists and agonists of the I_h current (ZD7288 and forskolin, respectively). Sciatic nerve blocks were performed, and analgesia was measured by paw withdrawal latency to a thermal stimulus every 30 min for 300 min postblock.

Results: The analgesic effect of dexmedetomidine added to ropivacaine was not reversed by either prazosin or idazoxan. There were no additive or attenuated effects from the pretreatment with ZD7288 (I_h current blocker) compared with dexmedetomidine added to ropivacaine. When forskolin was administered as a pretreatment to ropivacaine plus dexmedetomidine, there were statistically significant reductions in duration of analgesia at time points 90–180 min ($P < 0.0001$ for each individual comparison). The duration of blockade for the forskolin (768 mcM) followed by ropivacaine plus dexmedetomidine group mirrored the pattern of the ropivacaine alone group, thereby implying a reversal effect.

Conclusion: Dexmedetomidine added to ropivacaine caused approximately a 75% increase in the duration of analgesia, which was reversed by pretreatment with an I_h current enhancer. The analgesic effect of dexmedetomidine was not reversed by an alpha2-adrenoceptor antagonist.

Student Name: Allison Janda
Host Department: Regents of the University of Michigan
Primary Mentor Name: Chad M. Brummett, MD
Additional Mentors: Ms. Amy Shanks, MS
Title of Research Project: The Degree of Agreement Between Nurse-Recorded and Patient-Reported Pain Intensity Data Using the Brief Pain Inventory

Background: The present study was designed to test the hypothesis that there would be high concordance between preoperative pain scores verbally reported to nurses as a portion of standard clinical care when compared with the same questions administered in their validated pen-and-paper form using the Brief Pain Inventory (BPI).

Methods: This is a secondary analysis of an ongoing prospective study of chronic post-surgical pain outcomes. Frequency distribution analyzed the difference in report of chronic pain. The degree of agreement between pain scores by each method was compared using bias statistics (kappa statistics) and Bland Altman plots. STATA 11 was used for all statistical analyses.

Results: Of those patients indicating chronic pain on the written questionnaire, 88% were also asked by nurses about chronic pain, and of those asked, 69% consistently responded as having chronic pain verbally to nurses. The kappa statistics, for the current, worst, least, average, and average of all recorded scores, were 0.33, 0.38, 0.38, 0.25, and 0.23, respectively, indicating “fair” agreement amongst all scores. The limits of agreement found using Bland Altman plots indicate that no difference between the two methods falls within the 95% confidence interval of the mean difference.

Conclusions: There exists a fair agreement between those pain scores collected by validated written questionnaire and those collected verbally by nurses. This is significant in that those pain scores collected by nurses for all pre-operative patients could be utilized as a validated variable in clinical research, opening data from a large patient population to researchers.

Student Name: Stephen Johnston

Host Department: Medical College of Wisconsin

Primary Mentor Name: Judy Kersten, MD

Additional Mentors: Phillip Pratt, PhD, Dr. Jesse Procknow, PhD

Title of Research Project: Investigation of Histone Deacetylase-6 Regulation of Nitric Oxide Production in Human Coronary Artery Endothelial Cells

Non-selective inhibition of histone deacetylases (HDAC) provides protection against myocardial ischemia and reperfusion injury; however the mechanisms underlying this cardioprotective effect are unknown. Preliminary experiments showed that trichostatin A (0.2 mg/kg, i.v.) treatment of wild type mice reduced infarct size after coronary artery occlusion and reperfusion (38±4% vs. 53±4% control group). We have previously shown that endothelial nitric oxide synthase is a critical enzyme involved in cardioprotection. This pilot study tested the hypothesis that downregulation of HDAC-6 expression and activity enhances nitric oxide (NO) production and thus may be a unique intervention to enhance endogenous cardioprotective mechanisms. Human coronary artery endothelial cells (HCAEC) were transduced with lentiviral vectors [scrambled shRNA (SCR) or HDAC-6 shRNA] and cell lysates were collected to analyze acetylated α -tubulin and HDAC-6 expression by Western blot and HDAC activity by a colorimetric assay. Cell media was collected for measurement of NO using ozone chemiluminescence. HDAC-6 expression and HDAC activity were reduced in cells transduced with HDAC-6 shRNA (26.64 ± 7.28% and 19.26 ± 5.29%, respectively) as compared to SCR cells. Conversely, nitric oxide and acetylated α -tubulin were increased in HDAC-6 shRNA (1.40-fold and 1.95-fold, respectively) compared to SCR cells. These data support the concept that inhibition of HDAC-6 may contribute to endogenous cardioprotective pathways.

Student Name: Sunchin Kim

Host Department: Mayo Clinic Rochester

Primary Mentor Name: Y.S. Prakash, MD, PhD; Christina Pabelick, MD

Additional Mentors: William Hartman, MD, PhD

Title of Research Project: Responses of Human Fetal Airway Smooth Muscle to Oxygen

Background: Premature infants requiring supplemental oxygen (hyperoxia) with/without mechanical ventilation are at high risk for bronchopulmonary dysplasia (BPD) and childhood diseases such as asthma. Clinically, there is increasing interest in determining an optimal O₂ concentration to maintain oxygenation without excessive detriment. A major feature of both BPD and asthma is structural and functional changes in airway smooth muscle (ASM) involving enhanced ASM proliferation and airway remodeling. We used human fetal ASM cells to test the hypothesis that hyperoxia causes an imbalance between cellular proliferation and apoptosis, thus contributing to airway remodeling.

Methods: fASM cells (18-22 weeks PCA; de-identified samples, IRB exempt) were exposed to a range of oxygen concentrations (21% (normoxia) to 100%) for 48-72h. Cell proliferation and apoptosis were evaluated using fluorescence assays (Cyquant) as well as Western blot analysis of markers such as Ki-67, PCNA, Bcl-2, and cytochrome C.

Results: Compared to normoxia, fASM cells exposed to hyperoxia showed increased expression of proliferative markers up to 60% O₂. However, at 70% O₂ and beyond, pro-apoptotic protein expression increased, while markers for proliferation were downregulated. This pattern was supported by enhanced fASM proliferation at ≤60% O₂ in a dose-responsive fashion, but rapid increase in cell death and apoptosis with further O₂ increase.

Discussion: These results demonstrate that one determinant in the search for optimal hyperoxia in premature infants may be ASM proliferation. Here, O₂ levels beyond 60% may be particularly detrimental and may contribute to airway remodeling and airway diseases.

Student Name: Michael Kreger

Host Department: Vanderbilt University

Primary Mentor Name: Gina Whitney, MD

Additional Mentors: Brian Donahue, MD, PhD

Title of Research Project: Reduction in Intraoperative Blood Product Administration Following Introduction of a Standardized Transfusion Protocol

Transfusion is common following cardiopulmonary bypass in children. While transfusion is often life-sustaining, blood products are also associated with mortality, infection, and duration of mechanical ventilation. Transfusion in pediatric cardiac surgery is often based on clinical judgment rather than objective data, possibly leading to overutilization and increased patient morbidity. Although objective transfusion algorithms have demonstrated efficacy for reducing transfusion and improving outcome in adult cardiac surgery, such algorithms have not been applied in the pediatric setting. To measure the impact of an objective, laboratory-guided transfusion algorithm in pediatric cardiac surgery, we devised an evidence-based transfusion protocol to be implemented in January 2011, and we monitored the subsequent impact of this algorithm on blood utilization, both in the operating room and during the first 12 hours following ICU admission. When compared with the 5 months preceding implementation, blood utilization in the operating room for the 5 months following implementation decreased by 69% for red cells ($p=0.022$), and 88% for cryoprecipitate ($p<0.001$). Blood utilization during the first 12 hours of ICU admission did not increase during this time, and actually decreased 52% for plasma ($p=0.017$) and 39% for red cells ($p=0.046$), indicating that the decrease in operating room transfusion did not transfer the transfusion burden to the ICU. OR case volume did not change appreciably during the study interval ($p=0.307$). These results indicate that introduction of an objective transfusion algorithm in pediatric cardiac surgery significantly reduces intraoperative blood product utilization, and may thereby improve clinical outcome while reducing cost.

