### Medical Student Anesthesia Research Fellowship
#### 2016 Host Departments and Projects

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Children's Hospital Boston

**Project Topic:** Photoactivatable nanoparticles

**Overview:** We are developing nanoparticles with light-triggered surface properties for a wide range of biomedical applications. We will investigate differential binding of nanoparticles coated with a range of ligands to various cell types under light and dark conditions.

**Student Role:** Nanoparticle production and characterization, surface modification, cell culture, data acquisition.

**Mentors:** Daniel S. Kohane, MD, PhD

**Research Type:** Basic Science

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**Project Topic:** Development of a selective filter for Gram negative bacteria.

**Overview:** Many ICU admissions are complicated by bacteremia (bacterial in the blood). Some studies have suggested that the bacterial load in the blood when antibiotic treatment is initiated correlates with mortality and morbidity. If the bacterial load in the blood could be decreased relatively quickly when initiating antibiotic treatment, patients with bacteremia might have better outcomes. We are developing a filter device and testing its ability in vitro and in vivo to filter bacteria out of blood samples contaminated with E. coli.

**Student Role:** Bacterial cell culture, chemical synthesis, data acquisition.

Students with prior experience in polymer science, organic chemistry, and microbiology are encouraged to apply.

**Mentors:** Daniel S. Kohane, MD, PhD

**Research Type:** Basic Science

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**Project Topic:** Prolonged duration local anesthesia.

**Overview:** The goal is to help develop formulations that provide prolonged local anesthesia from a single injection, injectable formulations that can provide on-demand local or regional anesthesia triggered by external energy sources, and improved drug combinations for local anesthesia.

**Student Role:** Formulation of materials, neurobehavioral testing of animals.

**Mentors:** Daniel S. Kohane, MD, PhD

**Research Type:** Basic Science

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Cleveland Clinic Foundation

**Project Topic:** The RELIEF Trial REstrictive versus LIbEral Fluid Therapy in Major Abdominal Surgery

**Overview:** A large, randomized, parallel-group, controlled trial where patients will be randomly assigned to either a restrictive or liberal fluid group.

**Student Role:** Screening, consenting, patient enrollment, drug administration, and data acquisition
Mentors: Andrea Kurz, MD and Daniel I. Sessler, MD

Research Type: Clinical

Project Topic: The BALANCED Anaesthesia Study A prospective, randomised clinical trial of two levels of anaesthetic depth on patient outcome after major surgery

Overview: International multicenter double blind, prospective, intention to treat, safety and efficacy study.

Student Role: Identifying suitable patients, consenting, perioperative data collection, and data reporting.

Mentors: Daniel I. Sessler, MD

Research Type: Clinical

Project Topic: Intraveous acetaminophen and postoperative hypoxemia

Overview: Postoperative hypoxemia is common, severe, and prolonged. Opioids appear to be the major cause. Non-opioid analgesics reduce the need for opioids, and thus possibly the amount of postoperative hypoxemia. We are thus tested the hypothesis that intravenous acetaminophen reduces hypoxemia in patients recovering from major non-cardiac surgery.

Student Role: Identify suitable patients, obtain consent, randomize patients, implement the protocol, and record data.

Mentors: Alparslan Turan, M.D.

Research Type: Clinical

Duke University Medical Center

Project Topic: One of the most controversial and hotly contested topics in anesthesiology and perioperative medicine is whether anesthesia and surgery are associated with long term cognitive decline, and/or with an increased long term risk of developing dementia (such as Alzheimer's disease). Numerous studies in animal models have shown that anesthetic drugs and surgical stress accelerate AD pathogenesis, but the relevance of these preclinical studies to humans is unclear. Multiple retrospective studies in humans have provided conflicting results on these issues, but to date, no prospective studies have been done to evaluate whether anesthesia and surgery are associated with long term changes in cognition, CSF Alzheimer's disease biomarkers, and changes in functional brain connectivity. We are performing the MADCO-PC study (Markers of Alzheimer's Disease and neuroCognitive Outcomes after Perioperative Care) at Duke to address this important question.

Overview: This clinical/translational study has been approved by the Duke University Medical Center Institutional Review Board, and has been registered at clinicaltrials.gov by the study PI, Dr Miles Berger (trial ID NCT01993836). As part of this study, patients undergo detailed cognitive testing before anesthesia and surgery, 6 weeks and 1 year later. CSF and blood samples are also obtained just before the start of anesthesia, 24 hrs later, and then again at 6 weeks and 1 year later. Eligible patients also undergo resting state functional MRI scans before surgery and 6 weeks later. The primary outcome measure in surgical patients is to assess the correlation between the perioperative change in CSF markers of alzheimers disease
and the perioperative cognitive change. Non-surgical age- and education-matched community dwelling older adults will also be enrolled in this study, to achieve a matched cohort study design.

**Student Role:** The student will assist in enrolling patients in the study, will observe cognitive testing and delirium assessment sessions, will assist in processing CSF and blood samples obtained at the study time points described above, and will assist in recording raw EEG data during these patient's surgeries. The student may also assist in screening subjects for the functional MRI scans, which requires taking a detailed medical history to ensure that no patients with magnetic or otherwise unsafe joint implant materials enter the MRI scanner. In doing so, the student will be able to utilize as well as expand his or her medical knowledge, and will learn of the importance of careful clinical assessment in the research setting. The student will also assist in entering data from patients he or she enrolls in the study into our study database, and will likely also assist in examining some of the preliminary data from this study in surgical patients.

**Mentors:** Miles Berger, MD, PhD; Joseph Mathew, MD, MHSc, MBA

**Research Type:** Translational

**Project Topic:** The second project involves examining the effect of a new a new geriatric anesthesia resident E-learning curriculum, which focuses on teach residents how to titrate anesthetic administration in response to raw and processed EEG parameters. Several studies in the past few years have shown that intraoperative EEG burst suppression is associated with post operative delirium, and several studies have found that EEG-titrated anesthetic administration results in lower delirium and POCD rates. Yet, most anesthesia residents are still taught to titrate anesthetic agents in response to heart rate and blood pressure. This study is designed to measure the effect of a resident E-learning curriculum on the actual mean MAC fraction of inhaled anesthetic delivered to patients cared for by residents exposed to this new curriculum, vs those who receive standard resident education without this new curriculum (control).

**Overview:** The project involves developing an educational video, e-learning curriculum and a user centered checklist all designed to teach residents how to titrate anesthetic administration in response to raw and processed EEG parameters. Further, the checklist will help residents apply this knowledge in a real world setting while they are actually caring for older patients in the operating room. The results of this study will clarify how to best disseminate the results of new studies suggesting that EEG-guided anesthetic administration can lower POCD and delirium rates, and thus has the potential to lead to improved postoperative outcomes for the more than 16 million older Americans who undergo anesthesia and surgery each year.

**Student Role:** As part of this project, the student will learn a great deal about how to interpret raw and processed EEG parameters, and how to apply this knowledge to titrate anesthetics in the OR. The student will help administer tests to residents before and after this education intervention (i.e. E-learning curriculum) vs control resident education, will help analyze intraoperative data (to obtain the mean MAC fraction delivered to each patient, and will learn about univariate and multivariate statistical tools that can be utilized to analyze this type of data. In the course of carrying out this project, the student will also gain broad exposure to a variety of surgical cases performed at Duke, ranging from orthopedic to thoracic and cardiac to ENT and gynecologic surgery. Further, the student will have the opportunity to work closely with the Duke Anesthesiology residency assistant program director, Dr Ankeet Udani.

**Mentors:** Miles Berger, MD PhD; Ankeet Udani, MD M.Ed.
**Research Type:** Educational  

**Project Topic:** Dexamethasone as an analgesic adjunct for post-cesarean delivery pain relief  

**Overview:** The primary objective of this study is to compare post-cesarean section opioid consumption between two groups of patients undergoing cesarean delivery who receive a single-dose of intraoperative dexamethasone 8 milligrams versus placebo at 24 hours after surgery. This is a randomized, placebo-controlled, double-blind trial. A secondary objective of the study is to assess a continuous non-invasive blood pressure model to the standard of care intermittent non-invasive blood pressure monitor.  

**Student Role:** Collection and analysis of data and preparation of abstract for presentation.  

**Mentors:** Ashraf S Habib, MBBCh, MSc, MHSc, FRCA  

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**Research Type:** Clinical  

**Project Topic:** Impact of vasopressor administration on maternal and neonatal outcomes in women with pre-eclampsia  

**Overview:** Historically ephedrine was considered to be the vasopressor of choice for the management of spinal induced hypotension in women undergoing cesarean delivery. Over the past two decades studies have shown that phenylephrine is associated with improved maternal and neonatal outcomes compared to ephedrine, and therefore phenylephrine is now considered the vasopressor of choice in this patient population. A comparison between the two agents in women with placental insufficiency, such as those with pre-eclampsia has not been studied, and therefore it is not clear whether ephedrine or phenylephrine should be the vasopressor of choice in pre-eclamptic patients. This randomized controlled study will compare the effects of phenylephrine versus ephedrine on maternal and neonatal outcomes in women with pre-eclampsia undergoing cesarean section under spinal anesthesia. Blood pressure, cardiac output, cerebral tissue oxygen saturation, uterine and placental perfusion and cord gases will be compared between the two groups.  

**Student Role:** Collection and analysis of data and preparation of abstract for presentation.  

**Mentors:** Ashraf S Habib, MBBCh, MSc, MHSc, FRCA  

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**Research Type:** Clinical  

**Project Topic:** Impact of local anesthetic wound infiltration on post cesarean delivery analgesia  

**Overview:** The primary objective of this study is to assess the analgesic efficacy of wound infiltration with local anesthetics and NSAIDs in women undergoing cesarean delivery under spinal anesthesia and receiving neuraxial morphine. This is a randomized, placebo-controlled, double-blind trial, that would potentially enhance postoperative analgesia and increase satisfaction in women undergoing cesarean delivery.  

**Student Role:** Collection and analysis of data and preparation of abstract for presentation.  

**Mentors:** Ashraf S Habib, MBBCh, MSc, MHSc, FRCA  

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**Emory University School of Medicine**  

**Project Topic:** The Molecular Mechanisms of General Anesthetics and Sleep
Overview: We are investigating the role specific domains play in the activation and modulation of the GABAA receptor, a primary target for many general anesthetic drugs. By targeting specific amino acid residues for site-directed mutagenesis, we have selectively changed the pharmacology of the receptor; previous studies in the membrane domains are now being repeated in the cytoplasmic and synaptic domains of the receptor. The student will mutate one or more key amino acid residues and assay mutant protein function using whole cell patch clamp on cells transiently expressing the mutant receptor protein. Rapid solution jump protocols together with kinetic modeling will be used to assess the result of the mutation on receptor function.

Student Role: The student will be given a full training in modern laboratory molecular techniques such as site-directed mutagenesis, whole-cell patch-clamp electrophysiology, and molecular and kinetic simulation. By the end of the discovery phase, the student will be expected to design, perform, analyze and interpret electrophysiologic experiments. It is expected that the data will be presented at the National level within 12 months and subsequently published in journal format. The experimental schedule will leave ample time for shadowing in the OR.

Mentors: Andrew Jenkins PhD

Research Type: Basic Science

Project Topic: Identifying the risk factors and consequences of general anesthesia for cesarean section

Overview: This is a retrospective chart review covering 10 years of medical records of patients undergoing general anesthesia following cesarean section seeking to identify the risk factors for need for general anesthesia as well as the morbidity and mortality resulting from general anesthesia.

Student Role: Chart review and data analysis.

Mentors: Grant Lynde, MD

Research Type: Outcomes

Project Topic: Determining the risk of aspiration for elective terminations performed under deep sedation

Overview: This is a retrospective chart review covering 4 years worth of medical records at a women's health clinic identifying the prevalence and risk factors for complications from the provision of deep sedation for elective terminations.

Student Role: Chart review and data analysis

Mentors: Grant Lynde, MD; with Carrie Cwiak, MD, MPH

Research Type: Outcomes

Project Topic: How does natural sleep influence recovery from general anesthesia?

Overview: Sleep and anesthesia are not the same but share overlapping brain networks. It is becoming increasingly apparent that the recovery from anesthesia is not entirely a passive activity, but involves the initiation of networks specific for arousal and consciousness. The MSARF student will participate in a multi-site study intended to investigate the overlap between sleep and general anesthesia during emergence. Frontal EEG electrodes (applied via standard BIS or SedLine sensors) will be used to continuously monitor
patients from induction through maintenance and emergence. The EEG signatures that define the transition from unconscious to conscious will be characterized during the implementation of a standard emergence protocol.

**Student Role:** The student will be responsible for consenting patients, adherence to protocol, data entry, and introduced to data analysis and EEG interpretation. In addition to the advanced scientific techniques to be learned, there will be ample opportunity for the MSARF student to shadow Dr. Garcia in the operating room, learn statistical techniques and scientific communication skills.

**Mentors:** Paul S. Garcia, MD, PhD

**Research Type:** Translational

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**Project Topic:** The role of visuospatial memory deficits in recovery from general anesthesia

**Overview:** In higher mammals, the perirhinal cortex receives highly processed sensory information and sends neuronal information to planning and executive regions (e.g., prefrontal and orbitofrontal cortices) as well as output to subcortical structures such as basal ganglia, thalamus, amygdala, and the basal forebrain. Mostly, the perirhinal cortex is associated with visual perception and memory as it facilitates the recognition of environmental stimuli. Clinically, one way in which we designate the recovery from general anesthesia is by determining if the individual responds appropriately to its environment. The MSARF student will participate in a multi-investigator research team dedicated to determining the role of this brain region in recovery from general anesthesia.

**Student Role:** The student will measure and compare characteristics of emergence and recovery among different animals who have received either a lesion of the perirhinal cortex or sham. The student will be responsible for measuring behavioral characteristics during emergence, recovery, and post-anesthesia; as well as introduced to database entry, data analysis / interpretation, and statistical techniques. In addition there will be ample opportunity for the MSARF student to shadow Dr. Garcia in the operating room and practice scientific communication skills.

**Mentors:** Paul S. Garcia, MD, PhD

**Research Type:** Basic Science

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**Project Topic:** Cellular and molecular mechanisms of cancer cell death and related cancer related pain

This project will explore the mechanism of cancer cell death by targeting specific ion channels and membrane transporters. Molecular biological and electrophysiological

**Overview:** This is a basic and translational research that will elucidate some novel mechanisms and develop new treatments for cancer growth and cancer induced pain.

**Student Role:** Student can participate in cell culture procedures, learn basic molecular techniques and perform patch clamp recording from cultured cells. Students will also work with animal models to perform behavioral tests and assess cell death in brain slices using immunohistochemical techniques.

**Mentors:** Dr. Shan Ping Yu, MD/PhD

**Research Type:** Basic Science
**Project Topic:** Stem cell therapy for ischemic stroke

**Overview:** Stem cell therapy has emerged as a promising therapy for neurodegenerative disorders. We have studied the mechanisms of neuronal differentiation of stem cells including embryonic stem cells and induced pluripotent stem (iPS) cells. We focus on translational potential of the stem cell therapy after ischemic stroke and traumatic brain injury. We were one of the pioneers in the stem cell transplantation treatment after stroke in animal models. Currently, our lab continue the investigation on the molecular mechanism of neuronal differentiation, migration, and tissue repair in vitro and in animal models.

**Student Role:** Students in this project will have the opportunity to learn the state of art technologies of imaging, immunostaining, behavioral tests and brain injury assays.

**Mentors:** Dr. Ling Wei, MD

**Research Type:** Translational

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**Project Topic:** Alive or Dead: How accurate are various methods of inferring patient vitality and mortality from electronic health records?

**Overview:** Arguably the most important perioperative outcome to measure is mortality. It is often extremely difficult however to determine if a patient is alive or dead after their anesthetic encounter has ended – i.e., patients are often lost to follow-up. National sources of mortality data are scant, and the most widely used source, the Social Security Death Index (SSDI), has in recent years become subject to certain limitations that may severely limit the extent of its coverage. This project will use a large retrospective multicenter dataset of known outcomes to determine the reliably of various methods for inferring vitality and mortality, including the SSDI, lab results, and clinic visits.

See above for resources

**Student Role:** The goal of this summer project is for the student to learn the basic principles of biomedical informatics, that is, the methods and technologies required to optimize the use of information and data in health care research and practice. Dr.’s McCormick and Levin, both MIT trained computer scientists, will provide close supervision and expert tutelage.

Specifically, the student will be responsible for developing database queries (using SQL) to extract relevant data from our anesthesia data warehouse as well as performing spot chart review of the electronic medical record for specific cases. The student will merge data sets from other sites with our data and clean and harmonize the merged dataset (using R). They will perform preliminary analysis (using R) and work with a professional statistician on the full analysis. By the end of the summer they will have completed an abstract to present at a large national meeting.