Student Name: Jennifer Lee

Host Department: Columbia University

Primary Mentor Name: Lena Sun, MD

Title of Research Project: Epidemiology of Obesity in Pediatric Surgical Patients

Childhood obesity is a significant public health problem in the U.S. We sought to determine the epidemiology of obesity in a pediatric surgical population for future trial design to test the feasibility and utility of perioperative weight loss counseling by anesthesiologists. We reviewed CUMC electronic anesthesia records of 2-18 year olds from 2009-2010. Using body mass index (BMI), all children (excluding bariatric surgical patients) were classified as nonobese or obese using the CDC and International Obesity Task Force (IOTF) criteria. Of 8,850 total patients, 4,944 were males (56%), and 3,906 were females (44%). Mean age (\pm SD) was 9.4 ± 5.2 years, and BMI was 19.4 ± 5.4 kg/m². The prevalence of obesity was 17.7% by CDC and 13.2% by IOTF. These were comparable between males and females, but the age distribution of obese children differed by gender. A high proportion of obese males and females were in the 2-5 year age group, but in the 14-18 year age group only for obese females. 80% of obese children were either ASA 1 or 2. ENT surgical patients had the highest prevalence of obesity (20.9% by CDC; 15.3% by IOTF). A significantly higher percentage of obese 2-9 year olds (30%) underwent ENT surgery compared to nonobese 2-9 year olds (24%). Obese ENT patients also had longer duration of anesthesia than their nonobese counterparts. Our results suggest that 2-9 year old ENT surgical patients may be a group to test perioperative weight loss counseling as a possible public health intervention.

Student Name: Tong Liu

Host Department: State University of NY (SUNY) Stony Brook

Primary Mentor Name: Helene Benveniste, MD, PhD

Additional Mentors: Christopher Biel

Title of Research Project: Patient-Reported Outcomes Measurement Information System (PROMIS) Assessment in Lumbar Spinal Stenosis (LSS) Patients undergoing Minimally Invasive Lumbar Decompression (MILD)

Introduction: The NIH PROMIS questionnaire captures a series of domains reflecting physical, mental, and social health. We used PROMIS to characterize LSS patients before and after the MILD procedure.

Methods: Data were collected from 25 patients under an IRB-approved Quality-Assurance (QA) Program created to evaluate outcomes and safety following the MILD procedure at Center for Pain Management. In addition to demographic and health-related questionnaires, PROMIS was administered before and 1-month following MILD. Visual Analogue pain Scores (VAS) and functional assessments via the Oswestry Disability Index (ODI) were also obtained.

Results: The MILD patients' pre-operative PROMIS scores for 'anger', 'fatigue' and 'depression' were within average range compared to normalized population scores; however, pre-operative 'anxiety', 'pain interference', 'pain behavior', 'physical function' and 'satisfaction with social activities' scores were significantly worse. The depression statuses of MILD patients correlated highly with their post-operative VAS and 'pain interference' scores, but not with corresponding scores for 'pain behavior'. Post-operatively, the patients with the best ODI outcomes were characterized by superior functional, mental and social health compared to those who did not improve.

Conclusions: We implemented PROMIS as part of our QA Program to better assess LSS patients' functional, mental, and social health before and after the MILD procedure. Our preliminary data analysis suggests that conventional measures of chronic pain with VAS do not appear to capture pain behavioral patterns. In contrast, ODI appears to partly reflect social health data obtained from PROMIS.

Student Name: Robert Marron

Host Department: UMDNJ-NJMS

Primary Mentor Name: Melissa Davidson, MD

Additional Mentors: Vasanti Tilak, MD, Catherine Schoenberg, BSN

Title of Research Project: An Investigation Into Transitions of Anesthesia Care in the Operating Room

Purpose: To describe the prevalence of anesthesia transitions of care (TC) in the OR setting; and to assess providers' perceptions of the adequacy of transfer of patient information.

Methods: A retrospective chart review was performed for all anesthesia cases for the month of April 2011 at an urban teaching hospital to assess the prevalence of TC. Prospectively, an independent observer conducted and transcribed a standardized, three-question interview of anesthesia providers 30 minutes after they took over an on-going case: what remaining questions provider had after TC, what they would have done differently had they begun case themselves, and feelings about taking over case. Excluded were cases in which continuity of care was maintained at midlevel provider (Resident/CRNA) despite transition between attending physicians; transitions involving first year residents in first 30 days of residency; and cases where transfers were for short breaks. Interview response coding was performed individually by three investigators, and consensus reached on major themes.

Results: TC occurred in 237 out of 1129 anesthesia cases. Of 32 interviews (to date), no communication concerns were raised in 17 cases. Of those with concerns, the following themes were identified: postoperative pain plan, anesthesia technique, fluid management, monitoring, positioning, medication selection, equipment organization, temperature management, and preoperative medical information. In 15 cases the provider would have done something differently or stated negative feelings about taking over case.

Conclusion: Transfers of anesthesia care are common. Relieving providers had lingering questions, or indicated preferences had they started the case, or both.

Student Name: Thomas Masterson

Host Department: University of Miami Miller School of Medicine

Primary Mentor Name: Ken Proctor, PhD

Additional Mentors: Chad Thorson, MD

Title of Research Project: Hextend vs. Stanard of Care Fluids in Resuscitation of Operative Trauma Patients

Hextend (6% Hetastarch in Lactated electrolyte solution) was first used by the military for fluid resuscitation in combat situations due to its favorable weight to benefit ratio for intravascular expansion. Recently Hextend was tested during the initial resuscitation of trauma patients at Ryder Trauma Center. When Hextend was added as a therapeutic option, an

overall mortality reduction was found compared to standard of care. The current study evaluates standard of care fluids versus Hextend plus standard of care for the resuscitation of trauma patients requiring immediate operative intervention within 4 hours of arrival. Patients were further divided into groups based on the mechanism of injury (penetrating or blunt), and data for the first 24 hours was collected. Outcomes were determined using hemodynamic, laboratory, and fluid data. Statistical analysis showed no significant demographic differences between the standard of care fluid and the Hextend group. Patients receiving Hextend therapy were in worse condition than the standard of care group on arrival to the hospital, with a higher initial heart rate, and lower baseline hematocrit. Despite this, the Hextend group required less fluids and blood products within the first 24 hours, with a greater urine output. This data supports the use of Hextend by the military for both blunt and penetrating trauma, but to better understand the efficacy, a randomized clinical trial is necessary.

Student Name: Maleeha Mohiuddin

Host Department: Northwestern University's Feinberg School of Medicine

Primary Mentor Name: Paloma Toledo, MD, MPH

Additional Mentors: Cynthia Wong, MD

Title of Research Project: Racial/Ethnic Differences in Health Literacy and Use of Labor Neuraxial Analgesia

Background: Neuraxial analgesia is the most effective method of relieving labor pain; however, a racial/ ethnic disparity exists in labor neuraxial analgesia use. We hypothesized that patients with low health literacy would be less likely to utilize neuraxial analgesia than patients with high health literacy.

Methods: A survey was developed and tested for content validity. In-person interviews were conducted upon admission to the Labor and Delivery Unit, prior to a pre-anesthetic consultation. Data collected included demographic data, analgesic plans, source used for labor analgesia information, knowledge of neuraxial analgesia, and health literacy (s-TOFLA). Data were analyzed using χ^2 statistic. $P < 0.05$ was significant.

Results: One hundred patients were interviewed and 96% completed the survey (68 White, 17 Hispanic, and 11 African American). White patients were more likely to be married, college educated, have private insurance and higher incomes than minority patients ($P < 0.01$ for all). There were no differences in health literacy among the groups; however Hispanics were least likely to plan and receive neuraxial analgesia for labor ($P < 0.05$). White patients scored the highest on the knowledge assessment, and were more likely to use prenatal classes as their primary source of information ($P < 0.05$).

Conclusions: Despite adequate health literacy, knowledge and use of neuraxial analgesia was the lowest among minority patients, and they were more likely to be unsure of their labor analgesic plans. Future studies should evaluate whether prenatal educational interventions alter racial/ethnic disparities in neuraxial analgesia knowledge and use.

Student Name: Jennifer Mytar

Host Department: Texas Children's Hospital

Primary Mentor Name: Ken M. Brady, MD

Additional Mentors: R. Blaine Easley, MD

Title of Research Project: Autoregulation is intact when CPP is optimized after severe unilateral brain injury in a neonatal swine model

Background: Autoregulation is impaired by traumatic brain injury (TBI). CBF disturbances are known to be spatially heterogeneous. We tested the lateralization of autoregulatory responses during hypotension following unilateral TBI.

Methods: Neonatal piglets (5-7 days) had controlled cortical impact (severe, $n=12$; moderate, $n=13$; sham, $n=13$) and recovery for 6 hours. The lower limit of autoregulation (LLA) was determined for each subject by ABP lowering and the two best-fit lines method using laser-Doppler recordings. The static rate of autoregulation (SRoR) was determined for each subject at CPP immediately above the LLA.

Results: The ipsilateral LLA was not increased following injury (Sham 34 mmHg [29-39 mmHg], moderate injury 37 mmHg [33-41 mmHg], severe injury 35 mmHg [32-38]; $p=0.93$, mean [95% C.I.]). The ipsilateral SRoR, when measured

above and within 10 mmHg of the LLA showed intact autoregulation in the injured subjects and was not different compared to uninjured subjects (Sham 0.82 [0.53-1.1], moderate injury 1.0 [0.60-1.5], severe 0.91 [0.33-1.5], $p=0.44$). Interhemispheric LLA measurements were similar in the injured groups with an average hemispheric difference of 2.7 mmHg, (95% limits of agreement -7.5 – 7.0, bias -0.25; Spearman $r=0.73$, $p<0.0001$). Interhemispheric SRoR measurements also showed correlation in the injured groups (Spearman $r=0.85$, $p<0.0001$).

Conclusion: LLA was not increased by controlled cortical impact, nor did SRoR measurements demonstrate ineffective autoregulation when CPP was above and within 10 mmHg of the LLA in this study of acute TBI. CPP optimization was significantly similar between the two hemispheres despite severe unilateral injury.

Student Name: Darren Nabor

Host Department: Medical College of Wisconsin

Primary Mentor Name: Matthias Riess, MD, PhD

Additional Mentors: Quinli Cheng, MD

Title of Research Project: Resistance to Preconditioning in Rat Isolated Hearts: Is there a Genetic Component?

INTRODUCTION: Anesthetic and Ischemic Preconditioning (APC, IPC) have been shown to attenuate myocardial ischemia/reperfusion (IR) injury. However, genetic background may be a confounding factor in the outcome of cardioprotective strategies. Using an established rat model of genetically determined resistance to IR injury we tested the hypothesis of a genome-dependent resistance to APC/IPC.

METHODS: We measured ventricular and coronary function in 36 Langendorff-prepared hearts from eight-week old male Brown Norway (BN) and Dahl Salt-Sensitive (SS) rats. IPC was achieved by two 5-min periods of ischemia with 5 min reperfusion interspersed, APC by 2 MAC sevoflurane for two 5-min periods 5 min apart, ending 15 min before 30 min global no-flow ischemia and 120 min reperfusion. Control hearts were not preconditioned. Infarct size (IS) was determined by TTC staining and cumulative planimetry.

RESULTS: IPC more than APC resulted in a significant improvement in left ventricular developed pressure and contractility and decreased infarct size in BN hearts but not in SS hearts after 120 min reperfusion; coronary flow was not affected.

CONCLUSION: Our study shows for the first time that there appears to be a genome-dependent resistance to APC/IPC in SS vs BN rats. These results suggest a strong genetic dependence for endogenous cardioprotective signaling and provide a model for a more in-depth investigation of the genetic mechanisms of preconditioning using consomic and congenic animal models.

Student Name: Meaghan Neill

Host Department: Vanderbilt University

Primary Mentor Name: Gina Whitney, MD

Additional Mentors: Dan France, PhD

Title of Research Project: A Process-Flow and Economic Analysis of Blood Utilization and Blood Waste at Monroe Carell, Jr. Children's Hospital at Vanderbilt University

In 2011, in response to growing evidence that blood transfusions are associated with adverse patient outcomes, Monroe Carell, Jr. Children's Hospital at Vanderbilt University (MCJCHV) implemented an evidence-based blood transfusion protocol for pediatric patients undergoing surgery requiring cardiopulmonary bypass, which aimed to standardize blood transfusion practices. We conducted an activity-based economic analysis of transfusion practices in the pediatric cardiac population to determine the impact of this protocol on transfusion-related resource demands and the cost of wasted products. In specific units at the pediatric hospital in 2010, 57,004 units of blood product were transfused, while 383 units were wasted. Based on our economic model, the cost of these wasted units totaled \$ 134,050. In the first six months of 2011, these same pediatric units transfused 17,937 units of blood product and 173 units of blood (\$60,550) were wasted. These data demonstrate a 38% reduction in the number of units transfused and 10% reduction in the number of units of blood wasted in specific units at MCJCHV. An appropriate cost estimate of blood utilization and waste at MCJCHV will

enable us to undertake future cost-effectiveness analyses of blood conservation strategies while estimating direct financial impact of future blood management strategies. Future studies linking patient outcomes with the cost of transfusion, as well as estimating the financial impact of morbidities attributable to transfusion will be critical in directing the future of blood transfusion medicine and developing strategies to modify blood transfusion practices.

Student Name: Christopher Nguyen

Host Department: University of California Irvine

Primary Mentor Name: Maxime Cannesson, MD, PhD

Title of Research Project: The Ability of Stroke Volume Variations Obtained with the Endotracheal Cardiac Output Monitor to Predict Fluid Responsiveness in Mechanically Ventilated Patients

Introduction: Dynamic parameters of fluid responsiveness, such as stroke volume variation (SVV), are far superior to static indicators (such as central venous pressure). A new endotracheal cardiac output monitor (ECOM, Conmed Corporation; Irvine, CA) allows for cardiac output monitoring using bio-impedance. The ECOM continuously calculates and displays stroke volume variation (SVVECOM). The goal of this prospective study was to test the ability of SVVECOM to predict fluid responsiveness in mechanically ventilated patients under general anesthesia.

Methods: We studied 10 patients undergoing cardiac surgery. Exclusion criteria included severe tricuspid regurgitation, congestive heart failure (Ejection fraction < 25 %), and arrhythmia. All patients were equipped with an ECOM endotracheal tube and a pulmonary artery catheter (PAC). For all patients, cardiac output (CO) was measured using pulmonary artery thermodilution before and after 500 ml fluid infusion. SVV before and after fluid infusion were also recorded via ECOM. Fluid responders were defined as an increase in CO > 12% after fluid bolus.

Results: Overall, 10 measurements were performed. There were 4 responders, 6 non-responders. There was a statically significant correlation between SVV pre-fluid and change in CO after fluid infusion ($r = 0.76$). The SVV pre-fluid was significantly greater in responders than non-responders ($p < 0.05$).

Conclusion: The new ECOM is a promising device that continuously calculates and displays SVV. In this study, SVVECOM predicted fluid response in patients undergoing cardiac surgery. We hope to enroll more patients to better characterize the relationship between SVVECOM and fluid-responsiveness.