**Mentors:** Patrick J McCormick, MD; Matthew A Levin, MD

**Research Type:** Clinical

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**Project Topic:** Evaluation of oral olanzapine for the reduction post-discharge nausea and vomiting
Overview: Ambulatory surgery is occurring with increasing frequency as surgical and anesthetic techniques have improved and pressure to reduce health-care costs has increased. While there are many benefits to recovering from surgery at home, a significant disadvantage is the slow access to a healthcare provider when complications occur. Recent studies have demonstrated a high incidence of post-discharge nausea and vomiting (PDNV) after ambulatory surgery, particularly in high-risk groups. Practices known to reduce the risk of post-op nausea and vomiting in the PACU have little effect on the risk of delayed PDNV. Orally administered olanzapine demonstrates promise as a novel strategy for preventing PDNV. Its long half-life allows for a single dose to be administered preoperatively. This study will see if there is a difference in the incidence and severity of PDNV between patients who receive oral olanzapine vs placebo prior to general anesthesia for ambulatory gynecologic surgery.

Student Role: The role of the MSARF summer fellow will be to perform a standardized interview of study participants in the PACU, as well as by telephone 24 hours following surgery. The fellow will also review the electronic anesthesia record and post-operative medical record. All data collected by interview and chart review will be entered by the fellow into the research database.

Mentors: Jamie Hyman, MD

Research Type: Clinical

Loma Linda University

Project Topic: Neuroprotection after cardiac arrest

Overview: Global brain injury is the leading cause of morbidity / mortality in patients who initially survive cardiac arrest. Use of a novel rat model of ventricular fibrillation-induced cardiac arrest and cardiopulmonary resuscitation allows us to mimic human cardiac arrest and resuscitation. This model results in most of the typical pathological consequences of global ischemia-reperfusion injury. A number of agent, including volatile anesthetics, have been shown to provide some degree of neuroprotection, via various mechanisms. We are investigating the effects of isoflurane preconditioning on anti-inflammatory and/or anti-apoptosis signaling pathways following cardiac arrest/resuscitation-induced global brain ischemia-reperfusion injury.

Student Role: 1. Under the guidance of mentor or lab technician, assist in animal experiment as well as data analysis.
   2. Meet with the mentor weekly to discuss issues and questions regarding to the research.
   3. To be self-motivated and responsible for the research project including development of research and professional skills.

Mentors: Lei Huang, MD

Research Type: Basic Science

Massachusetts General Hospital

Project Topic: Novel Pharmacological Treatment of Opioid-induced Hyperalgesia

Role of Acupuncture in Chronic Pain Management
Overview: The MGH Center for Translational Pain Research is a combined preclinical and clinical research facility. Two research projects are available for this program. We are testing a new pharmacological therapy that could improve opioid analgesic effect and reduce opioid side effects such as opioid-induced hyperalgesia. In another project, we are examining the role of acupuncture in chronic pain management using an innovative research tool.

Student Role: The student will learn clinical study design, subject recruitment, and research data collection. The student will have the opportunity to be exposed to laboratory studies of pain and opioid-related disorders using the state-of-art neuroscience techniques.

Mentors: Jianren Mao, M.D., Ph.D., Richard J. Kitz Professor of Anesthesia Research, Harvard Medical School, and Vice Chair for Research, Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital; Lucy Chen M.D., Associate Professor

Research Type: Translational

Project Topic: Establishing zebrafish as a platform for discovering new potent general anesthetic drugs.

Overview: Wild-type zebrafish embryos (up to 7 days post-fertilization) will be used to screen libraries of compounds for suppression of motor responses to environmental stimuli, using a high-throughput programmable video analysis tool. Active compounds will be further characterized for potency and reversibility. Zebrafish colonies with knockout or knockin of specific genes associated with general anesthesia sensitivity will be created, and used for further screening of general anesthetics.

Student Role: Students will:

1) Learn how to perform zebrafish anesthesia assays and will be responsible for performing screening tests on libraries of new compounds.

2) Learn to maintain a research notebook, analyze their data using statistical software tools, participate in weekly lab meetings, and present their results in written and oral form.

3) Participate in weekly reading and discussions of literature related to anesthetic pharmacology and mechanisms. Attendance at weekly Grand Rounds conferences will be encouraged.

4) Observe and learn about clinical anesthesia in the MGH operating rooms and affiliated divisions (OB, Pain, ICU).

Mentors: Stuart A. Forman, M.D., Ph.D., Associate Professor of Anaesthesia, Harvard Medical School, and Associate Anesthetist, Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital

Research Type: Translational

Project Topic: Objective of this pilot study is to determine the potential association between sepsis and levels of hydrogen sulfide and its metabolites in plasma and urine. We hypothesize that plasma and or urine levels of hydrogen sulfide and its metabolites increase

Overview: Hydrogen sulfide (H2S) has been recognized as the third gaseous mediator in the last decade. Several studies indicate that plasma H2S levels increase in animal models of sepsis and in human septic
patients. However, in these past studies, levels of H2S have been measured with a non-specific method that measures total sulfide levels in the sample in a harshly acidic condition that liberates sulfide from sulfide-containing proteins. Therefore the validity of the reported biologically active “free” H2S levels has been questioned. In this proposal, we intend to define the levels of free H2S and its metabolites in plasma and urine samples obtained from mice that exhibit sepsis compared with healthy mice using the sensitive and specific H2S detection method developed in our laboratory.

**Student Role:**
1. After blood and urine samples are corrected by a study staff, student will assist processing, transportation, storage of samples.
2. Student will measure plasma and urine levels of H2S metabolites using HPLC
3. Student will analyze the data using graphing and statistical software.
4. Student will participate in preparation of a manuscript.

**Mentors:** Fumito Ichinose, M.D., Ph.D., Professor of Anaesthesia, Harvard Medical School, and Associate Anesthetist, Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital; Eizo Marutani, M.D., Research Fellow, Department of Anest

**Research Type:** Basic Science

**Project Topic:** Investigation of mechanisms through which adeno-associated virus mediated delivery of caspase-1 leads to destruction of experimental schwannomas.

**Overview:** Schwannoma tumors are benign (non-malignant) in that they grow slowly and are neither invasive nor metastatic. They can have devastating consequences for patients including intense pain and loss of motor and sensory function. Our proposal focuses on a new therapeutic approach to these nerve-associated tumors involving intratumoral injection of an adeno-associated virus vector carrying the pro-apoptotic gene caspase-1 under a Schwann cell specific promoter; the vector is denoted AAV-P0-ICE. Adeno-associated virus vectors have proven safe in clinical trials for multiple other diseases. Our initial pre-clinical studies have shown a remarkable ability of the AAV-P0-ICE vector to produce a prolonged reduction in tumor volume with no nerve damage. This proposal is focused on evaluation of the mechanisms underlying bystander killing associated with AAV-P0-ICE schwannoma treatment.

**Student Role:** A FAER student would assist with a variety of components of the project which will be determined based on the experiments that are running during the summer. It is very likely that there will be a need for behavioral testing of mouse sensory and motor function. This would require that the student become proficient with von Frey filament and rotarod tests. Further, we regularly perform immunohistochemical analyses of tumor bearing nerve. It is very likely that an FAER student would be involved in tissue preparation (cryostatic sectioning) and subsequent immunohistochemical staining, image capture, and analysis.

**Mentors:** Gary J Brenner, M.D., Ph.D., Assistant Professor of Anaesthesia, Harvard Medical School, and Assistant Anesthetist, Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital; Sherif Ahmed, Ph.D., Postdoctoral Associate, Dep

**Research Type:** Basic Science
**Project Topic**: Pain and Cognitive Impairment in Geriatric Subjects

**Overview**: Our published work has demonstrated a potential association between pain and cognitive impairment in rodents. Our preliminary data have shown that surgical incision-induced pain could cause neuroinflammation, reduction in synaptic NMDA receptors, and phosphorylation of Tau protein (part of a neuropathogenesis pathway in Alzheimer's disease). Moreover, we have shown that enhancement of cognitive function by enriched environment can lead to improvement of both surgical incision- and chemical stimulation-induced pain in the mice. Therefore, we will propose a series of studies to investigate the interaction of pain and cognition in animals and humans (both young and old) using such approaches as molecular biology, cellular biology, behavioral paradigms, electrophysiology, imaging, and human pain and cognitive function assessment.

**Student Role**: The student would perform the research under the supervision of mentors in both translational and clinical investigation. Specifically, the student would animal studies to determine whether pain can lead to cognitive impairment in both adult and aged mice, as well as Alzheimer’s disease transgenic mice. The underlying mechanisms (e.g., the interaction of Abeta and NMDA receptor) will also be investigated by the student. The student will also perform clinical investigation to assess whether there is association between pain and postoperative cognitive dysfunction/postoperative delirium in patients.

**Mentors**: Zhongcong Xie, M.D., Ph.D., Professor of Anesthesia in Harvard Medical School and Massachusetts General Hospital; Yiying (Laura) Zhang, M.D., Instructor of Anesthesia in Harvard Medical School and Massachusetts General Hospital; Kali Stevens, B.A.,

**Research Type**: Clinical

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**Project Topic**: 1) TASK tandem pore potassium channel molecular pharmacology. We are interested in the molecular mechanism(s) by which inhaled volatile anesthetic gases activate TASK potassium channels and how breathing stimulant compounds (e.g., doxapram) inhibit TASK

**Overview**: 1) Using random and targeted mutagenesis and guided by several recent potassium channel crystal structures, we will identify regions of the TASK potassium channel critical for inhibition by breathing stimulant compounds and for activation by volatile anesthetics. We will assess effects on potassium channel function using an Ussing chamber system and/or using a high throughput yeast-based system combined with next generation sequencing.

2) We will inject breathing stimulants compounds into rats, systemically or regionally (e.g., into CSF or carotid artery), and study its effect on breathing. We will inject the compounds systemically into rats treated with an opioid and quantify its effect on opioid-induced respiratory depression.

**Student Role**: The student would focus on either molecular biology/ion channel or rodent studies. A unique and important role will be defined based on the student's interests. The student will work closely with the mentor and/or his research assistant to master multiple basic laboratory skills in molecular biology, ion channel electrophysiology, basic electronics, respiratory physiology, and rodent handling/experimentation.

**Mentors**: Joseph F. Cotten, M.D., Ph.D., Assistant Professor of Anesthesia, Harvard Medical School

**Research Type**: Basic Science
**Project Topic:** The Weddell seal is a champion diver. Its key physiological specializations are remarkable cardiovascular control, managing regional blood flow based on metabolic need, and an ability to sustain periods without oxygen. Identifying underlying mechanisms has tremendous potential for human medicine, pointing to novel therapies for cardiovascular trauma (stroke, heart attack) and diseases associated with tissue hypoxia (pneumonia, sepsis, cancer).

In Fall 2015, we will collect tissue samples in Antarctica, which will be available for analyses in Summer 2016. We hypothesize that altered nitric oxide (NO) signaling underlies hypoxia tolerance in seals. In terrestrial mammals, NO production increases regional blood flow to counter tissue hypoxia, which could be detrimental to long-diving mammals requiring tight control of peripheral vasoconstriction to maintain central blood pressure underwater. NO activates soluble guanylate cyclase (sGC), producing cGMP and promoting local vasodilation.

**Overview:** Our overall aim is to determine how diving seals control local blood flow in the face of a strong centrally mediated dive response that confers intense bradycardia and peripheral vasoconstriction. From this we can understand variation in hypoxia tolerance by circumstance and in different tissues in this model species. We will measure variability of hypoxia tolerance in different cultured cell types and examine NO signaling in collected tissues to look for regional variation. Vasoregulatory control by NO will also be evaluated at the sequence level, in light of this species genome.

We will define a discrete student project transcripts in NO signaling to assess regional differences. The project could also expand to include in vitro experiments in cell lines we will establish in Antarctica, applying ant/agonist drugs relevant to NO signaling and identify key differences between seals and non-hypoxia tolerant humans/mice.

**Student Role:** The student will be introduced to the project and participate in weekly meetings/journal club with all project personnel. Additionally, at least one student-mentor meeting will be scheduled weekly to discuss project specifics and provide guidance as needed. We expect the student to conduct data collection and analyses for a subset of our larger project on Antarctic seal hypoxia tolerance. This project will be based on existing samples and we anticipate that the student could get started immediately. We further expect the student to understand the scientific background for their specific project, as attainable within an 8-week period.

**Timeline:**

- **Week 1:** Introduction to project, lab group, resources, techniques and lab safety.
- **Week 2:** Project-specific training in lab techniques and assays
- **Weeks 3-6:** Data collection and initiation of analyses
- **Week 7:** Completion of data collection, data analyses, prepare poster/presentation
- **Week 8:** Complete analyses, poster, presentation.

**Mentors:** Emmanuel Buys, Ph.D., Assistant Professor of Anesthesia, Harvard Medical School; Allyson Hindle, Ph.D., Assistant Professor of Anesthesia, Harvard Medical School

**Research Type:** Basic Science
**Project Topic:** Using the Electroencephalogram to Characterize the Anesthetic State of Elderly Patients Receiving General Anesthesia or Sedation

**Overview:** We have recently established that the unprocessed electroencephalogram (EEG) and its spectrogram can be used to track reliably the brain states of patients receiving general anesthesia and sedation. Each anesthetic has a specific EEG signature that relates to its neurophysiological mechanism of action in brain circuits. We have established also that each of these signatures changes as a function of age. We are now systematically collecting data on elderly patients (60 years and older) to precisely define the EEG signatures for the commonly used anesthetics, propofol, sevoflurane, ketamine and remifentanil. We are collecting the data in our operating rooms and using the spectral analysis techniques that we’ve developed to analyze the data. This provides a unique opportunity for medical student to join my colleagues and me in the operating room during the cases, to watch brain states on the EEG in real time, download data from the monitor and take it back to the laboratory for analysis.

**Student Role:** The medical student will have the unique opportunity to join my colleagues and me in the operating room during the cases, to watch the brain states on the EEG in real time, download the data from the monitor and take it back to the laboratory for analysis. The student will prepare a powerpoint presentation to give at the laboratory meeting and will be included as an author on the manuscript when it is submitted for publication. The student will also give a poster presentation at the ASA/FAER meeting.

**Mentors:** Emery N. Brown, M.D., Ph.D., Warren M. Zapol Professor of Anaesthesia, Harvard Medical School, and Attending Physician, Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital; Edward Hood Taplin, Professor of Medical Research

**Research Type:** Clinical

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**Project Topic:** Ventilator-associated pneumonia (VAP) is one of the most frequent hospital-acquired infections occurring in intubated and mechanically ventilated patients in Intensive Care Unit. Because VAP is associated with higher mortality, morbidity, and costs, there

**Overview:** Validation of markers for aspiration and endotracheal tube cuff leak.

**IRB Protocol #:** 2015P001931

The goal of this interventional study is to test Quinine, Red and Blue food dye as markers of aspiration (ETTs cuff leakage) in mechanically ventilated, critically ill patients. We will challenge the oropharyngeal cavity with a known concentration of Quinine, Red and Blue food dye suspended in sterile water. We hypothesized that the detection by spectrophotometry of the same substances in the tracheal secretions will prove aspiration.

Our specific aims are:

1. To quantify the measurements of Quinine, Red and Blue food dye in the tracheal sample and compare them to pepsin measurements in the same sample.

2. To assess association between the amount of oropharyngeal aspiration and the development of upper and lower respiratory complications (i.e. VAP, tracheo-bronchitis, ventilator-associated events, ARDS, etc.).

3. To determine patient’s risk factors associated with oropharyngeal aspiration.
**Student Role:** The student will join the research team led by Dr. Berra and Dr. Kacmarek. The research group is formed by two MD research fellows and one post-graduate student and is actively performing several study protocols in the field of the management of ventilat

**Mentors:** Lorenzo Berra, M.D., Assistant Professor of Anesthesia, Harvard Medical School, and Attending Anesthesiologist, Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital

**Research Type:** Clinical

**Project Topic:** Our work focuses on how nutrition may be a modifiable risk factor for adverse outcomes in critically ill patients.

**Overview:** Macronutrient (calories and protein) deficit during critical illness is associated with adverse outcomes. It is not clear whether temporal changes in macronutrient deficit during acute illness are associated with organ failure. Therefore, we propose to investigate whether there is an association between changes in caloric as well as protein deficit and changes in sequential organ failure assessment (SOFA) scores in intensive care unit patients. The presence of an association would suggest that macronutrient deficit maybe a modifiable risk for organ failure during critical illness. The proposed research project may also shed some light on an age-old debate of whether calories or proteins are more important in the acute phase of critical illness.

**Student Role:**
1. Extract data from existing database and access electronic medical records to pull additional data relevant to project.
2. Collate data for analysis in Excel data sheet.
3. Assist with data analysis and interpretation.
4. Write abstract for presentation at MGH Research Day and national meeting (either SCCM or CNW)
5. Publish manuscript on findings.

**Mentors:** Sadeq A. Quraishi, MD, MHA, MMSc, Assistant Professor of Anaesthesia, Harvard Medical School, and Attending Physician, Department of Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital

**Research Type:** Outcomes

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**Medical College of Wisconsin**

**Project Topic:** Preoperative Rehabilitation of Frail Elective Surgical Patients Improves Outcomes

**Overview:** Surgical procedures can result in unwanted health events and unanticipated longer hospital stays. The risk of an unwanted event after surgery is greater in frail patients who by definition have less physiological reserve. The Anesthesia Preoperative Screening Clinic assesses all patients scheduled for elective surgery and screens for frailty. Frail patients who provide informed consent will participate in the study and be randomly assigned to a control group (routine care), or an intervention group consisting of a program of nutritional supplementation and mild exercise, during the six to 12 weeks prior to and the six weeks following their surgery. This study will determine whether a program of nutritional supplementation
and mild exercise prior to surgery can make a positive impact on length of hospital stay, complication rates, and return to normal activities in the frail patient.