Student Name: Jonathan Paul

Host Department: SUNY Downstate Medical Center

Primary Mentor Name: Beklen Kerimoglu, MD

Title of Research Project: Distraction Induction With Videoglasses

Significant preoperative anxiety is observed amongst 40-60% of pediatric patients. The anxiolytic gold standard, midazolam, is not always available and may be contraindicated for those with moderate to severe obstructive sleep apnea. Music, video games, and childcare specialists reduce distress through partial distraction. Virtual reality systems have efficacy in pain management; but no such device, which distracts auditory and visual senses, has been evaluated perioperatively. Videoglasses provide comprehensive distraction and their portability enables continuous use up to and during inhalation induction. The goal of this study was to evaluate whether distraction with videoglasses decreases preoperative anxiety in comparison to midazolam. Children aged 4-9 years, ASA status I-II, scheduled to undergo ambulatory surgery with general anesthesia were recruited. Subjects were randomized into three groups receiving midazolam, videoglasses, or videoglasses and midazolam, twenty minutes before transport to the OR. Using the modified Yale Preoperative Anxiety Scale, a behavioral assessment tool, anxiety scores were recorded along with heart rates before intervention, during transport to the OR, and at the time of mask induction. Ninety-six children aged 4-9 years, with equally distributed age, gender, weight and height, participated in this study between July 2009 and August 2011. There was no difference in the mYPAS score or the heart rate at any of the observation time-points among the three groups. These results indicate that the level of anxiety experienced by a child given medication or videoglasses or both is the same. We conclude that videoglasses may be a novel anxiolytic alternative to midazolam.

Student Name: Marci Pepper

Host Department: Regents of the University of Michigan

Primary Mentor Name: Satya Krishna Ramachandran, MD, F.R.C.A.

Additional Mentors: Ms. Amy Shanks, M.S., Kevin Tremper, MD, PhD, Sachin Kheterpal, MD, MBA

Title of Research Project: High Risk of Obstructive Sleep Apnea is an Independent Predictor of Unanticipated Early Postoperative Tracheal Intubation

Purpose: Postoperative respiratory failure necessitating unanticipated intubation has ~2% incidence, and half of these intubations occur within 3 days of surgery. We undertook this study to evaluate the relationship between high risk of obstructive sleep apnea (OSA) and unanticipated early postoperative intubation (UEPI) after non-cardiac surgery.

Methods: Characteristics previously identified as independent predictors of UEPI were evaluated from a single center perioperative database with NSQIP outcomes data. High risk of OSA, defined as a Perioperative Sleep Apnea Prediction (PSAP) score of >5, was also an independent variable, with PSAP score <4 forming the control. UEPI was defined as occurring within 3 days of surgery to account for both peak respiratory depressant period up to the period of most severe postoperative sleep disturbances. 30-day unanticipated intubation was a secondary outcome.

Results: 17,124 subjects were studied, of whom 80 (0.47%) had UEPI. High risk of OSA was significantly associated with UEPI on both univariate and adjusted analyses. The area under receiver operating characteristic curve of the model was 0.70. High risk of OSA was associated with a 3 fold increase in UEPI and a 4.5 fold increase in 30-day unplanned intubation rates.

Conclusions: We identified an independent relationship between high risk of OSA and UEPI in a large surgical outcomes database. This finding has clinical implications as UEPI is a significant marker of mortality after non-cardiac surgery. These data could further refine the screening processes and potentially impact utilization of intensive monitoring and therapy in patients with high risk of OSA.

Student Name: Kasey Pierson

Host Department: Oregon Health & Science University

Primary Mentor Name: Angela Kendrick, MD

Title of Research Project: Is intra-operative acupuncture at P6 plus IV antiemetics more effective than IV antiemetic therapy alone in preventing postoperative vomiting in pediatric patients following tonsillectomy with or without adenoidectomy?

Background: Postoperative nausea and vomiting (PONV), together, embody one of the most common and dissatisfying side effects following anesthesia and surgery. More specifically, tonsillectomy is known as a particularly emetogenic operation. There has been accumulating evidence that intraoperative acupuncture at the P6 point is an efficacious measure at limiting PONV in adult patients, but the evidence supporting the use for children is not nearly as conclusive. There is no data for using the combination of both standard antiemetic therapy and acupuncture to decrease postoperative nausea and vomiting in children. This study aims to compare the effectiveness of standard antiemetic treatment versus standard antiemetic treatment plus P6 acupuncture at preventing PONV in pediatric patients undergoing tonsillectomy with or without adenoidectomy.

Methods: 200 patients, ages 3-9, will be randomly assigned to one of the two treatment groups prior to their surgery. Each group receives standard antiemetic medications while only one group receives acupuncture perioperatively. PONV is assessed via usual protocol while the patients remain at the post-anesthesia care unit and a follow-up phone call 24 hours following surgery to assess for overnight symptoms. Differences in vomiting incidence and time till vomiting are compared.

Results: This project remains ongoing and is currently enrolling patients. At this juncture, insufficient data has been collected to conduct any statistical analysis.

Conclusion: The investigators of this study hypothesize that P6 acupuncture will not add any significant reduction to postoperative nausea and vomiting in patients undergoing tonsillectomy with or without adenoidectomy.

Student Name: Naveen Reddy

Host Department: The Children's Hospital of Philadelphia

Primary Mentor Name: Gordon Barr, PhD

Additional Mentors: Ron Litman, DO

Title of Research Project: Immune system correlates in morphine withdrawal of infant rats: a flow cytometric analysis

Traditionally, research has concentrated on the neuron mediated effects of opiates. Within the past decade, some of the focus has shifted to non-neuronal effects. Here we focus on the interplay between morphine withdrawal and the infant rat immune system. While there has been increased research in recent years on how the immune system influences dependence and tolerance to drugs such as morphine, it is not known how those same processes work in infants. In the infant, many of the mechanisms of inflammation, including immune responses, are not yet mature. In adult rats chronic morphine withdrawal induced upregulation of glial fibrillary acidic protein (GFAP) and tumor necrosis factor alpha (TNF α) in the periaqueductal gray (PAG). It is not known whether there is a similar response in infants. We will investigate the level of immune system activation under eight experimental conditions: saline, morphine, lipopolysaccharide (LPS), and LPS and morphine injections combined with either saline or naloxone to precipitate withdrawal. LPS is a bacterial cell wall protein that activates toll like receptors (TLR) of the mammalian innate immune system. Flow cytometry is used to quantitatively assess the differences in specific cell populations between experimental groups. We are primarily looking at the levels of astrocytes and microglia by using fluorescent antibodies against GFAP and CD11/CD45 respectively. We also use antibodies against TNF α to see which cells, if any, are expressing this cytokine in infant rats. All assays are done on freshly dissected, complete spinal cords. Results: experiment ongoing.

Student Name: Damoon Rejaei

Host Department: University of Wisconsin-Madison

Primary Mentor Name: Robert Pearce, MD, PhD

Title of Research Project: Effects of Novel Intravenous Fluorocarbon-Based Emulsions of Sevoflurane in Canines

Intravenous delivery of fluorinated volatile anesthetics leads to rapid anesthetic induction by eliminating the lung equilibration time, and to rapid recovery following elimination through the lungs. This mode of delivery could be particularly beneficial for brief and intense stimuli. However, our previous canine investigations using novel intravenous 20% v/v sevoflurane solubilized by fluorinated surfactant polymer resulted in profound histamine release. We hypothesized that adding glucose moieties to the surfactant molecules would decrease their immunogenicity. We investigated the cardiovascular, immunogenic, and anesthetic effects of three re-formulated intravenous sevoflurane emulsions in beagles: M1F13 (n=3, no glucose), G1M1F13 (n=2, one glucose) and G3M1F13 (n=1, 3 glucose). All emulsions produced general anesthesia. However, dogs exhibited adverse clinical signs which worsened with increasing number of glucose molecules (eg. urticaria, vomiting, scleral injection, hematochezia); only 1 dog was administered G3M1F13 due to the severity of the reaction. Mean blood pressure decreased from 124 and 150 mm Hg pre-injection to a minimum of 32 and 74 mm Hg approximately 7 minutes following injection of M1F13 and G1M1F13, respectively. Activated prothrombin times were increased in G1M1F13 dogs post-injection versus control samples. Pre- and post-injection (5, 10, 14, 21, 28 days) plasma histamine, IgE, IgM and complement levels are pending. Given the small sample size, no statistical analysis was done. Our data suggest an anaphylactic or anaphylactoid hypersensitivity reaction entailing release of histamine, prostaglandins, and heparin. We conclude that bolus administration of these intravenous sevoflurane polymers are unsuitable for inducing general anesthesia in dogs due to side effects.

Student Name: Benjamin Roberts

Host Department: University of Alabama at Birmingham

Primary Mentor Name: Timothy Ness, MD, PhD

Additional Mentors: Meredith Robbins, PhD

Title of Research Project: Duration of Stress-induced Bladder Distention Hypersensitivity and Effects of an Enriched-environment Intervention in Rats

Stress-induced hypersensitivity is a common clinical observation associated with multiple painful diseases, including functional urinary disorders such as interstitial cystitis/painful bladder syndrome (IC/PBS). A majority of patients with IC/PBS report symptom exacerbation by clinical stress. Experimental stress increases bladder pain and urgency in these individuals. Previous studies have shown that stress can worsen bladder sensitivity in rat models of bladder nociception. The present study sought to (1) identify the duration of the effects of a 7-day chronic footshock (CFS) stressor on bladder nociception in female rats, and (2) determine whether exposure to an enriched environment (EE) can alleviate and/or prevent CFS stress-induced bladder hypersensitivity. It was confirmed that rats undergoing the CFS paradigm demonstrated bladder hypersensitivity, measured as an electromyographical (EMG) response to urinary bladder distension (UBD), compared to rats experiencing the non-CFS paradigm. Four hours post-exposure to chronic stress, rats still exhibited significantly greater responses compared to the non-CFS group, but this effect dissipated 24 hours after FS. One new group of rats was then exposed to the CFS paradigm with one 3-hour EE encounter on day 7. A second group of rats entered the EE for 3 hours post-FS treatment each day for 7 days. While a single exposure to the EE on day 7 did not alleviate the FS-induced effects, daily exposure immediately following FS prevented the development of bladder hypersensitivity. These experiments show that an “anti-stress” intervention can prevent the development of bladder hypersensitivity due to the enduring effects of chronic stress on bladder nociception.

Student Name: Victoria Saites

Host Department: Thomas Jefferson University

Primary Mentor Name: Jeffrey Joseph, DO

Additional Mentors: Brian Hipszer, PhD, Jon-Wung Park, MD, Channy Loeum

Title of Research Project: Perioperative hyperglycemia and glycosuria lead to dehydration and oliguria

In the perioperative period, urine volume and color are commonly used to assess a patient’s hydration status and to estimate the adequacy of renal perfusion. However, due to the stress response or to poor glycemic management, there is an incidence of hyperglycemia during surgery. This can cause glucose to overwhelm renal reabsorption and to “spill over” into the urine, leading to an unaccounted for osmotic diuresis, and thus a deceptively high urine output for the patient’s hydration status. Therefore, glycosuria calls into question the reliability of using urine volume and color as markers of hydration status and renal perfusion. The primary objective of this observational study is to determine the associations between plasma glucose levels and the rate of urine production, urine color, urine specific gravity, and the concentration of glucose in the urine (i.e. the threshold for glycosuria) in both diabetic and non-diabetic surgical patients. Blood samples from intravascular catheters and fingersticks were analyzed for plasma glucose. Subcutaneous continuous glucose sensors recorded changes in interstitial fluid glucose. Urine samples were analyzed for various components, including glucose, to quantify glycosuria. Thus far, we have observed that in patients with significant glycosuria (>50mg/dL), there is a concomitant drop in blood pressure, rise in heart rate, and delayed decrease in urine output due to dehydration of the intravascular space. Recognizing how the presence of glycosuria affects urine volume and composition in surgical patients is important for preemptively managing fluids and insulin for the best clinical outcomes.

Student Name: Michael Schnetz

Host Department: Cleveland Clinic

Primary Mentor Name: Andrea Kurz MD

Additional Mentors: Daniel Sessler MD

Title of Research Project: Comparison of hemodynamic effects between crystalloid and colloid perioperative fluid replacement in abdominal surgery patients.

Crystalloid and colloid solutions represent the two distinct strategies used during perioperative fluid replacement. While colloids largely remain in the intravascular space, the crystalloids distribute to both intravascular and interstitial spaces.

Thus colloids guarantee better hemodynamic stability as well as better perfusion and tissue oxygenation. In a large multi-center study we are currently assessing the effect of goal directed crystalloid (lactated Ringer) and colloid (HES 130/0.4) administration on 30-day morbidity. As a component of this study, we assessed the effect of colloid versus crystalloid administration on time-weighted average (TWA) of intraoperative corrected flow time, cardiac output, and stroke volume in the first 38 patients enrolled at the Cleveland Clinic. We used student t test or Wilcoxon rank sum test, as appropriate. The observed medians of the total amounts of colloid and crystalloid were 0.9 [Q1, Q3: 0.5, 1.1] L and 1.6 [1.0, 1.9] L in the colloid group, and 0 [0, 0] L and 2.9 [1.9, 6.1] L in the crystalloid group, respectively. No difference was observed between the colloid and the crystalloid groups on the TWA of corrected flow time (median [Q1, Q3]: 366 [352, 407] vs. 360 [338, 376] ms; $P = 0.16$), TWA of cardiac output (mean \pm SD: 5.7 ± 1.1 vs. 5.7 ± 1.2 L; $P > 0.99$), or TWA of stroke volume (71.6 ± 8.8 vs. 74.6 ± 17.5 mL; $P = 0.54$). In summary, hemodynamic parameters were comparable in both groups.

Student Name: Christa Schueller

Host Department: Regents of the University of Michigan

Primary Mentor Name: Chad Brummett, MD

Additional Mentors: Amy Shanks MS, Brian Hallstrom, MD, Andrew Urquhart MD, Daniel J. Clauw MD

Title of Research Project: The Impact of Comorbid Fibromyalgia on Acute Postoperative Pain and Perioperative Opioid Consumption in the Lower Extremity Joint Arthroplasty Population

Purpose: This study was designed to study the hypothesis that patients with comorbid fibromyalgia undergoing total knee and hip arthroplasty (TKA and THA) would describe more acute postoperative pain as measured by pain scores and opioid consumption.

Methods: This is a secondary analysis of patients prospectively recruited into a study investigating the chronic pain outcomes of TKA and THA. The American College of Rheumatology (ACR) fibromyalgia survey was used to calculate a fibromyalgianess score (0-31). Fibromyalgia (FM+) was classified as ≥ 13 . Perioperative opioid consumption was analyzed in relationship to fibromyalgianess using non-parametric tests ($\alpha = 0.05$).

Results: The mean fibromyalgianess score was 7 (+/-4), with 24 of the 311 patients defined as FM+ (7.7%). There were a higher proportion of female patients in the FM+ group (70.8% vs 50.9%, $p = 0.06$).

There were no differences between the groups in the use of regional anesthesia or intraoperative opioid dosing. FM+ received significantly more opioids in the PACU (median [IQR] FM+ 10 [0-20] vs. FM- 4 [0-10] mg IV morphine equivalents [IVME], $p = 0.034$) and for the remainder of their inpatient course (FM+ 74.1 [42.5-117.2] vs. FM- 50 [28.5-72.5] mg IVME, $p = 0.005$). FM+ reported higher pain scores in the PACU (FM+ 8 [5-10] vs. FM- 6 [3-9], $p = 0.024$).