**Student Role:** Assist with conduct of study, including patient interaction during weekly exercise/evaluation sessions. Data spread sheeting, analysis, and summary both graphically and statistically. Submission of research findings for presentation at local, regional or national meeting.

**Mentors:** Thomas J. Ebert, MD, PhD, Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Cardioprotection by Volatile Anesthetics

**Overview:** Nitrite and volatile anesthetics in cardioprotection. Biochemical and biophysical studies will be conducted to evaluate the impact of volatile anesthetics on nitrite-nitrate-nitric oxide biology during myocardial ischemia and reperfusion injury in normal and diabetic animals.

**Student Role:** Student(s) in the laboratory participate actively in ongoing research programs investigating the mechanisms of anesthetic cardioprotection that are conducted using cell culture and animal models of ischemia and reperfusion injury. The student(s) will acquire skills in small animal surgical techniques, vascular and cardiac physiological monitoring, and tissue and cell preparation for molecular (e.g. Western blotting, PCR) and biochemical analyses (e.g. ozone chemiluminescence). Student(s) will participate actively in weekly laboratory meetings by giving periodic presentations of their work. Student(s) are instructed on accurate data collection and are mentored in scientific technical writing skills. Student(s) interact on a daily basis with technical staff, visiting scientists, postdoctoral fellows, and junior faculty. The Anesthesiology Department annually hosts several world-renowned speakers for invited seminars for which all students and faculty are encouraged to attend.

**Mentors:** David C. Warltier, MD, PhD, Professor and Chairman of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Anesthetic-Induced Cardioprotection

**Overview:** Our laboratory has focused on the role of mitochondria in normal myocardial functions as well as in pathologies. One of the hypotheses is that a short exposure to volatile anesthetics provides protection for the heart against ischemic damage by preserving mitochondrial structure and function. This hypothesis is investigated in an interdisciplinary approach. We are using physiological, pharmacological and molecular techniques as well as proteomics to demonstrate that there are quantifiable alterations in protein expression, channel function and mitochondrial bioenergetics after their exposure to inhalational anesthetics.

**Student Role:** The student will participate with ongoing experiments examining the role of mitochondria in cardioprotection. Here are some specific methodologies pertaining to the mitochondrial isolation and functional studies using isolated mitochondria:

Measurements of ATP synthesis: The rate of mitochondrial ATP synthesis is calculated and expressed as μmol ATP/min-1/mg mitochondrial protein-1.
Measurements of membrane potential: Mitochondrial membrane potential is determined spectrofluorometrically utilizing the dye Rhodamine 123.

Measurements of oxygen consumption: Oxygen consumption is measured polarographically with a Clark-type oxygen electrode in a water-jacketed chamber. The electron transport chain is examined using different site-specific substrates.

Detection of reactive oxygen species: Mitochondrial reactive oxygen species are monitored with a fluorescent probe, dichlorohydro-fluoresce in diacetate, which is oxidized in the presence of hydrogen peroxide to dichlorohydro-fluorescein.

**Mentors:** Zeljko J. Bosnjak, PhD, Professor and Vice Chair for Research of Anesthesiology, Professor of Physiology

**Research Type:** Basic Science

**Project Topic:** Mitochondrial Cation Exchangers: Modeling Experimental Data

**Overview:** We conduct studies in isolated hearts and isolated mitochondrial to assess the changes in cation flux in cardiac myocytes and across mitochondrial membranes. Proton pumping by mitochondria furnishes the electrons for respiration and phosphorylation to meet the metabolic demands of cells. Proton pumping and proton reentry must be balanced by other cations such as sodium and calcium. The characteristics of the exchangers for these ions is little understood. When we understand their kinetics we can use this knowledge to fashion models of ion fluxes and make predictions on perturbation of one or more ions on other ions.

**Student Role:** Conduct experiments in isolated cardiac mitochondria using specific cation dye spectrophotofluorimetry, assess changes in cation flux and the effect of cation exchange inhibitors, and help develop models of cation exchange that underlie mitochondrial bioenergetics.

**Mentors:** David F. Stowe, MD, PhD, Professor of Anesthesiology and Physiology

**Research Type:** Basic Science

**Project Topic:** Role of Calcium In the Cellular Mechanisms of Pain Following Nerve Injury

**Overview:** Calcium levels in the neuronal cytoplasm regulate most functions including the response to injury. Neuropathic pain is poorly treated. Our lab is focused on identifying pathogenesis of chronic pain that persists following nerve injury or inflammation. We use a variety of approaches to examine changes in the peripheral sensory neurons. Our translational therapeutic efforts include gene therapy through viral transduction of sensory neurons and stem cell therapy using transduced mesenchymal stromal cells.

**Student Role:** The student will have responsibility for planning protocols, generation of data, analysis, and presentation of findings in a project involving measurement of rat pain behavior, cell dissociation, and recording.

**Mentors:** Quinn Hogan, MD, Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Photobiomodulation as a treatment of cardiac ischemia and reperfusion injury
Overview: Protective strategies against cardiac ischemia and reperfusion injury fail when the cardiovascular damage is complicated by diabetes mellitus or other underlying diseases. One underlying cause for insufficient cardioprotection is the loss of nitric oxide bioavailability due to endothelial dysfunction in diabetes. We previously discovered that photobiomodulation with far red/near infrared light may overcome the NO-deficiency via a unique non endothelium-derived NO-producing mechanism. We hypothesize that photobiomodulation protects the diabetic heart from IR injury through nitric oxide synthase-independent nitric oxide generation from heme-containing proteins. We examine the effect of NIR in mice hearts as well as in cellular models, and use nitrosylated heme proteins to assess NIR-induced NO release and its effect on mitochondrial bioenergetics.

Student Role: Student will be trained in cell culture, cellular damage assays, and bioenergetics assays. He will perform all experimental procedures, compile the results of the assays, and learn to analyze them with the help of the preceptor. He will also have the chance to observe or participate in experiments on a mouse model of in vivo cardiac ischemia and reperfusion injury. The student will have a chance to participate in an abstract and/or a publication at the end of the project.

Mentors: Martin Bienengraeber, PhD, Associate Professor of Anesthesiology

Research Type: Basic Science

Project Topic: Developmental Differences in Opioid-Induced Respiratory Depression

Overview: Our current approaches to identify the sites of opioid-induced respiratory depression in the brainstem consist of injection of opioid agonists and antagonists as well as neurotransmitter agonists and antagonists into functionally identified areas of the brainstem in adult and young rabbits in vivo. The resulting functional information is amended by histological evaluation of the identified areas for opioid receptors, neurotransmitter receptors and projection of the identified neurons into other areas of the respiratory pattern generator.

Student Role: Participation in in vivo experiments including our neurosurgical approach to the brainstem; participation in neuronal recordings and drug injection protocols; mentored to independent performance of histological preparations; mentored to independent data analysis; mentored poster preparation; participation in publishing the results (this would be after the end of the project).

Mentors: Astrid G. Stucke, MD, Associate Professor of Anesthesiology

Research Type: Basic Science

Medical University of South Carolina

Project Topic: Dose Response of Ketorolac in Out-Patients Undergoing Knee Arthroscopy

Overview: While a single dose of ketorolac is administered as current practice to the majority of patients undergoing knee arthroscopy, this appropriate dose of ketorolac to be administered has not been evaluated. Past studies have examined different doses of ketorolac administered to patients after spinal fusion surgery and found that 7.5 mg every 6 hours was as effective as 15 or 30 mg every 6 hours in decreasing postoperative pain and patient opiate consumption. Since ketorolac side effects such as gastrointestinal and surgical site bleeding seem to be dose related, utilizing a lower dose of ketorolac may be more efficacious. There will be four groups in this randomized trial listed below:
Receieving a dose of 7.5 mg ketorolac
Receieving a dose of 15 mg ketorolac
Receieving a dose of 30 mg ketorolac
Receiving a placebo (saline without a study drug).

**Student Role:** The student will participate in clinical execution of the study, data collection and entry, literature review, manuscript preparation, and presentation of results. No specific experience is necessary, but the student will be expected to invest considerable time self-educating on the relevant topics to this research.

**Mentors:** Dr. Sylvia Wilson, MD

**Research Type:** Clinical

**Project Topic:** Are Portal Blood Flashes Useful in Maintaining Hemodynamic Stability in the Peri-Reperfusion Stage of Orthotopic Liver Transplantation

**Overview:** This study is designed as a prospective observational trial on participants having orthotopic liver transplantation. As is the norm at our institution, approximately half (20 patients) will receive a portal blood flush prior to reperfusion of the transplanted liver graft.

The primary outcome of interest is whether patients are more hemodynamically stable after reperfusion with a blood flush as evidenced by a smaller change in heart rate, blood pressure, central venous pressure, systemic vascular resistance, and stroke volume variation and whether these changes correlate to changes in lab values and cardiac function as seen on TEE.

The two groups will be compared by the following parameters:

- Pre and post reperfusion blood pressure, heart rate, central venous pressure, stroke volume variation, systemic vascular resistance.
- Pre and post reperfusion serum pH, K+, lactate
- Pre and post reperfusion cardiac function
- Need for hemodynamic intervention with fluids or pressors

**Student Role:** The medical student will be asked to do the following: data collection and entry, literature review, manuscript preparation, and presentation of results. During times without research activity, they will be welcome to spend time with the investigators learning about operative anesthesia or other research based on their interest.

**Mentors:** Dr. Grayce Davis, MD

**Research Type:** Clinical

**Project Topic:** Transcranial Direct Current Stimulation in the Management of Post-operative pain

**Overview:** The goal of the study is to determine whether the new technology of tDCS (transcranial direct current stimulation) can help to reduce post-operative total knee replacement pain and to determine if
there is an optimal electrode placement array for the management of post-operative pain. Preliminary studies suggest that tDCS may be effective in reducing post-operative total knee replacement pain, altering pain perception in healthy adults and in patients with various types of pain conditions.

**Student Role:** The student will be responsible for conducting patient eligibility screens, consenting patients, and conducting brain stimulation sessions once surgery is complete. The student will be required to work in a team setting in order to maintain the double-blinded nature of the experiment. Therefore, the student's responsibilities will vary from setting up the brain stimulation sessions to conducting patient evaluations. Student will become comfortable with patient contact as it applies to clinical research and will become familiar with the principles and use of transcranial direct current stimulation (tDCS) and its uses for pain management. Finally, the student will participate in both the data entry and management portion of conducting clinical research.

**Mentors:** Dr. Jeffrey J. Borckardt, PhD

**Research Type:** Clinical

**Project Topic:** RELIEF A Global Registry to Evaluate the Long-Term Effectiveness of Neurostimulation Therapy for Pain

**Overview:** The purpose of this registry is to compile characteristics of clinical outcomes for Boston Scientific commercially approved neurostimulation systems for pain in routine clinical practice. And evaluate the economic value and technical performance of the neurostimulators.

**Student Role:** Medical student will be involved in data acquisition, obtaining informed consent, and assisting in data entry and analysis.

**Mentors:** Ryan Nobles, MD

**Research Type:** Clinical

**Project Topic:** Factors Influencing Postpartum Epidural Reactivation

**Overview:** Numerous women desire tubal ligation following vaginal delivery for birth control. Many women also have an epidural placed for pain control during labor. Ideally, an epidural catheter placed for labor can also be used to provide anesthesia for a subsequent tubal ligation procedure. Research shows that a percentage of epidural catheters function poorly and are not sufficient for anesthesia for tubal ligation following labor and delivery. This study will test whether an infusion of preservative-free saline (salt-water) in the epidural will decrease the number of labor epidurals that function poorly or not at all, and thereby, decrease the need for additional procedures (a spinal or general anesthetic) to provide anesthesia for post partum tubal ligation.

**Student Role:** Student will be directly involved in patient consenting, chart review, data analysis, data entry, and statistical analysis.

**Mentors:** Laura Roberts, MD

**Research Type:** Clinical
**Project Topic:** Evaluation of the duration of bupivacaine spinal block as the primary anesthetic for orthopedic procedures with and without epinephrine wash

**Overview:** The hypothesis is that epinephrine prolongs the duration of bupivacaine 0.5% (total dose 15mg) subarachnoid block (SAB) for total joint replacement (TJR) in a dose dependent fashion. Patients undergoing primary TJR (THA or TKA) will be randomized to one of the 5 study groups- The bupivacaine only group will receive bupivacaine 0.5% 3cc plus sterile saline 0.1cc. The EPI25 group will receive bupivacaine 0.5% 3cc, epinephrine 1:1000 0.025cc, and sterile saline 0.075cc. The EPI50 group will receive bupivacaine 0.5% 3cc, epinephrine 1:1000 0.05cc, and sterile saline 0.05cc. The EPI75 group will receive bupivacaine 0.5% 3cc, epinephrine 1:1000 0.075cc, and sterile saline 0.025%. The EPI100 group will receive bupivacaine 0.5% 3cc, and epinephrine 1:1000 0.1c.

**Student Role:** The medical student will be asked to do the following: data collection and entry, literature review, manuscript preparation, and presentation of results. During times without research activity, they will be welcome to spend time with the investigators learning about operative anesthesia or other research based on their interest.

**Mentors:** Eric Bolin, MD

**Research Type:** Clinical

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**Project Topic:** Crew Health During Coastal Cruising

**Overview:** The overall aim of this project is to learn the illnesses and injuries that occur during coastal cruising. The specific aim of this project is to survey those coastal cruising sailors to determine during the course of their travels:

1) what illnesses and injuries are encountered;
2) the treatment of the illness and injury; and
3) the effectiveness of the therapy and final disposition.

**Student Role:** This is an ongoing study using web-based RedCap survey technology and the student will learn about this type of research, assist in data analysis, present the data at an appropriate scientific meeting.

**Mentors:** J.G. Reves, MD

**Research Type:** Health Services

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**Project Topic:** Impact of Dural Puncture Epidural versus Traditional Lumbar Epidural on Onset of Labor Analgesia

**Overview:** Epidural block is the gold standard for labor analgesia. However, the onset of optimal analgesia can take 15-20 minutes. This is because the epidural medication has to cross the duramater to block the pain fibres. Puncturing the duramater and depositing of drugs directly in the cerebrospinal fluid results in a quicker onset of action, but is associated with maternal and fetal sideeffects. The current study will make a dural puncture but will not deposit the medication in the cerebrospinal fluid. Instead after the dural puncture, the medication will be placed in the epidural space. However, the theoretical dural puncture will facilitate a quicker onset of action without the maternal and fetal side-effects.
**Student Role:** "The student’s involvement in this project will give him/her the experience in conducting ethical research. The educational experience of understanding the physiology of labor pain and its impact on both the mom and baby will be achieved. It will also provide insight into the scope of anesthesia as it relates to obstetrics. The student will help with the recruitment of patients for the study fully understanding the inclusion and exclusion criteria for the study. The student will also help with complete data collection on study patients on the day of the study. The student will assist with data collection 24 and 48 hours after the initial encounter. Date entry into an electronic database RedCap will also be expected of the student. This is a vital component of the study which facilitates with data analysis. The process of data collection and storage will emphasize the importance of maintaining patient confidentiality, a very important aspect of clinical research. The student will be expected to conduct a study specific literature search and help with writing the manuscript."

**Mentors:** Latha Hebbar, MD

**Research Type:** Clinical

**Project Topic:** Tissue Plasmin Activity in Infants and Children Undergoing Cardiac Surgery

**Overview:** Extensive blood loss and multiple blood transfusions are a major source of patient complications during and after infant cardiac surgery. The activation of the fibrinolytic system (an enzyme system that breaks down blood clots) during surgery is thought to be a main cause of blood clot instability in these patients. Although medications that inhibit this system are routinely used, they also display very variable efficacy and can cause serious side effects. The primary hypothesis of this study is that direct measurement of the activation status of the fibrinolytic system directly inside local tissue (e.g. muscle or wound surfaces) will enable physicians to better evaluate the blood clotting ability of a pediatric heart surgery patient and will substantially improve diagnostic accuracy and drug dosing, thereby reducing the observed side effects such as kidney injury and increased risk of thrombosis.

**Student Role:** The medical student will assist in the design and implementation of this rather complex study that involves the handling of samples at the bedside and analysis of samples at the bench. The student will learn research methodology, challenges of bedside to bench research, and the rewards of science at

**Mentors:** Ilka Theruvath, MD, PhD

**Research Type:** Clinical

**Montefiore Medical Center

**Project Topic:** Are Current Transfusion Practices Consistent with Recommended Guidelines?

**Overview:** Massive Transfusion Protocols (MTPs) have become nearly a standard of care at trauma centers, because of studies that have documented improved patient survival rates. However, while some patients’ lives are saved in the short term due to massive volume replacement, it is likely that some patients suffer negative consequences due to the complications of unnecessary transfusions.

The goal of this study is to review charts of patients who have been transfused in the Operating Room and to determine whether anesthesiologists are modifying their practice towards current guidelines that are intended to minimize unnecessary blood transfusions.
Medical records will be queried to identify the factors associated with blood transfusion and also will evaluate the adherence of anesthesiologists to the guidelines of blood transfusion. Different transfusion thresholds were created to evaluate the likelihood of transfusion in a particular case and also will collect the adverse reactions assoicate

**Student Role:** Reviewing medical records, entering data into the spreadsheet, cleaning the database helping in analysis and manuscript writing.

**Mentors:** Dr. Sheldon Goldstein

**Research Type:** Translational

**Project Topic:** Use of the FORE-SIGHT Elite Tissue Oximeter to Assess Leg Ischemia during Peripheral Cannulation for V-A ECMO

**Overview:** Extracorporeal membrane oxygenation (ECMO) is a technique of advanced life support which allows gas exchange outside the body and supports tissue perfusion in a manner similar to cardiopulmonary bypass (CPB). The improved survival has increased the number of adult patients receiving ECMO for many applications and clinicians are forced to deal with a number of complications associated with the application. For the purpose of this study, we plan to focus on the limb ischemia complication that may arise during the course of ECMO treatment. A FORE-SIGHT Elite monitor is a newly FDA cleared device as a tissue oximeter for cerebral and somatic tissues will be used to assess the blood flow of the cannulated limb. Values obtained from the two lower extremities will be compared a clinical diagnosis will be used in identifying limb ischemia. Planning to enroll 30 VA-ECMO subjects.

**Student Role:** Obtaining consents, working closely with the ECMO team and the PI. Collecting and entering data into paper and electronic CRF. Documenting adverse events

**Mentors:** Dr. Jonathan Leff MD

**Research Type:** Translational

**Project Topic:** The Inflammatory response to robotic CABG: Implications for timing of hybrid revascularization. A comparison of the inflammatory response with other methods of revascularization.

**Overview:** The development of minimally invasive techniques for coronary artery bypass graft (CABG) procedures include robotic surgery. By avoiding median sternotomy, aortic cross-clamping, and cardiopulmonary bypass, the intention of this alternative surgical method aims to decrease the incidence of adverse neurologic events, coagulopathy and bleeding, infection, and pulmonary complications compared to conventional CABG. While Robotic CABG provides definitive treatment for single vessel LAD disease, it can also be combined with percutaneous coronary intervention (PCI) to non-LAD targets as therapy for multivessel coronary artery disease. Robotic CABG plus PCI revascularization has been termed Hybrid Coronary Revascularization (HCR). In this study, we aim to quantify and describe the inflammatory response in patients that undergo robotic CABG, PCI, and HCR.

**Student Role:** Obtaining research consents from the patients, obtaining and processing blood samples from patients, monitoring patients in the operating room and after surgery, collecting data from electronic medical records, entering data into electronic CRF.
Mentors: Dr. Galina Leyvi, MD

New York University School of Medicine

**Project Topic:** Long-lasting effects of anesthetics on synapse development and plasticity.

The goal of this project is to elucidate the long-term consequences of general anesthetics on synapse development and function, and to develop therapeutic strategies to prevent sy

**Overview:** In this application, we will investigate the effects of single and repeated exposure to anesthetics on synaptic plasticity and function at specific stages of brain development. By using in vivo two-photon microscopy in combination with newly-generated glutamate and calcium sensors, we will determine whether repeated exposure to anesthetics during early postnatal development has long-lasting detrimental impacts on learning-dependent synaptic plasticity and function later in life. In addition, we will test the hypothesis that the adverse effects of anesthetics such as ketamine or sevoflurane are due to persistent hypofunction of glutamatergic neurotransmission and that pharmacological enhancement of the activities of \( \alpha \)-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid (AMPA) receptors or N-methyl-D-aspartate (NMDA) receptors would alleviate such effects. This may help establish novel treatment strategies directed at rescuing the detrimental effects of anesthesia on the developing brain.

**Student Role:** Using a combination of techniques including in vivo two-photon imaging, molecular manipulation, biochemistry and behavioral analysis to examine the effect of anesthetics on neuronal structure and function.

Mentors: Guang Wang, PhD

**Research Type:** Basic Science

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**Project Topic:** Molecular mechanism of Barth syndrome

**Overview:** This is an ongoing, NIH-funded project to determine the consequences of aberrant cardiolipin metabolism in Barth syndrome, an X-linked cardiomyopathy. The work includes studies in mice, Drosophila, and cell cultures.

**Student Role:** The student will learn a new experimental technique and apply it to the project.

Mentors: Michael Schlame, MD

**Research Type:** Basic Science

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**Project Topic:** Central glutamate signaling in pain regulation

Pain has both sensory and affective components. How pain is represented and regulated in the brain, however, is not well understood at the molecular and circuit levels. We employ a combination of optogenetic

**Overview:** Our previous works show that excitatory glutamate outputs from the prefrontal cortex to the nucleus accumbens, a key projection within the brain’s reward circuitry, provides powerful control over both sensory and affective pain experiences. In addition, our most recent data have identified distinct patterns of neuronal activities in the somatosensory cortex and the prefrontal cortex in response to an acute pain stimulus, suggesting that sensory and affective experiences of pain are differentially coded in the brain. We
are currently examining how the connection between the prefrontal cortex and nucleus accumbens regulate the pain experience.

**Student Role**: learning and performance of pharmacology experiments, animal surgeries (intracranial and peripheral nerve surgeries), behavior testing, optogenetics

**Mentors**: Jing Wang MD, PhD

**Research Type**: Basic Science

**Project Topic**: Peripheral nerve injury changes the expression of hundreds of protein-coding RNAs (mRNAs) in the dorsal root ganglia (DRG) and spinal cord. A single microRNA (miR) can affect the translation of many mRNAs. Hence, alterations of a few miRs could underlie

**Overview**: We have recently described the time course of allodynia in two variants of the SNI model, the Tibial-SNI and the Sural-SNI (Norcini et al 2014). Rats that underwent Sural-SNI developed sustained neuropathic pain whereas Tibial-SNI animals recovery from the injury-induced neuropathic pain. Since both SNI models involve peripheral nerve injury, their simultaneous use increases the probability of identifying differentially regulated miRs that correlate with the quality and magnitude of neuropathic pain and decreases the probability of detecting miRs that are involved in other cellular functions that are not related to neuropathic pain. By using this approach we have already identified differential regulated miRs between Sural-SNI and Tibial-SNI in dorsal root ganglia (7 miRs, Norcini et al 2014), in spinal cord (7 miRs) and in blood plasma (2 miRs). Moreover, these miRs displayed regional specificity.

**Student Role**: The student will be involved in the preparation of viral vectors containing the sequence information for the identified miR or its corresponding miR inhibitor. The student would assist in the injection of the corresponding viral vectors and in behavioral measurements (mechanical and cold allodynia) to determine their efficacy

**Mentors**: Esperanza Recio-Pinto, PhD; Monica Norcini, PhD

**Research Type**: Basic Science

**Project Topic**: The endocannabinoid system and pain

**Overview**: My current research interests and approaches are focused on elucidating the role of the endocannabinoid (eCB) system in the development of pain. Research approaches include the use of a rodent model of neuropathic pain, and a combination of behavioral testing, calcium imaging, electrophysiology, histology and molecular biology. I have a particular interest in characterizing how the cannabinoid 1 receptor is modulated following nerve injury, and what intrinsic and extrinsic factors affect its expression in the context of persistent pain-like behaviors.

**Student Role**: The student will learn a new experimental technique and apply it to the project.

**Mentors**: Alexandra Sideris, PhD

**Research Type**: Basic Science

**Project Topic**: Oxidation of Calmodulin
Overview: Calmodulin is a calcium binding protein that regulates the activity of more than 50 proteins including enzymes and channels. It has been shown to be susceptible to oxidation of its nine methionine constituents in aging rats and potentially might be a target of reactive oxygen species following ischemic reperfusion. We are examining the modification of calmodulin in the hippocampus following a period of cerebral ischemia.

Student Role: The student will be responsible for:
1. isolating calmodulin from the hippocampus;
2. performing Western Blot analysis of calmodulin and oxidized calmodulin;
3. Preparing the samples for mass spectrographic analysis.

Mentors: Thomas J. J. Blanck, MD, PhD; Jin Zhang, MD

Research Type: Basic Science

Project Topic: What is the incidence of desaturation during transport from OR to PACU

Overview: The purpose of this study is to determine the incidence of O2 saturations less than 90% during the time the patient is being transported from the operating room to the recovery room (PACU). Patient who suffer a significant oxygen desaturation are at risk of hypoxia and if sustained, hypoxic brain injury. Vital sign (VS) monitoring (heart rate [HR], respiratory rate [RR] and/or O2 saturation is standard of care in the OR and PACU, it has not been established that all patients require or receive standard VS monitoring during transport from the OR to the PACU. No literature exists regarding this topic. Without this monitoring, it is impossible to determine if a patient has a hypoxic event during transport. We would like to determine the incidence of desaturation in patients during transport from the OR to PACU.

Student Role: The student will be responsible for collecting and entering all data points, analysis of trends and reporting of findings to department

Mentors: Germaine Cuff, PhD

Research Type: Outcomes

Project Topic: OR prophylactic PONV treatment and the need for rescue medication in PACU

Overview: Current guidelines for PONV prevention are implemented widely, but their effectiveness may be limited by poor adherence and there is no consensus on a specific protocol for anti-emetic use in surgical patients. Thus, knowledge of antiemetic efficacy and safety, and establishment of a specific protocol may increase patient satisfaction, reduce medical costs, and decrease negative health consequences. This study reviewed the anti-emetic use at a large academic institution in high-risk PONV surgical patients to examine the factors that predict PONV, the nursing documentation of PONV in patients that required the use of anti-emetics, and thus whether prophylactic or rescue anti-emetics were given based on the data.

Student Role: The student would be responsible for analysis of all cases requiring PONV rescue, stratifying risk and presenting suggested department wide changes to practice.

Mentors: Germaine Cuff PhD
Research Type: Outcomes

Northwestern University Feinberg School of Medicine

Project Topic: Evaluation of the implications of acute postpartum pain

Overview: Childbirth is the most common reason for admission to a hospital in the United States and labor is considered to be one of the most painful experiences a woman will experience in her lifetime. There are several implications, both in the short-term, and long-term for both mothers and their infants, of untreated pain. Our group is undertaking studies that will elucidate the role of acute pain management on long-term outcomes.

Student Role: The student will have an active role in this project. The medical student will participate in data collection and analysis, and abstract and manuscript preparation.

Mentors: Paloma Toledo, MD, MPH

Research Type: Health Services

Project Topic: Finding solutions to disparities in labor analgesia

Overview: Racial and ethnic disparities exist in epidural labor analgesia use. Hispanic and African American women are less likely than non-Hispanic white women to use neuraxial labor analgesia. Our group has done significant work at the patient-, provider-, and systems-level to help understand factors that contribute to racial and ethnic disparities in epidural analgesia use. We plan to use the knowledge gained from these previous projects to develop a patient-centered website to help patients better understand their analgesic options. We have several projects that can be completed during the eight-week fellowship; the student will be assigned one component of the overall study. This may include experiences using both quantitative and qualitative methodologies.

Student Role: The student will have an active role in this project. The medical student will participate in participant recruitment, data collection and analysis, as well as abstract and manuscript preparation.

Mentors: Paloma Toledo, MD, MPH

Research Type: Health Services

Project Topic: Evaluating the diversity of the anesthesia physician workforce

Overview: Diversity in the workforce is essential for promoting high-quality, accessible, and equitable care. Gender and racial/ethnic diversity continue to grow in America; however, this diversity is not reflected in the general physician workforce. Many benefits have been associated with a more diverse physician workforce. To date, no one has completed a comprehensive survey of the diversity of the physician anesthesia workforce, its governmental or academic leadership.

Student Role: The student will have an active role in this project. The medical student will participate in data collection and analysis, and abstract and manuscript preparation.

Mentors: Paloma Toledo, MD, MPH

Research Type: Health Services
**Project Topic**: Evaluation of the association between magnesium administration and maternal fever

**Overview**: Maternal fever complicates one third of all labors. It is associated with several adverse neonatal outcomes such as hypotonia, need for assisted ventilation, cardiopulmonary resuscitation, neonatal seizures, and cerebral palsy. Several studies have demonstrated an association between maternal fever and the use of intrapartum neuraxial analgesia. It has been postulated that the increase in maternal temperature is modulated by interleukin-6. In a rat model, magnesium sulfate was able to suppress interleukin-6 induced increases in maternal temperature. The association between magnesium sulfate administration and maternal fever has not been evaluated to date. We are evaluating the association between maternal fever and magnesium administration.

**Student Role**: The student will have an active role in this project. The medical student will participate in data collection and analysis, and abstract and manuscript preparation.

**Mentors**: Paloma Toledo, MD, MPH

**Research Type**: Clinical

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**NYPH (Columbia Campus) Program**

**Project Topic**: Airway GABAA receptors and reactive airway disease.

**Overview**: Dr. Emala's main area of research interest is in the understanding of interactions between signal transduction pathways in airway nerves and smooth muscle and how these interactions contribute to diseases such as asthma. A broader understanding of the non-neuronal expression and function of GABAA receptors in smooth muscle is a central focus.

**Student Role**: Assist with measuring airway smooth muscle contraction in vitro.

**Mentors**: Charles Emala, MD

**Research Type**: Basic Science

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**Project Topic**: Chloride and calcium signaling in airway smooth muscle cells

**Overview**: Dr. Emala's main area of research interest is in the understanding of interactions between signal transduction pathways in airway nerves and smooth muscle and how these interactions contribute to diseases such as asthma. We seek to understand how cellular chloride fluxes control cellular calcium fluxes and in turn airway smooth muscle contraction.

**Student Role**: Assist with in vitro cell signaling experiments in airway smooth muscle measuring membrane potential, intracellular chloride and intracellular calcium using fluorescent indicators. Measurements in cell monolayers and individual cells are measured by plate reader and confocal microscopy, respectively.

**Mentors**: Charles Emala, MD

**Research Type**: Basic Science

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**Project Topic**: Research in Neuroscience

**Overview**: Effects of alcohol and anesthetics on gene expression and neuronal excitability.
**Student Role:** Electrophysiology and molecular biology laboratory studies.

**Mentors:** Neil Harrison, PhD

**Research Type:** Basic Science

**Project Topic:** Acute kidney injury and remote organ dysfunction

**Overview:** Dr. Lee's research focuses on the pathomechanisms of perioperative acute kidney injury, AKI induced remote organ dysfunction and translational approaches to attenuate this injury. One focus of the laboratory is the role of ischemic preconditioning on acute kidney injury in vivo as well as in vitro.

**Student Role:** Assist with in vitro cell signaling experiments.

**Mentors:** H.T. Lee, MD, PhD

**Research Type:** Basic Science

**Project Topic:** Volatile anesthetics and lipid kinases

**Overview:** Dr. Lee's research focuses on the pathomechanisms of perioperative acute kidney injury and translational approaches to attenuate this injury. One focus of the laboratory is the role of volatile anesthetics on the injury process. The laboratory uses multiple molecular and biochemical approaches to better understand both the injurious and protective signaling pathways involved in the injury.

**Student Role:** Assist with in vitro cell signaling experiments.

**Mentors:** H.T. Lee, MD, PhD

**Research Type:** Basic Science

**Project Topic:** Epidemiology of perioperative care and intensive care outcomes; patient safety; risk stratification and management; anesthesia complications; malignant hyperthermia; opioid overdose.

**Overview:** The project consists of a series epidemiological studies aimed at understanding the risk factors and causes of major anesthesia complications in surgical patients and obstetric patients and developing interventions to improve the quality and safety of perioperative care.

**Student Role:** The student will be actively involved in the entire process of organized research and have the opportunity to pursue an independent study under the supervision of established investigators.

**Mentors:** Guohua Li, MD, DrPH; Minjae Kim, MD, MS; Caleb Ing, MD, MS; May Hua, MD, MS.

**Research Type:** Outcomes

**Project Topic:** Neural plasticity and chronic pain

**Overview:** Peripheral nerve injury triggers abnormal activity of injured and neighboring uninjured nerve fibers. This increase in afferent input is paradoxically met with further signal amplification in the spinal cord, a process involving central sensitization to excitatory input and a loss of GABAergic inhibition. We are studying the mechanisms underlying these long-term consequences of nerve injury and their involvement in
chronic pain. We study synaptic changes in mouse models of persistent pain after nerve injury, utilizing transgenic mice, high-resolution imaging techniques and patch-clamp recordings of spinal cord neurons.

**Student Role:** The student will be trained to assist with nerve surgery in the mouse, dissection and processing of spinal cord tissue, immunostaining, quantitative imaging and Western blotting.