Discussion: This is the first study to demonstrate that comorbid fibromyalgia impacts perioperative pain and opioid consumption. Given the known neurophysiologic alterations in fibromyalgia, future studies should consider alternative treatments, such as gabapentinoids and/or serotonin-norepinephrine reuptake inhibitors.

Student Name: Chirag Shah

Host Department: University of Colorado Denver

Primary Mentor Name: Ana Fernandez-Bustamante, MD, PhD

Title of Research Project: Effect of obesity on ICU admission after prolonged abdominal surgery

Introduction: To determine the effect of obesity on the incidence of postoperative ICU admission.

Methods: We performed a retrospective cross-sectional study in our electronic database including all adult patients undergoing elective abdominal surgery of ≥ 4 h duration during a 3 year period. Demographic, preoperative (comorbidities), intraoperative (i.e. ventilatory settings, fluid administration) and postoperative (outcomes) information was collected and analyzed. Patients were classified based on their Body Mass Index (BMI) as "obese" (BMI ≥ 30) and "non-obese" (BMI < 30). We compared the incidence of postoperative ICU admission and potential confounding factors (i.e. cardiopulmonary comorbidities, blood loss, need of intraoperative vasopressors) using univariate and logistic regression analyses.

Results: A total of 486 patients were included. 170 (35.0%) patients were classified as obese and 316 (65.0%) patients as non-obese. Postoperative ICU admission was observed in 9.5% of non-obese patients and 22.9% of obese patients ($p \leq 0.001$). Univariate analysis showed the following statistically significant differences in obese patients compared to non-obese ones: higher incidence of sleep apnea and oxygen dependency; greater median tidal volume (mL/kg of predicted body weight), respiratory rate and PEEP level; less optimum oxygenation (PaO_2/FiO_2); more reduced fluid balance (mL/kg actual body weight/h). Logistic regression analysis, including all significant variables from the univariate analysis, found obesity as the most significant risk factor for postoperative ICU admission (OR 2.7) but did not result in a reliable prediction equation.

Conclusions: Obesity may increase postoperative ICU admission. Further confirmation of the influence of sleep apnea, oxygen dependency and ventilatory parameters in our findings is needed.

Student Name: Renuka Shenoy

Host Department: The Ohio State University - Medical Center

Primary Mentor Name: Sergio Bergese, MD

Additional Mentors: David Tulman, Eric Lopez and Alberto Uribe, MD

Title of Research Project: Studying the Effectiveness of Triple Therapy with Scopolamine, Ondansetron and Dexamethasone for Prevention of Post Operative Nausea and Vomiting in High Risk Patients Undergoing Neurological Surgery and General Anesthesia

Post-operative nausea and vomiting (PONV) are common complications for high risk surgery patients. The recommendation for treating PONV is combination drug therapy such as a triple drug therapy with droperidol, dexamethasone, and a 5-HT₃ receptor antagonist. Due to a recent FDA black box warning, Droperidol is no longer recommended and Scopolamine was chosen as a substitute for Droperidol. We hypothesized that the use of a prophylactic triple-therapy consisting of Scopolamine, Ondansetron and Dexamethasone, would be an effective treatment for the prevention of PONV in high risk patients undergoing neurological surgery under general anesthesia during the first 120 hours after surgery.

A Scopolamine patch was applied to each subject over the mastoid area within 2 hours prior to surgery. Nausea and vomiting were assessed by patient interview for 5 days post-surgery. Vomiting was rated on a 1-3 scale while nausea was rated on a 1-10 scale. Opioids, intraoperative medications, and rescue medication were also recorded. 37 patients provided informed consent and 32 patients were included for data analysis. As compared to placebo at 48 hours: the cumulative incidence of vomiting was reduced by 54% ($P = 0.0006$); the cumulative incidence of nausea was reduced by 37.6% ($P = 0.0012$); the cumulative incidence of rescue medication was reduced by 53.9% ($P = 0.0001$). Compared to placebo, the triple-therapy treatment significantly reduced the incidence of nausea, vomiting, and rescue medication. Though our results were significant, future studies need to be conducted in which this triple therapy is compared to other combination therapies.

Student Name: James Todaro

Host Department: Columbia University

Primary Mentor Name: Guohua Li, MD, PhD

Additional Mentors: Joanne Brady, MS

Title of Research Project: Charlson Comorbidity Score and Maternal Mortality in White, Black, and Hispanic Women: A Case-Control Study

Introduction: Maternal mortality continues to be a serious public health problem in the United States. Identification of high-risk pregnant women may lead to the development of effective interventions. This study tests the hypothesis that an elevated Charlson Comorbidity Score (CCS) is associated with a significantly increased risk of maternal mortality.

Methods: This was a case-control study utilizing data from the Nationwide Inpatient Sample for the years 2000-2009. Cases ($n=438$) were white, black, or Hispanic women who died during labor and delivery. Two groups of controls with a 1:4 case-control ratio were selected at random from women who were discharged alive after delivery. One control group

was matched on year of delivery and the other was matched on year of delivery, maternal age and race. Comorbidity Software v3.6 was used to compute CCS from ICD-9-CM codes. Conditional logistic regression modeling was used to estimate the odds ratios (ORs) while adjusting for patient characteristics and delivery mode.

Results: Overall, 18% of the cases and 2.5% of the controls had an elevated CCS (≥ 1). Compared to women with a CCS=0, risk of maternal mortality tripled for women with CCS=1 (adjusted OR 2.97; 95% CI 1.56-5.65) and increased by 14 fold for women with CCS ≥ 2 (adjusted OR 14.1; 95% CI 5.53-35.8). Approximately 16% of all the maternal mortalities were attributable to elevated CCS.

Conclusions: CCS is a major, independent predictor of maternal mortality risk and might be used as a simple screening tool in prenatal care to identify high-risk women for clinical interventions.

Student Name: Michael Topf

Host Department: University of Rochester

Primary Mentor Name: Gail V.W. Johnson, PhD, Professor Department of Anesthesiology

Title of Research Project: Developing Alzheimer disease therapeutics: Does the activation of the Nrf2 pathway protect against tau toxicity?

Alzheimer disease (AD), the leading cause of dementia, affects 5.3 million Americans and millions more worldwide. Tau, the protein that accumulates as neurofibrillary tangles (NFT) in AD brain, is a microtubule-associated protein that stabilizes microtubules and regulates axonal transport. However, recent research suggests that pathological forms of tau that precede NFT formation are the toxic species in AD. In addition, caspase-cleavage of tau at Asp-421 plays a role in the formation of pathological tau. Because tau undergoes this abnormal posttranslational processing in the early stages of AD, it is believed that these modifications are central to its toxicity. Concurrent with these changes in tau is the development of mitochondrial abnormalities. In AD, the ability of the mitochondria to buffer increases in cytosolic calcium, regulate oxidative stress, and produce ATP is impaired which results in neuronal cell death. To regulate oxidative stress and eliminate reactive oxygen species (ROS) the cell activates the Nrf2 pathway. Recent research suggests that curcumin, and other electrophiles such as sulforaphane, may have neuroprotective effects in the treatment of AD. Because the Nrf2 pathway is responsive to a broad range of electrophiles, the pharmacological prophylactic activation of the Nrf2 pathway is a real possibility for treatment of AD. With upregulation of the Nrf2 pathway the negative effects from the ROS can be countered, thus limiting damage to the cell. This research aims to further investigate the manner in which curcumin and sulforaphane activate the Nrf2 pathway and whether this has an effect on cell viability.