**Mentors:** Joachim Scholz, MD

**Research Type:** Basic Science

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**Project Topic:** Neuroimmune interaction after nerve injury

**Overview:** Nerve and immune cells communicate intensely, at all time. We study specifically the inflammatory response in the central nervous system to peripheral nerve injury. We isolate neurons, monocytes and microglia and grow them in culture to identify the signals neurons exchange with distinct immune cell populations. In vivo studies of neuroimmune interaction involve mouse models of peripheral nerve injury, genetically altered mice, and a variety of techniques to determine the activity of chemokine and cytokine signaling pathways.

**Student Role:** The student will be trained to assist with peripheral nerve surgery in the mouse, collection and processing of spinal cord tissue, isolation of neurons and immune cells for in vitro cultures, flow cytometry and chemotaxis assays.

**Mentors:** Joachim Scholz, MD

**Research Type:** Basic Science

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**Project Topic:** Modeling painful diabetic neuropathy in vitro

**Overview:** The prevalence of polyneuropathy among patients with diabetes mellitus is approximately 60%. Half of these patients will develop chronic pain. We examine structural and functional changes in diabetic nerve fibers using mouse models and stem cell technology. We have collected blood and skin samples from subjects with diabetes mellitus and healthy control subjects and generate neurons from human cells to explore genetic factors that determine their vulnerability to hyperglycemic stress.

**Student Role:** The student will be trained in the growth of neuronal cells in culture and assist with the evaluation of morphological and functional tests to examine the molecular biochemistry of hyperglycemia-induced neuron dysfunction and degeneration.

**Mentors:** Joachim Scholz, MD

**Research Type:** Basic Science

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**Project Topic:** Chemotherapy-induced polyneuropathy

**Overview:** Polyneuropathy is a serious complication of chemotherapy which requires major modification of cancer treatment that may compromise its efficacy. We employ in vitro and in vivo mouse models and stem cell technology to study nerve damage provoked by commonly used chemotherapeutic drugs. We are interested in determining toxic effects that affect axon growth, mitochondrial energy delivery and neuron survival. We are also investigating endogenous defense mechanisms that reveal the potential of peripheral nerves to respond to cellular damage and regenerate.
**Student Role:** The student will be trained in the growth of neuronal cells in culture and assist with the evaluation of morphological and functional tests to examine the molecular biochemistry of chemotherapy-induced cellular and mitochondrial degeneration.

**Mentors:** Joachim Scholz, MD

**Research Type:** Basic Science

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**Project Topic:** Carbon monoxide and anesthesia-induced neurotoxicity

**Project Overview:** There is evidence from animal studies that common clinical anesthetics are neurotoxic to the developing brain and cause long-term neurobehavioural abnormalities. Carbon monoxide can prevent and offset this toxicity. The overall goal of this study is to determine the mechanisms of such therapy and outcomes in mice exposed to carbon monoxide and inhaled anesthetics.

**Student Role:** Assist in rodent exposures and data analysis. Perform immunohistochemistry and assist in counting the number of neurons in slide mounted brain sections.

**Mentor Names:** Richard J. Levy, MD

**Research Type:** Basic Science

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**Project Topic:** Carbon monoxide and Fragile X Syndrome.

**Project Overview:** Fragile X syndrome is the leading genetic cause of autism. Recently, traffic-related pollution was identified as a risk factor for developing autism. In this project, we are evaluating the effect of exposing Fragile X mice to a common component of air pollution (carbon monoxide)

**Student Role:** Assist in rodent exposures. Assist in measuring various aspects of the apoptosis pathway in the mouse brain through a variety of basic science techniques.

**Mentor Names:** Richard J. Levy, MD

**Research Type:** Basic Science

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**Project Topic:** Pediatric anesthesia neurodevelopment assessment project (PANDA)

**Overview:** There is evidence from animal studies that common clinical anesthetics are neurotoxic to the developing brain and cause long-term neurobehavioural abnormalities. The overall goal of the PANDA study is to months of age is associated with impairment in specific neurocognitive, social or determine whether anesthetic exposure in behavioral functions.

**Student Role:** Assist the study team to perform analysis of the PANDA cohort study.

**Mentor Names:** Lena Sun, MD

**Research Type:** Clinical

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**Research Topic:** Pediatric patient safety and outcome during the peri-operative period.

**Overview:** The goal of this project is to characterize and identify risk factors for anesthesia-related complications in children.
**Student Role:** Assist faculty in performing query of CHONY ANQA (anesthesia QA) database and anesthesia-related complications in children.

**Mentor Names:** Lena Sun, MD

**Research Type:** Clinical

**Project Topic:** Use of Smartphone App to teach pain management in hospitalized children in housestaff and nurses.

**Overview:** The goal of this project is to test whether a Smartphone App for pain management in pediatric patients can assist in pain management by pediatric housestaff, pediatric surgical housestaff and bedside nurses.

**Student Role:** Assist faculty in data collection to test specific issues related to pain management in users of the pain management App, pre-App and post-App implementation.

**Mentor Names:** Lena Sun, MD

**Research Type:** Clinical

**Ochsner Clinic Foundation Program**

**Project Topic:** Recovery profile of intrathecal chloroprocaine versus mepivacaine for cervical cerclage.

**Overview:** This a prospective, randomized, controlled, double blinded trial using two accepted doses of intrathecal chloroprocaine and mepivacaine as part of a spinal anesthetic for cervical cerclage. The objective of this study is to determine the length of PACU stay in cerclage patients following the two different spinal medications. Secondary study end points include the time to onset, maximum block height, time to ambulation and voiding. The findings of this study will allow to the development of clinical protocols to improve patient satisfaction and reduce costs.

**Student Role:** The student will be involved in the identification of appropriate study candidates. He/She will assist the investigators with enrolling subjects, randomization, and collection of data perioperatively. The student will be involved in statistical analysis, manuscript preparation, and presentation of research findings at a national meeting.

**Mentors:** Allison Clark, MD; Adrienne Ray, MD

**Research Type:** Clinical

**Project Topic:** Efficacy of Multidisciplinary approach in treating patients with chronic pain after single level laminectomy and/or single level fusion in a randomized clinical trial compared to the standard Narcotic medication treatment.

**Overview:** This study will be a unique clinical trial to determine if the use of multidisciplinary approach is superior to the use of Narcotic medication in decreasing PDI score, time to PACU release and money expenditure used on narcotic medication than the standard treatment and if it should be used as the new standard of care for those undergoing these kind of operations to control their pain and speed up their recovery to a normal functioning status.
**Student Role:** The student will be involved in the identification of appropriate study candidates. He/She will assist the investigators with enrolling subjects, randomization, and collection of data perioperatively. The student will be involved in statistical analysis, manuscript preparation, and presentation of research findings at a national meeting.

**Mentors:** Logan Emory, MD

**Research Type:** Clinical

Ohio State University Wexner Medical Center

**Project Topic:** ACTIVE EMERGENCE FROM ISOFLURANE GENERAL ANESTHESIA INDUCED BY METHYLPHENIDATE

**Overview:** HYPOTHESIS:

Based on this significant arousal stimulatory effect, we hypothesize that methylphenidate (inhibitor of dopamine and norepinephrine transporters) decreases the emergence time from isoflurane general anesthesia.

III. PRIMARY OBJECTIVE:

To assess whether methylphenidate affects time of emergence from isoflurane general anesthesia.

IV. SECONDARY OBJECTIVES:

To assess the efficacy of methylphenidate in preventing PONV (limited opioids consumption).

To assess the efficacy of methylphenidate in preventing opioids dose escalation (fast cognitive improvement with better pain control).

**Student Role:** The student will be involved in screening, consenting and enrolling patients into the study. He/she will be trained to identify possible candidates for the study, perform the informed consent, and once the patient is enrolled, the student will perform an interview to collect demographics, medical history and medications. The student will have the opportunity to interact and assist the anesthesiologist on the case with any study procedures. He/she will perform the necessary assessments intraoperatively and will record the data on the case report forms.

Finally, the student will transfer the data to a database for analysis and will be trained to interpret the data. The student will be expected prepare an abstract and/or poster to present at the local OSUMC Research Day and at an Anesthesiology National Meeting. There will be an opportunity for the student to be a co-author on the manuscript if sufficient work is completed.

**Mentors:** Sergio D. Bergese, MD/ Nicoleta Stoica MD, PhD.

Departments of Anesthesiology and Neurological Surgery

**Research Type:** Clinical

**Project Topic:** "Early postoperative cognitive dysfunction and postoperative delirium after anaesthesia with various hypnotics: a double blind, prospective, randomized, controlled clinical trial - The PINOCCHIO trial"
**Overview:** Postoperative delirium can result in increased postoperative morbidity and mortality, major demand for postoperative care and higher hospital costs. Hypnotics serve to induce and maintain anesthesia and to abolish patients’ consciousness. Their persisting clinical action can delay postoperative cognitive recovery and favor postoperative delirium. We designed this study to evaluate postoperative delirium rate after general anesthesia with various hypnotics in patients undergoing surgical procedures other than cardiac or brain surgery. We also aimed to test whether delayed postoperative cognitive recovery increases the risk of postoperative delirium.

**Student Role:** The Student will be involved in screening, consenting and enrolling patients into the study. He/she will be trained to identify possible candidates for the study, perform the informed consent, and once the patient is enrolled, the student will perform an interview to collect demographics, medical history and medications. The student will have the opportunity to interact and assist the anesthesiologist on the case with any study procedures. He/she will perform the necessary assessments intraoperatively and will record the data on the case report forms. Finally, the student will transfer the data to a database for analysis and will be trained to interpret the data. The student will be expected to prepare an abstract and/or poster to present at the local OSUMC Research Day and at an Anesthesiology National Meeting. There will be an opportunity for the student to be a co-author on the manuscript if sufficient work is completed.

**Mentors:** Sergio D. Bergese, MD

Professor, Division Chief of Neuroanesthesia and Director of Clinical and Neurological Research
Departments of Anesthesiology and Neurological Surgery

**Research Type:** Clinical

**Project Topic:** Postoperative Delirium in Patients Undergoing Hip Arthroplasty

**Overview:** Specific circulating microRNA’s have been identified in patients with neurological diseases or deficits, and specifically those with neurodegenerative conditions. Furthermore, available evidence primarily in pre-clinical / animal models supports the hypothesis that post-surgical/anesthesia – induced neuroinflammation leads to post-operative cognitive decline or dysfunction. We hypothesize that specific circulating microRNA’s involved in the pro-inflammatory response to surgery/anesthesia are a suitable biomarker of Delirium and/or POCD in surgical hip-arthroplasty patients.

**Student Role:** The Student will be involved in screening, consenting and enrolling patients into the study. He/she will be trained to identify possible candidates for the study, perform the informed consent, and once the patient is enrolled, the student will perform an interview to collect demographics, medical history and medications. The student will have the opportunity to interact and assist the anesthesiologist on the case with any study procedures. He/she will perform the necessary assessments intraoperatively and will record the data on the case report forms. In order to collect the data, the student will be trained on how to administer the neuropsychological testing as part of the study procedures. Finally, the student will transfer the data to a database for analysis and will be trained to interpret the data. The student will be expected to prepare an abstract and/or poster to present at the local OSUMC Research Day and at an Anesthesiology National Meeting.

**Mentors:** Sergio D. Bergese, MD/ Nicoleta Stoicea, MD, PhD
Associate Professor, Division Chief of Neuroanesthesia and Director of Clinical and Neurological Research
Departments of Anesthesiology and Neurological Surgery

Research Type: Clinical

Project Topic: A retrospective case review for transsphenoidal skull base surgeries

Overview: When tumors involve the base of the skull, cranial nerves and blood vessels lie in close proximity and present challenges to the neurosurgical and anesthesiology teams. A common approach is to use minimally invasive endoscopic endonasal surgery to resect these skull base tumors. This study aims to examine the use of endoscopic endonasal surgical procedures for the treatment of skull base tumors. Previous studies have demonstrated the effectiveness of the endoscopic endonasal approach for tumor resection, but larger analyses are needed in order to make stronger comparisons to other surgical techniques. In this study we will look specifically at intraoperative complications, remission rates, hospital readmissions, and survival rates at 30 days and 6 months postoperatively.

Student Role: As this is a retrospective study, students will have the opportunity to review medical charts for outcomes of this type of surgery. The student will be responsible for data collection and organization into a database for analysis. The student will be trained on data interpretation and will have the opportunity to write the manuscript. First-authorship will be offered if the project and manuscript is completed during the summer.

Mentors: Joseph Werner MD; Assistant Professor, Clinical

Research Type: Clinical

Project Topic: A retrospective study evaluating the usefulness of the polypharmacy-comorbidity score (CPS) for assessing patients undergoing surgery

Overview: The comorbidity-polypharmacy score (CPS) was originally conceived as an attempt to better quantify the impact of co-morbid conditions and polypharmacy on trauma outcomes in patients who are 45 years and older. Based on our previous experience, CPS is an easy-to-use measure of the combined impact of the patient’s comorbidities and the “intensity” of medical therapy utilized for each respective comorbid condition. This study aims to evaluate the use of CPS in assessing surgical patients and compare to other surgical scoring systems. We will review medical charts of patients who have undergone peripheral vascular surgery at OSUMC, as this population will provide a large range of scores.

Student Role: As this is a retrospective study, students will have the opportunity to review medical charts for outcomes of this type of surgery. The student will be responsible for data collection and organization into a database for analysis. The student will be trained on data interpretation and will have the opportunity to write the manuscript. First-authorship will be offered if the project and manuscript is completed during the summer.

Mentors: Sergio D. Bergese, MD

Associate Professor, Division Chief of Neuroanesthesia and Director of Clinical and Neurological Research
Departments of Anesthesiology and Neurological Surgery
Research Type: Clinical

Oregon Health & Science University

Project Topic: Role of pericytes in microvascular no-reflow after stroke

Overview: The project seeks to understand the role of endothelial-pericyte interaction in control of capillary perfusion in brain and their role in microvascular no-reflow after stroke.

Student Role: The student will learn how to prepare mouse brain endothelial and pericyte cell cultures, and how to analyze their responses to pharmacological agents and ischemic injury induced by incubation under oxygen-glucose deprivation.

Mentors: Nabil J. Alkayed, MD, PhD

Research Type: Basic Science

Project Topic: Role of pexophagy in ischemic brain.

Overview: The projected aims to understand role of peroxisomal autophagy (pexophagy) in stroke. Autophagy is a cell survival mechanism, whereby intracellular organelles, including peroxisomes, are degraded under conditions of nutrient stress.

Student Role: The student will help in image acquisition and analysis of peroxisomal dynamics after neuronal ischemic injury

Mentors: Nabil J. Alkayed, MD, PhD

Research Type: Basic Science

Project Topic: Sex-dependent Role of Acute Ischemic Primary Albuminuria-induced Tubular Apoptosis in Acute Kidney Injury

Overview: The project is aimed at determining the effect of sex on albumin-mediated tubular epithelial apoptosis in acute kidney injury after cardiac arrest.

Student Role: The student will learn how to prepare primary tubular epithelial cell culture from mice after cardiac arrest and resuscitation, and analyze the sex-dependent tubular epithelial response to albumin loading, using high-resolution fluorescence microscopy and apoptosis assays.

Mentors: Michael P. Hutchens, MD, MA

Research Type: Basic Science

Project Topic: Role of Ischemic Glomerular Hyperpermeability in Acute Kidney Injury after Cardiac Arrest and Cardiopulmonary Resuscitation

Overview: Within minutes after cardiac arrest and resuscitation, glomerular barrier integrity is transiently opened, altering the composition of the primary urine. This project investigates the hypothesis that reversing or preventing this acute hyperpermeability will prevent or ameliorate acute kidney injury, using a mouse model of cardiac arrest and cardiopulmonary resuscitation and advanced outcome measures including multiphoton microscopy, molecular ultrasound, proteomics, and others.
**Student Role:** The student will collect and analyze data, as well as help with manuscript writing.

**Mentors:** Michael P. Hutchens, MD, MA

**Research Type:** Basic Science

**Project Topic:** Evaluation of a needle guide

**Overview:** This is an evaluation of the effectiveness of a needle guide developed at OHSU. Student will recruit volunteers to attempt simulated nerve blocks in cadavers using this needle guide versus traditional ultrasound methods.

**Student Role:** The student will learn how to prepare primary tubular epithelial cell culture from mice after cardiac arrest and resuscitation, and analyze the sex-dependent tubular epithelial response to albumin loading, using high-resolution fluorescence microscopy and apoptosis assays.

**Mentors:** Andrew Neice, MD

**Research Type:** Clinical

**Project Topic:** Development of Competency Achievement curves in Anesthesiology Training:

**Overview:** This multi institutional project is to develop competency achievement curves based on end of rotation milestone scores in anesthesiology residencies. The project will involve creating training tools to help faculty raters and the creation of the curves themselves from collected data.

**Student Role:** development of training, data abstraction and analysis, manuscript preparation

**Mentors:** Glenn Woodworth, MD

**Research Type:** Clinical

**Project Topic:** Validation of direct observation tool of anesthesiology procedural skills

**Overview:** This project is a study to determine the reliability and validity of a direct observation assessment of anesthesiology procedural skills. In addition, the study will analyze the acquisition of procedural skills during residency training.