Student Name: Janelle Tryjankowski

Host Department: Thomas Jefferson University

Primary Mentor Name: Jeffrey Joseph, DO

Additional Mentors: Brian Hipszer, PhD; Channy Loeum; Jung-Won Park, MD

Title of Research Project: Perioperative hyperglycemia and glycosuria lead to dehydration and oliguria

In the perioperative period, urine volume and color are commonly used to assess a patient's hydration status and to estimate the adequacy of renal perfusion. However, due to the stress response or to poor glycemic management, there is an incidence of hyperglycemia during surgery. This can cause glucose to overwhelm renal reabsorption and to "spill over" into the urine, leading to an unaccounted for osmotic diuresis, and thus a deceptively high urine output for the patient's hydration status. Therefore, glycosuria calls into question the reliability of using urine volume and color as markers of hydration status and renal perfusion. The primary objective of this observational study is to determine the associations between plasma glucose levels and the rate of urine production, urine color, urine specific gravity, and the concentration of glucose in the urine (i.e. the threshold for glycosuria) in both diabetic and non-diabetic surgical patients. Blood samples from intravascular catheters and fingersticks were analyzed for plasma glucose. Subcutaneous continuous glucose sensors recorded changes in interstitial fluid glucose. Urine samples were analyzed for various components, including glucose, to quantify glycosuria. Thus far, we have observed that in patients with significant glycosuria ($>50\text{mg/dL}$), there is a concomitant drop in blood pressure, rise in heart rate, and delayed decrease in urine output due to

dehydration of the intravascular space. Recognizing how the presence of glycosuria affects urine volume and composition in surgical patients is important for preemptively managing fluids and insulin for the best clinical outcomes.

Student Name: Albert Tsai

Host Department: University of Pennsylvania School of Medicine

Primary Mentor Name: Max Kelz, MD, PhD

Title of Research Project: Disruption of Circadian Rhythms Following Extended Exposure to Isoflurane in Drosophila

Background: Circadian rhythms are fundamental to all eukaryotes and can be characterized by a neuronal circuit consisting of input, core clock, and output components. Given that anesthetics disrupt synaptic signaling, it is not surprising recent studies suggest anesthetics might affect circadian rhythms. However, the mechanisms through which this occur remain unknown. Using *Drosophila* we investigate the effects of volatile anesthetics upon circadian functioning.

Methods: Flies were entrained on a 12-h light/12-h dark schedule and subsequently placed into constant darkness. 1.2% isoflurane was delivered for 2 or 6 hours at different circadian times to determine anesthetic effects on a circadian output—locomotor behavior. Separately, light pulses were given during 2-hour isoflurane exposures to determine if the clock remained responsive to inputs. Finally, isoflurane and halothane were applied directly to cultured cell reporter system to determine the effects upon the core clock.

Results: During a 2-hour 1.2% isoflurane anesthetic, input, output, and core circadian clock functions remained unaffected. Core clock function was also unaffected by 1.0% halothane. However, output of the clock was significantly shifted by a 6-hour 1.2% isoflurane exposure, yielding phase shifts ranging from -43 minutes to +75 minutes, with no effect on the circadian period.

Conclusions: These results suggest normal circadian functioning following acute exposures to volatile anesthetics. However, following prolonged exposure to isoflurane, circadian disturbances arise, which may be attributable to accumulation of homeostatic drive and its interaction with the circadian process. Clinically, this might suggest a dose-dependent effect of general anesthetics on circadian rhythm disruptions following surgery.

Student Name: Ajayram Ullal

Host Department: Montefiore Medical Center The University Hospital for the Albert Einstein College of Medicine

Primary Mentor Name: Linda Shore-Lesserson, MD

Additional Mentors: Elise Delphin, MD

Title of Research Project: A randomized, double-blinded trial comparing the efficacy of tranexamic acid and epsilon-aminocaproic acid in reducing bleeding and transfusion in cardiac surgery.

Background: Patients who undergo cardiopulmonary bypass (CPB) for cardiac surgery are at high risk for post-operative bleeding. Without aprotinin available, two lysine-analogues, tranexamic Acid (TA) and epsilon-aminocaproic acid (EACA) have become the standard of care to control bleeding following CPB. The purpose of this study is to compare TA to EACA in reducing bleeding and transfusion requirements following CPB.

Methods: This is a single-center, randomized, double-blind trial targeted to enroll 196 adult patients undergoing cardiac surgery involving CPB. Patients randomly receive prophylactic EACA or TA at standard dose. Blood is sampled at baseline, after loading dose, and post-protamine for ROTEM®, Thromboelastography (TEG), and D-Dimer analyses. Chest tube drainage(CTD) and transfusions are followed for 24 hours, and complications assessed up to 30 days.

Results: Blinded interim analysis after 81 patients reveals no statistically significant differences between groups in CTD, transfusion volumes, TEG/ROTEM parameters, or complications. One group, did have a non-statistically significant trend towards a lower transfusion rate ($p < 0.1$) but a higher rate of respiratory failure ($p = .27$) and cardiogenic shock ($p = .12$). A complete un-blinded analysis will be conducted at the conclusion of the study.

Discussion: Lysine analogues are routinely used to reduce blood loss in CPB surgery. Regional preferences and cost often dictate which drug is used, however head-to-head comparisons studying efficacy and safety are lacking. This prospective trial seeks to evaluate these questions so that the risks and benefits of these agents are better defined.

Student Name: Nathan Waldron

Host Department: Duke University Medical Center

Primary Mentor Name: Tong Joo Gan, MD, MHS

Additional Mentors: Tim Miller, MD, Ashraf Habib, MBChB

Title of Research Project: NICOM versus EDM Guided Goal Directed Fluid Therapy in the Perioperative Period

Introduction: Goal-directed fluid therapy (GDFT) has been associated with improved outcomes following major surgery. The esophageal Doppler monitor (EDM) is widely used as a minimally invasive cardiac output (CO) monitor. However, it has several limitations. The non-invasive cardiac output monitor (NICOM-Cheetah Medical), a bioreactance-based CO assessment, is a sensitive and specific method for assessing fluid responsiveness. There are no prospective studies comparing the NICOM and the EDM for GDFT. It is our hypothesis that the NICOM will be equivalent to the EDM in assessing baseline stroke volume (SV) and fluid response.

Methods: Baseline SV and changes in SV after bolus were compared between NICOM and EDM. Patients whose SV increased >10% after a bolus were declared “fluid responsive”. Baseline SV was compared using correlations, and the proportion of patients who were “fluid responsive” at each time point were compared using agreement statistics and McNemar’s test.

Results: Data from 61 patients were available for analysis. There was a consistent and significant correlation of baseline SV between monitors (Pearson Correlation Coefficient 0.48138, $p=0.0002$). Agreement was best at 15 minutes, where it approached 67%.

Discussion: In this analysis, there was a good correlation of baseline SV measurements between monitors. Both monitors demonstrate about 50% of patients were “fluid responsive” (10% increase in SV). Agreement on “fluid responsiveness” between the two monitors was highest at 15 min. However, there were no systematic differences between the two monitors. NICOM performs similarly to the EDM and may be a viable alternative to guide fluid administration.

Student Name: Louise Wen

Host Department: Stanford University, Dept. of Anesthesia

Primary Mentor Name: Brendan Carvalho MBBCh, FRCA

Additional Mentors: Gillian Hilton MBChB, FRCA

Title of Research Project: The Impact of Breastfeeding on Maternal Pain after Vaginal and Cesarean Delivery

Introduction: Approximately 75% women in the USA attempt breastfeeding in the early postpartum period [1]. Breastfeeding benefits include complete nutrition, enhanced uterine involution, and maternal-neonatal bonding [2]. Intrathecal oxytocin has shown to increase pain thresholds in animal models [3]. The analgesic effects of endogenous oxytocin surges during breastfeeding have not been well investigated. The study aim was to determine the impact of breastfeeding on perineal, incisional and cramping pain following vaginal and cesarean delivery.