**Student Role:** Data abstraction and analysis, manuscript preparation

**Mentors:** Glenn Woodworth, MD

**Research Type:** Clinical

**Project Topic:** ICU Laryngoscopy study

**Overview:** This is a prospective multi-center RCT evaluating the efficacy of video laryngoscopy in critical care medicine.

**Student Role:** The student will participate in recruitment, data collection and entry, data analysis, abstract and manuscript preparation for submission to a peer-reviewed journal for publication.

**Mentors:** Michael Aziz, MD
**Research Type:** Clinical

**Project Topic:** Association between Na administration, Na serum level and midline shift in patients with brain injury

**Overview:** This is a retrospective analysis of Na administration, Na serum level and midline shift in patients with brain injury in the ICU setting.

**Student Role:** The student will participate in data collection and entry, data analysis, abstract and manuscript preparation for submission to a peer-reviewed journal for publication.

**Mentors:** Miriam Treggiari, MD

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**Rutgers/New Jersey Medical School (formerly UMDNJ)**

**Project Topic:** Dorsal root ganglion transcriptome analysis following peripheral nerve injury

**Overview:** Peripheral nerve injury leads to changes in gene expression in primary sensory neurons of the injured dorsal root ganglia (DRG). These changes are believed to be involved in neuropathic pain genesis. Changes have been identified using gene microarrays or next generation RNA sequencing with poly-A tail selection, but these approaches cannot provide a more thorough analysis of gene expression alterations after nerve injury. We chose to eliminate mRNA poly-A tail selection and perform strand-specific next generation RNA sequencing to analyze whole transcriptomes in the injured DRG following spinal nerve ligation (SNL). Hundred million mapped paired sequences will be identified and their transcriptional changes be compared between SNL and sham groups. Differentially expressed coding RNAs and long non-coding RNAs will be observed. Quantitative real-time RT-PCR assay will be carried out.

**Student Role:** The student will be involved in all phases of the project, including preclinical animal model preparation, behavioral tests, tissue harvest, data collection and analysis, and abstract/manuscript preparation.

**Mentors:** Yuan Xiang Tao, MD, Msc PhD

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**Research Type:** Basic Science

**Project Topic:** Title: Endothelin-type A receptors are necessary for pain hypersensitivity in a mouse model of sickle cell disease

Sickle Cell Disease (SCD) is associated with acute painful episodes and persistent intractable pain. All patients report chronic pain sympto

**Overview:** Endothelin-1, a known pain inducer, is elevated in the blood plasma of both SCD patients and SCD mouse models. Endothelin-1 binds to Endothelin-type A (ETA) receptors that express in the neurons of dorsal root ganglion (DRG). We hypothesize that ET-1 binding to ETA receptors on peripheral nerve terminals initiates nociceptor sensitization which contributes to chronic pain in a mouse model of SCD. Mechanical, thermal, and cold sensitivities will be assessed in 6 month old HBSS-BERK (SCD) and HBAA control mice before and after exposure to hypoxia with and without the addition of the ETA receptor
antagonist, ABT-627. The ETA/Cre mice, from the cross-breeding of ETA receptorfl/fl mice with Advillin-Cre mice and display ETA receptor knockdown only in DRG and trigeminal ganglion, will undergo total body irradiation and bone marrow transplantation (BMT) using HBSS or HBAA bone marrow. Pain behavior will be assessed in these mice before/after BMT, and after hypoxia.

**Student Role:** The student will be involved in all phases of the project, including preclinical animal model preparation, behavioral tests, tissue harvest, data collection and analysis, and abstract/manuscript preparation.

**Mentors:** Yuan-Xiang Tao, MD, Msc, Phd

**Research Type:** Basic Science

**Stanford University School of Medicine**

**Project Topic:** Obstetric Anesthesia: Cesarean Anesthesia and Labor Analgesia Clinical and Translational Studies

**Overview:** The research covers various aspects of cesarean anesthesia and labor analgesia with the aim of developing novel ways of improving post-cesarean and peripartum labor pain. The current area of research is to develop individualized treatment protocols to optimize postoperative pain management. Current labor epidural studies are focusing on optimizing epidural drug delivery methods. Previous studies have examined the role of inflammatory mediators in the development and maintenance of pain following cesarean delivery, determined the efficacy of peripheral wound drug administration, evaluated the influence of pharmacogenomics on labor pain and the response to opioids, and developed labor and delivery pain and analgesic consumption prediction and measurement tools.

**Student Role:** Students can participate in clinical data collection and analysis and will have the opportunity to present their research results at departmental and national meetings.

**Mentors:** Brendan Carvalho, MD, Chief of Obstetric Anesthesia Division. Associate Professor, Department of Anesthesia

**Research Type:** Translational

**Project Topic:** Obstetric Anesthesia: Maternal-Fetal Pharmacokinetics and Pharmacodynamics Drug Modeling

**Overview:** Studies to determine the pharmacokinetics/pharmacodynamics of drugs administered to pregnant women to develop detailed pharmacokinetics/pharmacodynamics models of key antenatal medications. The aim is to construct drug models and determine fetal drug transfer to improve drug delivery and dosing in pregnant patients and fetuses.

**Student Role:** Students can participate in clinical data collection and analysis and will have the opportunity to present their research results at departmental and national meetings.

**Mentors:** Brendan Carvalho, MD, Associate Professor, Department of Anesthesia and David Drover, MD, Professor, Department of Anesthesia

**Research Type:** Translational
**Project Topic:** Mechanisms of action of central nervous system drugs

**Overview:** We investigate the cellular, synaptic and molecular mechanisms of action of central nervous system drugs; especially barbiturates, opiates, anesthetics, abused inhalants and other CNS depressants. High resolution recording techniques and selective pharmacological probes are used to investigate drug effects on nerve cells recorded in brain slices or awake freely moving animals. Nerve cells appear to be depressed by anesthetics through a combination of pre- and post-synaptic actions on a number of neurotransmitter systems, including synapses using glutamate and GABA for excitatory and inhibitory transmission, respectively. We also study the effects of drugs on brain electrical (EEG) waves (gamma, theta, alpha and delta) in relation to endpoints like loss of consciousness and immobility for surgical anesthesia.

**Student Role:** Students would be directly involved in collecting and analyzing electrophysiology data from rodent brain slice models. Patch clamp and electrophysiological recording techniques will be used to look at drug effects on brain slice neurons and/or on transmitter-induced EEG activity in neocortical brain slices.

**Mentors:** Bruce MacIver, PhD; Professor, Anesthesia (Neurophysiology)

**Research Type:** Basic Science

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**Project Topic:** Experimental clinical science to study immune health in the context of surgery and trauma

**Overview:** Surgery and trauma are associated with significant morbidity including delayed recovery, protracted pain, organ dysfunction, and infection. We use high-dimensional mass cytometry to study patients’ response to surgery/trauma in-vivo and as it occurs in the context of the entire immune system. The overarching goal is to identify patient-specific immune features and mechanisms that predict indices of surgical recovery. Immune-phenotyping will allow patient stratification and holds significant promise to improve surgical recovery and decrease surgery-associated morbidity.

**Student Role:** The student’s role will be determined on an individual basis and will depend on the student’s particular interests and current ongoing research efforts.

**Mentors:** Martin Angst, MD; Professor of Anesthesia

**Research Type:** Translational

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**Project Topic:** Cardioprotection

**Overview:** No pain, no gain? I have been interested in the mechanisms of cardioprotection for over 10 years. One aspect of recent interest is in remote conditioning and how the nervous system, via a nociceptive pathway, may mediate protection from cardiac ischemia-reperfusion injury. This is a NIH funded project to examine the role of TRPV1 in the cardiovascular system, including how altering TRPV1 function may affect myocardial damage.

**Student Role:** The student will be responsible for performing experiments in cell culture to measure TRPV1 activity by a cell based assay in cardiac cells. The student will primarily be performing cell culture experiments for the summer, but will also be able to gain experience regarding in vivo and isolated heart myocardial ischemia-reperfusion models if the student desires.

**Mentors:** Eric R. Gross MD, PhD, MS
**Research Type:** Basic Science

**Project Topic:** Drug Discovery

**Overview:** Peptides and peptide-based therapeutics have become more increasingly used by Anesthesiologists. Drugs such as eptifibatide, octreotide, hiruidin, insulin and oxytocin are all peptides the profession commonly uses. Design of peptides specific for anesthetic purposes, such as for analgesics, paralytics or anesthetics have enormous potential to improve on the drugs we presently use in the operating room and provide agents with rapid context sensitive half-times that are rapidly titrated.

**Student Role:** For this project, the student will be trained in peptide theory and peptide design, including using computational programs including DOCK, Chimera and other computational software to develop lead compounds which in turn could be validated in the basic science laboratory. Primarily the student will be using a computational based approach, with lead compounds, if time permitting, be tested in the basic science laboratory for validation.

**Mentors:** Eric R. Gross MD, PhD, MS

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**Research Type:** Basic Science

**Project Topic:** Predictors of Perioperative Ischemic Injury

**Overview:** With access to electronic hospital medical records, patients in the perioperative setting which suffer from ischemic injury, in particular myocardial infarction or stroke, can be determined on an individual hospital basis. This is important to determine since the patient population, types of procedures performed, analgesics used and degree of patient co-morbidities vary in different hospitals.

**Student Role:** For this project, the student with the assistance of our research team and bioinformatics, will continue to build upon specific algorithms designed to first determine which patients sustain a perioperative stroke and further validate this method using a manual chart review. In turn, the student will then examine this data set to determine whether there are further predictive algorithms which can be implemented for patients at high risk particularly in the post-operative period.

**Mentors:** Eric R. Gross MD, PhD, MS

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**Research Type:** Outcomes

**Project Topic:** Correlation of Electroencephalographic Signals with Brain States and Pharmacology During General Anesthesia

**Overview:** The primary target of general anesthetics is the CNS, yet anesthesiologists use surrogate measures (heart rate and blood pressure) to determine whether their patients are unconscious and pain-free. The ideal patient monitor would be a real-time, non-invasive monitor to read brain activity. Commercially available devices use proprietary algorithms to give the anesthesiologist a number that reflects unknown processing of the EEG, doesn’t reflect all possible drug classes effects, and have a long (minutes) lag time, providing poor real-time feedback. This study determines electrical/EEG correlates of changes in brain state (e.g. loss and recovery of consciousness, depth of anesthesia) and also measures the frontal EEG to determine the brain’s differential response to drugs, operative interventions, and changes in
the environment. The goal is to investigate neural mechanisms of anesthesia, and determine more dynamic algorithms and approaches to safely manage anesthetic administration.

**Student Role:** The student will be expected to:

1. Intraoperatively collect EEG data from patients undergoing elective surgery
2. Record relevant anesthetic and surgical interventional markers in the operating room (e.g. administration of drugs, loss of consciousness, incision, anesthetic type)
3. Database development and entry
4. Computational application of pre-written programming scripts (MATLAB and/or Python) to data analysis

A background in neuroscience, physics and/or signal processing and has some facility with basic programming is preferred but not necessary. Most medical students, with a willingness to learn, would be able to handle the tasks required and would learn how to implement neural analysis and biostatics to collected data. Students are encouraged to contribute sufficiently to generate abstracts, present at a national meeting, and if substantial intellectual contribution is made, to become part of manuscript writing and publication.

**Mentors:** Investigator: Divya Chander, MD, PhD

**Research Type:** Clinical

**Project Topic:** Obstetric Anesthesia: Clinical Outcome Improvement

**Overview:** The research covers various aspects of obstetric anesthesia outcomes with the aim to improve maternal and fetal outcomes and clinical care. The studies aim to examine potential anesthetic-related side effects and outcomes (e.g. post-dural puncture headaches, spinal hypotension) as well as quality improvement interventions to better prevent and treat these outcomes.

**Student Role:** Students can participate in patient surveys, medical record extraction, and/or clinical data collection and analysis and will have the opportunity to present their research results at departmental and national meetings.

**Mentors:** Brendan Carvalho, MD, Chief of Obstetric Anesthesia Division. Associate Professor, Department of Anesthesia

**Research Type:**

**Project Topic:** The Economic Impact of Perioperative Opioid Use: A Population-Level and Patient Utility Analysis

**Overview:** The first study has two goals: 1) a retrospective cross-sectional economic analysis of perioperative opioid use through a retrospective cross-sectional analysis using patients who were discharged alive in FY 2011, and 2) a prospective study to identify orthopedic patient utilities for opioid use. This survey will rank pain relief vs. adverse events, determine the importance of these attributes, and have patients evaluate tradeoff questions. The survey will also note information such as socioeconomic data, surgery type and date, pre- and post-operative opioid prescriptions, facility, mental health, substance abuse diagnoses, and survey data. The responses will be used to estimate a utility function using regression
techniques. To analyze the data, the annual costs of medical care incurred by the VA system will be estimated. For the entire cohort, the total annual costs on patient predictors will be regressed.

**Student Role:** The student will perform a retrospective cross-sectional economic analysis of perioperative opioid use, administer the patient survey to identify utilities for opioid use, perform the data analysis, compile a literary database and assist in the preparation of a manuscript. A strong background in public health and/or database analysis techniques would be desirable.

**Mentors:** Seshadri Mudumbai, M.D., M.S.

**Research Type:** Health Services

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**SUNY at Stony Brook-University Hospital**

**Project Topic:** Measurement of Intraoperative CO2 in Neonates and Infants by Two Methods

**Overview:** The objective of this protocol is to evaluate the performance and correlation between end tidal CO2 (EtCO2) and transdermal CO2 (TCO2) in neonates and infants less than 10kg under general anesthesia in the OR. This assessment will be done by applying a noninvasive TCO2 monitor to supplement the EtCO2 monitor, which is the current standard monitor for CO2 monitoring. Preliminary observations indicate that the two monitors do not give the same result. We will investigate the factors which affect CO2 readings by the two different methods. Results of this study may help to set institutional guidelines for optimal capnography monitoring at SBUH, and potentially give additional insight into appropriate CO2 monitoring in multiple settings (e.g. NICU).

**Student Role:** Medical students would observe anesthesia care of neonates and infants, participate in intraoperative capnography monitoring, record vital signs and assist in data processing and analysis.

**Mentors:** Peggy Ann Seidman, M.D.; Professor & Division Chief, Pediatric Anesthesia

**Research Type:** Clinical

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**Project Topic:** Patient and Provider Expectations for Spinal Cord Stimulation Implantation

**Overview:** This study uses psychological evaluation to assess the psychosocial characteristics of patients with chronic pain refractory to treatment who are scheduled for implant of a spinal cord stimulator (SCS). Concordance of expectations between patients and pain service physician is expected to correlate with better outcomes for pain management.

**Student Role:** Students will be actively involved with the study, i.e. from start-recruitment, evaluation, and follow-up of data for probably more than 15% clinical time since this is a clinical study.

**Mentors:** Patricia Tsui, Ph.D; Assistant Professor; Center for Pain Management

**Research Type:** Clinical

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**Project Topic:** Neurotransmitter modulation of nociceptor excitability

**Overview:** Dopamine and noradrenaline modulation of TRPV1 channels in dorsal root ganglia neurons
**Student Role:** Students will be actively involved with the study, and follow up data. Students will carry out patch clamp electrophysiology experiments in acutely isolated dorsal root ganglia neurons to study the effect of dopamine and noradrenaline on the capsaicin-activated current.

**Mentors:** Michelino Puopolo; Assistant Professor

**Research Type:** Basic Science

**Project Topic:** Learning disabilities in young rats exposed to various anesthetics and associated MRI spectroscopy findings.

**Overview:** Rats will be exposed to various anesthetics and MRIs will be taken of the rats after the anesthetics. Rats will be further tested for potential learning disabilities.

**Student Role:** Medical students would participate in observation of animal anesthesia preparation, participate in placing animals in MRI scanner and positioning animals for scans. Students would also participate in the use of Microwave fixation and brain preparation for advanced ex-vivo MRI scanning.

**Mentors:** Rany Makaryus, M.D.; Assistant Professor

**Research Type:** Basic Science

**Project Topic:** Osteogenic Potential of In Silico-Derived Bioactive Peptides.

**Overview:** This study seeks to understand the effects of bioinformatically derived peptides on bone cell proliferation and bone matrix production.

**Student Role:** Students will be able to perform animal, cell biological, biochemical, and proteomics studies to evaluate peptide effects on bone formation. Week 1: Introduction to laboratory techniques (Cell Culture, Microscopy and Biochemical protocols).

Week 2-3: Participate in on-going animal studies and learn lead drug compound dosing, sacrificing animals and harvesting tissues.

Week 2-5: Participate in on-going cell culture studies and perform microscopy studies.

Week 6-8: Biochemical/Proteomics studies on Cellular extracts and MicroCT/Histomorphometry studies on harvested bones.

Week 8: Submission of project report.

**Mentors:** Srinivas Pentyala, PhD; Associate Professor Director: Translational Research

**Research Type:** Basic Science

**Project Topic:** Glymphatics

**Overview:** Using magnetic resonance imaging (MRI) and tau-like paramagnetic contrast agents, we are evaluating if tau kinetics can be used to predict the development of cognitive deficits following mild traumatic brain injuries.
**Student Role:** Medical students would participate in observation of animal anesthesia preparation, participate in placing animals in the MRI scanner and positioning animals for scans. Students will be actively involved with the study, and follow-up data processing and analysis as well as submission of a project report.

**Mentors:** Helene Benveniste, MD, PhD; Professor; Vice Chair for Research; Director, SBU 9.4T microMRI Facility

**Research Type:** Basic Science

**Project Topic:** Potentiation of Glycine Receptors by Volatile Anesthetics

**Overview:** Homomeric glycine receptors have at least two, distinct, functional behaviors; these are differentially affected by anesthetics.

**Student Role:** Perform patch clamp electrophysiology experiments using a sub-millisecond solution exchange system.

**Mentors:** James P. Dilger, PhD; Professor

**Research Type:** Basic Science

**Project Topic:** Role of 2-AG in postoperative pain

**Overview:** This project seeks to determine whether 2-AG and its metabolites contribute to postoperative pain in rats.

**Student Role:** It is anticipated that the student will assist with surgeries, nociceptive testing of rats, and biochemical analyses including but not limited to western blotting and immunocytochemistry.

**Mentors:** Martin Kaczocha, PhD; Assistant Professor

**Research Type:** Basic Science

**Project Topic:** Effects of Anesthetics on Cancer Cell Proliferation and Migration

**Overview:** Anesthesia management affects the outcome of cancer patients following surgery. Anesthetics affect the proliferation and migration and the choice of anesthetics may affect the outcome of cancer patients.

**Student Role:** Students will be actively involved with the study, and follow-up data. They will perform the experiments using cultured cell line models to determine the effects of anesthetics on cancer cell proliferation and migration.

**Mentors:** Jun Lin, MD, PhD; Associate Professor

**Research Type:** Basic Science

**Project Topic:** Anemia, Aging, Hypertension, and Plasticity

**Overview:** Aims to test the hypothesis that chronic hypertension alters cellular oxygenation and synaptic plasticity with anemia.
**Student Role:** Students will learn Electrophysiological approaches to study hippocampal plasticity, molecular determinants of memory and memory and plasticity, and techniques used to test animal learning and memory. Students would gain an understanding of the role of cellular hypoxia sensing in the control of disease.

**Mentors:** Thomas Floyd, MD; Professor; Interim Division Chief of Cardiac Anesthesia

**Research Type:** Basic Science

**SUNY Downstate Medical Center**

**Project Topic:** Complement Expression Profiles in Maternal Human Cord Blood

**Overview:** Studies show certain components of the complement system are present in fetal serum at approximately eighteen weeks gestation. As the fetus matures such complement levels increase proportionally to fetal maturity. Deficiency of complement factors in neonates correlated with gestational age and may predispose the infants to severe invasive bacterial infection. However, new factors of complement system, particularly those of MBL pathway, are not well studied in the fetal circulation. The aim of this study is to: 1) quantify the profile of the initial molecules in three complement pathways in cord blood.

**Student Role:** Responsible for specimen collection and storage. Assist with protocol implementation, data collection, Elisa procedure, analysis and subject/patient recruitment.

**Mentors:** Ming Zhang, MD, PhD - Assistant Professor, Department of Anesthesiology, MCB of Seminar Series in the Department of Molecular and Cellular Biology

Ivan Velickovic, MD - Clinical Professor of Anesthesiology, Director of Obstetric Anesthesiology.

**Research Type:** Clinical

**Project Topic:** The effect of volatile anesthetics on behavior, molecular signaling pathways and neuropathology in neonatal and adult mice.

**Overview:** Anesthetics when given during the neonatal period are thought to lead to persistent cognitive and behavioral dysfunction in humans and mice. It is critical to understand the mechanisms by which this dysfunction occurs in order to reduce it. We will use neonatal mice to examine the molecular, physiological and behavioral effects of anesthetics. The questions we are investigating are critical for the safe administration of anesthetics to these at risk populations.

**Student Role:** Student will assist in anesthetizing the neonatal mice and carryout molecular, histological and behavioral experiments on neonatal and adult mice.

**Mentors:** Daisy Lin, Ph.D., Department of Anesthesiology, Department of Physiology and Pharmacology

Ira S. Kass, PhD, Professor, Department of anesthesiology, Department of Physiology and Pharmacology

James E. Cottrell, M.D, Distinguished Professor & Chair Department of Anesthesiology

**Research Type:** Basic Science
**Project Topic**: A Comparison of Insulin Sensitivity and Management in Hyperglycemic Patients in the Perioperative Period: ESRD vs non-ESRD.

**Overview**: The objective of our study is to compare perioperative changes in blood glucose levels following insulin administration for preoperative hyperglycemia (as defined by blood glucose between 150 and 300 mg/dL) in ESRD patients vs. non-ESRD patients. The ESRD group will consist of patients on dialysis and non-ESRD patients are defined as those with a glomerular filtration rate (GFR) of 60 mL/min per 1.73 m2. We hypothesize that ESRD patients with preoperative hyperglycemia will demonstrate a more acute decrease in blood glucose following insulin administration, compared to non-ESRD patients.

**Student Role**: Assist with protocol implementation, patient recruitment, data collection and analysis.

**Mentors**: Ketan Shevde, MD - Professor of Clinical Anesthesiology, Director, Cardiothoracic Anesthesiology, Vice-Chair of Research & Assistant Clinical Dean

**Research Type**: Clinical

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**Project Topic**: Development of novel amnesic agents using a strategy of blocking PKM activity

**Overview**: Development of novel amnesic agents using a strategy of blocking Protein Kinase M-zeta (PKM-zeta) activity: PKM-zeta is a brain-specific, constitutively active isoform of PKC which plays a key role in the maintenance of long-term memory. We have devised an antisense oligodeoxynucleotide (ODN) sequence which specifically blocks new PKM-zeta synthesis from the PKM-zeta mRNA. In vivo intrahippocampal injection of the antisense ODN blocks long-term synaptic potentiation (LTP) and long-term memory formation. We are planning on modifying the ODN so that it can cross the blood brain barrier and block the formation of new memories during anesthesia.

**Student Role**: Students will perform the intrahippocampal injections of different drugs. This will involve cranial surgery and the implantation of cannulae into the brain. Students with prior laboratory experience may become involved with other aspects of the project. Knowledge of basic techniques in protein biochemistry (western immunoblotting) and tissue staining (immunohistochemistry) would therefore be useful, but not necessary.

**Mentors**: James E. Cottrell, M.D. Distinguished Professor & Chair Department of Anesthesiology
Panayiotis Tsokas, Ph.D. (Co-Mentor) Research Assistant Professor at State University of New York Downstate Medical Center

**Research Type**: Basic Science

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**Project Topic**: Retrospective chart review of the effect of dexmedetomidine (Precedex) on the change of perioperative cardiac and inflammatory markers.

**Overview**: This study seeks to review the effect of dexmedetomidine on the change of perioperative cardiac and inflammatory markers, i.e. cardiac troponin I, CK-MB, white cell, platelet and serum creatinine level.

This retrospective chart review is a review of the clinical information of total goal of 200 patients undergoing open heart surgery and seeks to investigate the effect of dexmedetomidine on the perioperative changes. This study explores the advantages/disadvantages of the use of dexmedetomidine during cardiac surgery.
Results may provide an important insight into a new mechanism of myocardial ischemia-reperfusion injury, and may contribute to an important anesthetic management of open heart surgery.

**Student Role:** Assist with chart review, data collection and analysis.

**Mentors:** Ming Zhang, MD, PhD - Assistant Professor, Department of Anesthesiology, MCB of Seminar Series in the Department of Molecular and Cellular Biology

**Research Type:** Clinical

**Project Topic:** Should Ambulatory Surgery and Day of Surgery Admission Patients Discontinue Angiotensin Converting Enzyme Inhibitors (ACEI) and Angiotensin Receptor Blockers (ARBs) Preoperatively?

**Overview:** Literature is equivocal about whether patients who are on chronic ACEI or ARBs should discontinue their medication preoperatively. Data on inpatients suggest that patients who continue these medications will develop significant hypotension, possibly refractory to vasopressor treatment. The current study is a randomized single blind controlled trial evaluating perioperative hemodynamics and outcomes on patients scheduled to receive general anesthesia using LMA for airway management on ambulatory or same day surgery patients.

**Student Role:** Active and independent role in conducting the study- responsible for patient recruitment, data collection in the operating room, data management and entry and analysis.

**Mentors:** Ketan Shevde, MD - Professor of Clinical Anesthesiology, Director, Cardiothoracic Anesthesiology, Vice-Chair of Research & Assistant Clinical Dean
Rebecca S. Twersky, MD, MPH - Professor of Anesthesiology, Chief of Anesthesia, Memorial Sloan Kettering Cancer Center

**Research Type:** Clinical

**Project Topic:** Study Comparing the effects of Patient Controlled Epidural Analgesia (PCEA) vs. periarticular Single Shot Injection (SSI) vs. Continuous Periarticular Infiltration(CPI) of local anesthetics on top of a standard multimodal post-op pain management strategy on Pain and Rehabilitation Outcomes in patients undergoing Total Hip Replacement Surgery.

**Overview:** Total hip replacements are known to be associated with severe post-operative pain. Uncontrolled post-operative pain may impact perioperative outcomes because they can delay early rehabilitation, may prolong general recovery and discharge. Developing new and effective techniques that could provide better outcomes in the postoperative care after JRS pose a very important challenge to the healthcare provider. Recently we have seen the introduction of new techniques for post-operative pain management after total hip arthroplasty (THA), particularly: (1) periarticular single shot injection (SSI) of a mixture of local anesthetics, morphine, epinephrine and ketorolac and (2) continuous periarticular infiltration (CPI) of local anesthetics around the replaced joint. Our proposed study aims to determine whether these new modalities (SSI or CPI) are comparable or better than a 24hr PCEA on top of our usual multimodal pain control management strategy after THR surgery.

**Student Role:** Assist with protocol implementation, data collection, analysis and subject/patient recruitment.
**Mentors:** Dennis Dimaculangan, MD - Clinical Assistant Professor of Anesthesiology; Clinical Director of Anesthesiology, Subspeciality Director of Regional Anesthesia.

**Research Type:** Clinical

**Project Topic:** Effects of anesthetics on excitability, metabolism, intracellular signaling pathways and molecular biological changes in hippocampal slices after anesthesia alone and after anesthesia and hypoxia.

**Overview:** This project uses mouse and rat hippocampal slices to examine how sevoflurane affects cellular metabolism and signaling pathways. We focus on how volatile anesthetic induced preconditioning protects against hypoxic damage and how anesthetics by themselves lead to damage in neonatal animals. We are currently examining the hypothesis that sevoflurane enhances the synthesis of certain protein kinases and that this alters the cellular and molecular biology of the cell. This project uses western blots, intracellular and extracellular electrophysiological techniques and ion measurements to examine the mechanisms leading to neuronal damage.

**Student Role:** Student will be involved in carrying out experiments using mouse and/or rat brain slices. The student will learn and use modern molecular and biochemical techniques to analyze cellular signaling pathways in the tissue.

**Mentors:** Ira Kass, PhD - Professor, Department of Anesthesiology, Professor, Department of Physiology and Pharmacology.

**Research Type:** Basic Science

**Project Topic:** Incidence of Perioperative Dysglycemia in Patients with Chronic Kidney Disease undergoing Ambulatory and Same-Day Admission Surgery

**Overview:** The objectives of the study are to identify whether patients with chronic kidney disease are at a high risk for preoperative dysglycemia and if so, whether the secondary outcomes including patient disposition and whether interventions for hypoglycemia or hyperglycemia occur. Our hypothesis is that patients with CKD, regardless of DM status, have increased risk of preoperative dysglycemia compared to non CKD DM patients.

This ongoing study was designed as a retrospective case control chart review study of patients who had undergone ambulatory or 23-hour-stay procedures between January 2006 and December 2012 indicating CKD ranging from mild to end-stage renal disease. The study data were abstracted from the hospital’s medical records, however, several variables were added post-hoc and require further chart review.

**Student Role:** Assist with chart review, data collection and analysis.

**Mentors:** Ketan Shevde, MD - Professor of Clinical Anesthesiology, Director, Cardiothoracic Anesthesiology, Vice-Chair of Research & Assistant Clinical Dean

Rebecca S. Twersky, MD, MPH - Professor of Anesthesiology, Chief of Anesthesia, Memorial Sloan Kettering Cancer Center

**Research Type:** Clinical
**Project Topic:** Local infiltration analgesia with liposomal bupivacaine versus continuous adductor canal nerve block with ropivacaine for pain control after total knee arthroplasty

**Overview:** LIA with liposomal bupivacaine is comparable to cACNB with ropivicaine for pain and rehabilitation outcomes after TKA. cACNB and liposomal bupivacaine represent proven effective postoperative analgesic strategies with significantly less hindrance to postoperative mobilization/rehabilitation than epidural analgesia and femoral nerve block due to lack of motor blockade. However, to date there are no studies to date that compare the effectiveness of LIA liposomal bupivacaine with cACNB. The objective of this study is to evaluate and compare the analgesic effect and the rehabilitation outcomes of liposomal bupivacaine use as a single-dose LIA versus continuous Adductor Canal Nerve Blockade with ropivicaine. If proven equivalent for analgesia, LIA with liposomal bupivacaine may offer several advantages versus cACNB, such as decreased administration time/discomfort as well as less risk of infection, bleeding and nerve injury due to the indwelling catheter. In addition although the saphenous nerve, targeted by the ACNB, it typically thought to be purely sensory, case reports of quadriceps weakness after ACNB have been reported, likely secondary to anatomic variants. This would likely suggest that avoidance of ACNB may improve mobilization/rehabilitation in this population. This study is a double blind, prospective, randomized controlled trial.

**Student Role:** Assist with protocol implementation, data collection, analysis and subject/patient recruitment.

**Mentors:** Dennis Dimaculangan, MD - Clinical Assistant Professor of Anesthesiology; Clinical Director of Anesthesiology, Subspeciality Director of Regional Anesthesia.

**Research Type:** Clinical

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**Project Topic:** Using simulation to validate checklists created in response to an untoward clinical event

**Overview:** The Department of Anesthesiology at Scott & White Memorial Hospital has a continuous mechanism for reporting untoward clinical events. Traditionally, the morbidity/mortality conference has been the primary venue for learning from our mistakes. While these conferences provide helpful information, the learning is done in a passive nature. We propose a system where an untoward event is identified from quality data, a root cause analysis is performed and a checklist is created using a Delphi process to address the response to a similar event in the future. Multidisciplinary in situ simulation will be used with and without the checklist. The hypothesis is that team performance in simulations will be better when the checklist is used.

**Student Role:** The student will participate in all stages of this project. The student will examine the reported clinical events and participate in a root cause analysis. The student will then participate in a Delphi process to develop a checklist to prevent a similar event from occurring in the future. Once the checklist is created, the student will help facilitate multidisciplinary in situ simulation to measure the performance of the team. The student will collect data, analyze it and participate in presentation of abstracts and/or manuscripts. While the time from identification of clinical event to completion of simulation activities may take more than eight weeks for any one clinical event, we envision a steady stream of multiple clinical events that will allow the student an opportunity to work on each step of our process.
Mentors: Michael Hofkamp, M.D.; Benjamin Vacula, M.D.

Research Type: Clinical

Project Topic: Echocardiography for Non Cardiac Anesthesiologists

Overview: Echocardiography is increasingly becoming an important diagnostic tool to evaluate hemodynamic status. Physicians trained in echocardiography such as cardiologists and cardiac anesthesiologists have specialized skill sets to perform comprehensive echocardiography exams. Every physician, particularly anesthesiologists, should have some competence in performing and interpreting a basic echocardiography exam. We will create an online curriculum that will allow learners to access teaching information about obtaining echocardiographic views to assess cardiac function. The didactic material will contain Powerpoint presentations along with echocardiography videos. There will be a pre test and post test to assess knowledge. The aim is to provide an educational experience that will allow the practicing physician to evaluate basic echocardiography findings.

Student Role: The student will assist in the evaluation of this curriculum. This will consist of data collection, data analysis and preparation of abstracts and possibly manuscripts. The student will also be given the opportunity to learn the material under the mentorship of a cardiac anesthesiologist.

Mentors: J. Clint Tippett, M.D.

Research Type: Clinical

Project Topic: The effect of anesthetic technique on holmium laser enucleation of the prostate

Overview: Holmium laser enucleation of the prostate is a novel therapy aimed at treating benign prostatic hypertrophy. Some surgeons believe that patients who receive endotracheal tubes for this procedure have more postoperative complications such as bleeding and re-exploration due to coughing which disrupts surgical clots. We would like to perform a retrospective chart review to determine the incidence of complications between patients receiving endotracheal intubation and those who receive a laryngeal mask airway.

Student Role: The student will be responsible for chart review, data collection, data analysis and preparation of posters and possibly manuscripts.

Mentors: Michael Hofkamp, M.D.

Research Type: Clinical

Thomas Jefferson University

Project Topic: Students will work with Drs. Joseph and Torjman on a variety of animal studies to evaluate the safety and performance of implantable vital sign sensors (in collaboration with RTM Vital Signs, LLC).