Methods: Women who underwent vaginal (n=40) and cesarean deliveries (n=20) were enrolled on postpartum day one in this IRB-approved, observational cohort study. Women with vaginal deliveries were recruited 6-24 hours post-delivery, cesarean deliveries recruited 24-48 hours post-delivery. The study population included healthy multiparous women with healthy singleton term infants and who were breastfeeding. All subjects received diaries to record pain (perineal or incisional, and cramping) over five breastfeeds. Pain scores (0-10) were recorded five minutes before, during, and five minutes after breastfeeding. Demographic, obstetric and outcome measures including analgesia and epidural placement, birth weight, and laceration/episiotomy were recorded. Pain scores will be compared using paired t-tests, ANOVA and non-parametric statistical tests as appropriate ($P<0.05$). Associations amongst discrete variables will be investigated using Chi-square and Fisher’s exact test.

Results: Data collection and analysis is still ongoing at this time. Final results will be available and presented at the ASA meeting.

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1. Morb Mortal Wkly Rep. 2011;60:1020-5
2. J Natl Med Assoc. 2005; 97:1010-9
3. Peptides. 2007; 28:1113-9

Student Name: Keith Wirth

Host Department: University of Pittsburgh

Primary Mentor Name: Manuel C. Vallejo, MD

Title of Research Project: Efficacy of Successful Epidural Catheter Placement in Morbidly Obese Parturients with the Use of Ultrasound in Conjunction with an Epidural Depth Equation

Background: Morbidly obese (MO) parturients have a higher epidural failure rate than non-obese parturients. Balki et al. previously determined the Pearson correlation coefficient between ultrasound estimated depth and actual depth to the epidural space was 0.85 in MO parturients. Our aim was to determine if the use of the Epidural Depth Equation (EDE) before ultrasound visualization can provide high clinical correlation in ultrasound estimation of the distance from the skin to the epidural space in MO parturients.

Methods: 160 MO (? 40 kg/m²) parturients requesting labor epidural analgesia or epidural anesthesia for elective cesarean section were enrolled. Before epidural catheter placement, the epidural depth equation (EDE) was used to estimate depth to the epidural space. This estimation was used to help visualize the epidural space with the transverse and midline longitudinal ultrasound views and to measure depth to epidural space. The measured epidural depths (EDE + transverse/longitudinal ultrasound views) were made available to the resident trainee before needle insertion.

Results: Pearson's correlation coefficients comparing the actual Needle Depth (ND) versus ultrasound estimated depth to the epidural space, using EDE in the longitudinal median and transverse planes were 0.905 and 0.899, respectively, greater than 0.850 as previously reported by Balki.

Conclusion: The use of the epidural depth equation (EDE) combined with ultrasound visualization results in a higher clinical correlation than with the use of ultrasound alone. We recommend the use of EDE + ultrasound be considered prior to catheter placement in morbidly obese parturients.

Student Name: Jocelyn Wong

Host Department: Stanford University, Dept. of Anesthesia

Primary Mentor Name: Brendan Carvalho, MBBCH, FRCA. Associate Professor

Additional Mentors: Edward Riley, MD, Associate Professor

Title of Research Project: Analgesic efficacy of 100 mcg compared to 200 mcg intrathecal morphine after cesarean delivery

Introduction: Intrathecal (IT) morphine is highly effective for post-cesarean analgesia, however, the optimal dose is yet to be established (Anesthesiology. 1999;90:437). The aim of this study was to compare the analgesia and side-effects associated with 100 versus 200 mcg intrathecal morphine.

Methods: We conducted a retrospective chart review of 241 patients who had had an elective cesarean delivery, receiving either 100 or 200 mcg of IT morphine. The primary outcome variables were mean and peak verbal pain scores (VPS) (0-10) and analgesic use (mg-morphine equivalents). Postoperative administration of antiemetics and nausea scores (0-10) were recorded. Data are reported as mean±S.D. or percentages. P <0.05 was considered statistically significant.

Results: The 200 mcg group had significantly lower VPS and opioid use. Mean VPS were (1.6±1.1 versus 2.0±1.1; P=0.0114) and peak VPS's were (4.9± 2.0 versus 5.6±1.8; P=0.0079). The 200 mcg group used less opioid in the first 24 hours after surgery (25±21 versus 31±23 mg-morphine equivalents; P=0.016) and a lower percentage used intravenous

opioids (18% versus 30% $P=0.02$). However, the 200 mcg group suffered more nausea (mean nausea score of 1.9 ± 1.3 versus 1.6 ± 1.3 ; $P=0.0374$ and 52% use of antiemetics versus 24%; $P<0.0001$).

Conclusion: Doses greater than 100 mcg of IT morphine provide more analgesia, but the nausea is significantly greater with the 200 mcg dose. Results from this study can be used to help guide IT morphine dosing in the cesarean delivery setting, basing dosages on patient preference for analgesia and side-effects.

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Title of Research Project: Intravenous Fluids Affect Conductivity-based Point of Care Hematocrit

Background. Point of care devices measuring hematocrit rely on determination of electrical conductivity of whole blood. We hypothesize that commonly administered intravenous fluids independently alter blood conductivity and confound hematocrit determination.

Methods. Whole human blood was diluted to pre-determined hematocrit values with normal saline, lactated Ringer's, hetastarch, and plasma. Electrical conductivity and hematocrit (i-STAT® and spun methods) was measured at each dilution. In separate experiments, the effects of propofol and heparin were noted on these parameters.

Results. Greater dilution significantly increased conductivity irrespective of diluent type. Conductivity slopes increased negatively in order for plasma, hetastarch, lactated Ringer's, and normal saline dilution. Moreover, each slope significantly varied from every other slope. For all points, 94.2% ($n=211/224$) of hematocrits measured by i-STAT® were less than those for the spun method. Dilution with plasma, normal saline, lactated Ringer's, and hetastarch caused bias (limits of agreement) of -2.7% ($-6.9/1.4$), -4.6% ($-7.3/-2.0$), -4.8% ($-7.8/-1.7$), and -2.0% ($-5.6/1.9$)%, respectively. The Cohen Kappa statistic agreement values for a transfusion trigger of 30% were 0.90 (all values), 0.25 (hematocrit<30%) and 0.21 (hematocrit 18-30%). Clinically relevant concentrations of propofol and heparin had minimal effects on electrical conductivity or hematocrit determination.

Conclusions. Dilution of blood with commonly used intravenous solutions affects whole blood conductivity determinations and thereby decreases hematocrits measured by a POC device relying on this method as compared with spun hematocrit. Conductivity-based hematocrit POC devices should be cautiously interpreted when hemodilution is present.

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Title of Research Project: Impact of Three Labor Analgesia Techniques on Labor Duration

Introduction: The impact of neuraxial analgesic techniques on labor duration is currently unknown. The objective of this study is to determine whether there is a difference in duration of first stage of labor in nulliparous women who receive neuraxial analgesia via one of three techniques.

Methods: Nulliparous women with term, singleton, vertex pregnancies desiring neuraxial labor analgesia were enrolled. Parturients <4.0 cm cervical dilation when requesting neuraxial analgesia were randomized to one of three groups: Group 1 - CSE with intrathecal fentanyl 25 µg, Group 2 - CSE with intrathecal 0.5% bupivacaine 2.5 mg and fentanyl 15 µg, Group 3 - epidural with fentanyl 100 µg + bupivacaine 0.125% 10-20 mL. Maintenance epidural infusions and rates were standardized between groups.

Results: To date, 74 patients who underwent spontaneous vaginal delivery have been enrolled. The median duration of first stage of labor for each group was: Group 1 – 403 min (95% CI, 295.8 to 510.1 min); Group 2 – 458 min (95% CI,

397.8 to 518.2 min); Group 3 – 453 min (95% CI, 258.2 to 647.8 min). There was no difference in duration of first stage of labor between the three groups.

Conclusion: We were unable to demonstrate a difference in duration of first stage of labor between the three groups with our preliminary data. Conclusions based on this data cannot be made at this time as the results likely represent a type II error due to the study currently being underpowered.

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