Overview: The students will assist with management of general anesthesia, data collection, animal care, data analysis, and manuscript preparation. Students will compare the investigational vital sign sensors for blood pressure, hemoglobin oxygen saturation, electrocardiogram and temperature to commercial non-invasive vital sign sensors. Students will help evaluate the tissue histology surrounding the implantable sensors.
**Student Role:** key personnel

**Mentors:** Jeffrey Joseph, D.O. and Marc C. Torjman, Ph.D.

**Research Type:** Translational

**Project Topic:** Banting Foundation - clinical trial to evaluate tissue histology following insulin infusion catheter insertion in humans undergoing abdominoplasty plastic surgery.

**Overview:** The student will require IRB certification to be able to assist with research procedures such as placement of subcutaneous insulin delivery catheters. Students will help evaluate the tissue histology surrounding the implantable CSII catheters. They will also be exposed to the operating room environment when obtaining human tissue, and the pathology laboratory.

**Student Role:** Key personnel

**Mentors:** Jeffrey Joseph, D.O. and Marc C. Torjman, Ph.D.

**Research Type:** Clinical

**Project Topic:** The research will evaluate clinical outcomes following various pain management techniques that combine non-narcotic analgesic medications, local anesthetic medications and narcotic medications. Analgesic medications will be delivered orally or parenteral

**Overview:** Student will work with Drs. Viscusi and Torjman on a variety of research projects related to the management of acute pain in the hospital following surgery. They will gain a better understanding of Acute Pain Management and complications. The students will also develop an appreciation for study design and biostatistics as well as gain fundamental knowledge in those areas.

**Student Role:** key personnel

**Mentors:** Marc C. Torjman, Ph.D., Eugene Viscusi, M.D.

**Research Type:** Clinical

**Project Topic:** Students will work with Drs. Joseph and Torjman on a variety of animal studies to evaluate the safety and performance of implantable glucose monitoring system (in collaboration with Capillary Biomedical, Inc).

**Overview:** The students will assist with management of general anesthesia, data collection, animal care, data analysis, and manuscript preparation. Students will compare the investigational glucose monitoring system (glucose sensor) to commercial glucose sensors and reference BG measurements during glucose clamp experiments. Students will help evaluate the tissue histology surrounding the implantable glucose sensors.

**Student Role:** Key personnel

**Mentors:** Jeffrey Joseph, D.O. and Marc C. Torjman, Ph.D.

**Research Type:** Translational
**Project Topic:** Students will work with Drs. Joseph and Torjman on a variety of animal studies to evaluate the PK and PD of insulin infused through CSII catheters (in collaboration with Capillary Biomedical and Thermalin Diabetes).

**Overview:** Glucose clamp studies will be performed in large animals to evaluate the PK-PD of insulin absorption using a pump and CSII catheter. Students will assist with catheter insertion, blood sampling, blood glucose measurement, animal care, tissue preparation, histology evaluation, data management, data analysis, and manuscript preparation.

**Student Role:** key personnel

**Mentors:** Jeffrey I Joseph, D.O. and Marc Torjman, Ph.D.

**Research Type:** Translational

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University of Alabama at Birmingham

**Project Topic:** CIALIS® reverses halogen induced injury to pregnant animals and their offspring: The halogen bromine (Br2) is used as water disinfectant, for bleaching fibers, manufacturing antiepileptic drugs, dyestuffs, flame-retardants, insecticides, drilling fluids,

**Overview:** Oral administration of an FDA-approved type 5 cyclic nucleotide-specific phosphodiesterase inhibitor (PDE5i; tadalafil) to the dams post-exposure, dramatically improved maternal survival, fetal growth restriction and neonatal survival. Specific Aim #1. To test the hypothesis that exposure of pregnant mice to Br2 at gestational day 15 causes extensive pulmonary injury as well as systemic endothelial injury, placental injury, pulmonary hypertension, right heart failure resulting in maternal mortality, fetal growth restriction and fetal demise/stillbirth. Specific Aim #2: To identify the sequence of events and mechanisms involved in the development of maternal vasoconstriction, pulmonary hypertension and right heart failure. Specific Aim #3. To investigate the efficacy of post halogen exposure administration of tadalafil to decrease maternal and fetal death and morbidity and to develop a rabbit (non-rodent) model of Br2 toxicity in pregnancy.

**Student Role:** This is a well defined project that can be easily completed by a medical student with some biochemistry background working during the summer. The student will learn a number of important techniques which will be of great help to future research endeavors. In addition, he/she will present every week during our lab meeting and learn how to present data succinctly. Previous students have presented their work in national meetings and have received a number of awards.

**Mentors:** Sadis Matalon, Ph.D., Alice McNeal Professor of Anesthesiology and Vice Chairman for Research

**Research Type:** Basic Science

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**Project Topic:** Bromine Inhalation Induced Lung Injury: Novel Mechanisms and Treatment Strategies: Bromine (Br2) a highly toxic dark-reddish liquid, evaporates readily to a red vapor with a suffocating odor. Production of Br2 exceeds 300,000 tons per year. Exposure cause

**Overview:** Specific aim 1 assesses physiological, biochemical, and morphological changes in mice exposed to Br2 and returned to room air for up to 3 weeks and tests the effectiveness of aerosolized Yabro administered post exposure to decrease lung injury and mortality. We will then identify the mechanisms by which Br2 damages rodent and human airway smooth muscle (ASM), bronchial and alveolar type II (ATII) cells. We posit that Br2, brominated lipids, and L-HA increase intracellular Ca2+ and activate RhoA, which
lead to increased airway contractility and epithelial permeability. Experiments will: (i) determine membrane potentials by patch clamp; (ii) intracellular Ca+2 by fura-2 fluorescence; (iii) RhoA and ROCK activation; (iv) myosin light chain phosphorylation; and (v) (for epithelial cells) permeability to fluorescent dextrans. Finally, we will isolate mouse tracheal rings at 1, 24, 72 hr. post Br2 exposure and measure smooth muscle contraction in response to methacholine.

**Student Role:** This is a well defined project that can be easily completed by a medical student with some biochemistry background working during the summer. The student will learn a number of important techniques which will be of great help to future research endeavors. In addition, he/she will present every week during our lab meeting and learn how to present data succinctly. Previous students have presented their work in national meetings and have received a number of awards.

**Mentors:** Sadis Matalon, Ph.D., Alice McNeal Professor of Anesthesiology and Vice Chairman for Research

**Research Type:** Basic Science

**Project Topic:**

a. Targeting MMP9 to Improve Outcomes in Serious Influenza Infections.


c. Animal Models of Infectious Diseases.

**Overview:** Dr. Kevin Harrod is a new researcher at UAB Anesthesiology, who brings with him the above projects. His research goals are grounded in the use of emerging or high throughput technologies to elucidate system-wide knowledge of host-pathogen interactions in respiratory infection. He has a primary focus in the molecular mechanisms underlying pathogenesis, immunity and host defense to respiratory viruses such as influenza, paramyxoviruses and SARS-CoV, and a long-standing interest in community-acquired bacterial infections of the lung including sepsis. He has a broad background in lung, cell, and molecular biology, infectious disease of the respiratory tract using both bacterial and viral pathogens, and an extensive expertise in systems biology and bioinformatic approaches to investigate underlying mechanisms of disease. He has been a continuously funded investigator/scientist for 18 years including large, multifaceted studies of pulmonary infection in various animal models.

**Student Role:** Computational biology and genome research, and the student would primarily perform computational studies in support of lab projects.

**Mentors:** Kevin S. Harrod, Ph.D., Benjamin Monroe Carraway Endowed Chair and Professor

**Research Type:** Health Services

**Project Topic:** Enhanced Recovery After Surgery (ERAS) is a clinical pathway designed around a collection of best surgical practices that has been shown to reduce hospital length of stay, total complications, reduce rates of readmission, and increase patient satisfaction

**Overview:** Does ERAS reduce total opioid consumption in the perioperative period? Reduction of total opioid consumption is one likely mechanism for reduced rates of post-operative ileus. This is being studied as part of a resident mentored research project in the Department of Anesthesiology and Perioperative Medicine (Simmons, Mills).
• Does ERAS reduce the length of stay for all patient populations? There is a disparity of length of stay for white patients vs. African American patients. ERAS implementations is showing equalization of these length of stays with a median reduction of 2 days. ERAS Pathways can thus reduce length of stays for certain populations and create equal standard of care. (Chu, Simmons, Wahl)

• Selection of regional anesthesia technique in certain patient population undergoing an ERAS Pathway? (Simmons, Short)

• Implementation and Operationalizing an ERAS Care Plan?

Student Role: Date collection, review, presentation.

Mentors: Jeffrey W. Simmons, M.D., Assistant Professor

Research Type: Clinical

Project Topic: The Role of Traumatic Brain Injury in Lung Immunosuppression and Secondary Pneumonia

Overview: Overview: The objective of this study is to determine the mechanism(s) by which traumatic brain injury induces lung immunosuppression via parasympathetic/sympathetic nervous system imbalances. This study is conducted at The University of Birmingham at Alabama in both research laboratories and the Neurosurgical ICU.

Student Role: Student Role: Possible roles include:

Clinical: Data analysis of sympathovagal balance and clinical correlations. Basic: Animal (observational) and cell culture models of TBI to understand mechanism of lung immunosuppression.

Mentors: Brant M. Wagener, M.D., Ph.D.

Research Type: Clinical

Project Topic: Anesthetics are routinely used for surgical removal of tumors. Some studies have shown that anesthetics can also alter cancer metastasis and progression. Other studies have reported that anesthetics can alter levels of the hypoxia-inducible transcriptio

Overview: Title: Effect of anesthetic on the activation of hypoxia-inducible transcription factors (HIF-1a and HIF-2a).

Approach: These studies will initially be carried out using invitro cell culture based assays. A HIF-reporter cell line will be used to screen for anesthetics. Additionally, anesthetics will be used to assess cell proliferation, migration and angiogenic potential of endothelial cells. Biopsies of tumors before and after the use of anesthetics will be obtained in collaboration with Dr. Mali Mathru. These samples will be assayed for downstream transcriptional targets of HIF-1 like VEGF, hexokinase-2 and phosphofructokinase using Realtime RTPCR.

Resources: The lab is equipped with the necessary infrastructure and expertise to carry out these studies. The student will be trained to carry out all the work. The HIF-reporter cell line is currently being used in the lab for other studies.
**Student Role**: Timeline: We anticipate the work to be completed in a 6-7 week time frame. Additional time will allow the student to compile data and prepare presentations for the ASA meeting.

**Mentors**: Aftab Ahmad, PhD and Mali Mathru, MD

**Research Type**: Basic Science

**Project Topic**: Primary afferent mechanisms underlying bladder pain and overactivity

**Overview**: Research in Dr. DeBerry’s laboratory is focused on better understanding the mechanisms underlying dysfunction and sensory dysregulation in the urological system due to a variety of pathologies. We are particularly interested in how bladder primary afferent neurons with distinct anatomical, neurochemical, and functional properties change with organ insult, and give rise to chronic bladder pain and overactivity. We utilize a variety of in vivo and in vitro techniques, including behavioral models of visceral pain and bladder function, optogenetic regulation of sensory neurons, immunohistochemistry, molecular genetics and calcium imaging to study growth factor signaling, TRP channels, and remote control of neural excitability. Our research has translational implications for patient populations with interstitial cystitis/painful bladder syndrome (IC/PBS), overactive bladder (OAB), and diabetes.

**Student Role**: 1) data collection (mouse behavioral models, tissue processing and immunohistochemistry, RNA isolation and PCR)

2) data extraction and database entry

3) assist with data analyses and interpretation and preparation of abstracts and/or manuscripts

**Mentors**: Jennifer J. DeBerry, Ph.D.

**Research Type**: Basic Science

**Project Topic**: Mechanism of Nociception Induced by Innocuous Cold in Trigeminal System

**Overview**: Research in Dr. Gu’s lab has been to study sensory transduction, encoding and transmission in the somatosensory system, to investigate cellular and molecular mechanisms underlying inflammatory and neuropathic pain, and to explore new therapeutic targets for effectively treating pathological pain conditions in patients. A current focus of his lab is on transient receptor potential M8 channels (TRPM8) and low-threshold voltage-gated K+ channels. Dr. Gu’s lab is studying the roles of these channels in encoding cold stimuli at primary afferent nerve endings and in mediating physiological and pathological pain induced by cold temperatures. The long-term goal of this research project is to develop therapeutic compounds targeting these channels for clinical treatment of cold pain in patients.

**Student Role**: As a summer student working in Dr. Gu’s lab in 2016, you will perform behavioral tests to assess neuropathic and inflammatory pain using methods such as von Frey Test for mechanical sensitivity, orofacial operant test for thermal sensitivity, and orofacia

**Mentors**: Jianguo Gu, M.D., Ph.D., Edward A. Ernst M.D. Endowed Professor

**Research Type**: Basic Science

**Project Topic**: Cellular and Ion Channel Mechanisms Underlying the Sense of Light Touch in Mammal
Overview: Another current research focus of Dr. Gu’s lab is on the cellular and molecular mechanisms underlying the transduction and encoding of mechanical stimulation such as gentle touch. The long-term goal of this project is to identify therapeutic targets for treating sensory disorders such as mechanical allodynia (i.e. pain induced by gentle touch) seen in patients with neuropathic and inflammatory diseases.

Student Role: As a summer student working in Dr. Gu’s lab in 2016, you will perform behavioral tests to assess neuropathic and inflammatory pain using methods such as von Frey Test for mechanical sensitivity, orofacial operant test for thermal sensitivity, and orofacial operant test for mechanical sensitivity in orofacial regions. You will also give animals testing compounds to see if pain in these animals gets effectively relieved by the testing drugs.

Mentors: Jianguo Gu, M.D., Ph.D., Edward A. Ernst M.D. Endowed Professor

Research Type: Basic Science

University of California, San Francisco

Project Topic: Developing innovative therapies for the treatment of brain arteriovenous malformation.

Overview: Brain arteriovenous malformation (bAVM) is an important cause of intracranial hemorrhage. Available therapies are all invasive and have potentially high morbidity. Excessive VEGF expression is a fundamental part of the bAVM pathology. Compelling evidence show interruption of VEGF signaling could be a therapeutic strategy. Soluble FLT (sFLT1) binds to VEGF in the tissue, thus reducing its downstream signaling through membrane-bound VEGFRs. Soluble FLT1 in an AAV construct packaged in AAV serotype 2 capsid (AAV2) inhibited choroidal neovascularization in a non-human primate model. However, AAV2 does not cross the blood-brain barrier (BBB). We will test a non-invasive route, intravenous, using AAV serotype 9 (AAV9), because AAV9 enters the brain parenchyma much more effectively.

The goal of the project is to test if intravenous delivery of AAV9-sFLT will prevent progression of or reverse the AVM phenotype in our models.

Student Role: Student will participate in an ongoing project, testing therapeutic efficacy of systemic delivered adeno-associated viral vector that expressing a soluble form of VEGF receptor 1. The goal for the student is to be a co-author on a publication resulting from the student’s activities during the fellowship period.

Mentors: Hua Su, MD

Research Type: Basic Science

Project Topic: Endothelial Cell Innate Immune Pathways in Sepsis

Overview: General focus areas of my laboratory include the (1) effects of sepsis and inflammation on endothelial and leukocyte cell functions, (2) the role of innate immune pathways, including Toll-like receptor (TLR)-dependent signaling pathways in sepsis and inflammatory critical illness, and (3) the immunomodulatory effects of the endogenous cannabinoid system in inflammation and sepsis.

Student Role: The student will have the opportunity to participate in in vitro and in vivo studies on endothelial cell and leukocyte inflammatory pathways in sepsis-induced inflammation and injury, and in studies on the immunomodulatory role of lipid cannabinoid receptor agonists.
The student will gain experience in basic methods, including, but not limited to tissue culture, immunoassays for quantifying inflammation and coagulation, q PCR, and fluorescence-based assays. They will also have the opportunity to participate in studies using mouse sepsis models.

The student will gain experience in basic methods, including, but not limited to tissue culture, immunoassays for quantifying inflammation and coagulation, q PCR, and fluorescence-based assays. They will also have the opportunity to participate in studies using mouse sepsis models.

**Mentors:** Judith Hellman, M.D., Professor and Vice Chair for Research

**Research Type:** Basic Science

**Project Topic:** Pathophysiology of Intracranial Aneurysms

**Overview:** Our research program focuses on the translational research of vascular diseases, specifically intracranial aneurysms, brain arteriovenous malformations, and aortic aneurysms. We utilize novel animal models to understand mechanisms for the development, growth, and rupture of these lesions. Our goal is to identify new pharmacological targets to prevent rupture of these lesions.

The FAER project will focus on the mechanisms for the development of aneurysmal rupture. The project will utilize a mouse model of aneurysm.

**Student Role:** The student will participate in an ongoing research project in our laboratory (NIH R01NS055876 and NIH R01NS082280). The student will harvest the tissues from mice and conduct analysis of the mouse tissues. In addition, the student may assist the mouse surgery, genotyping, and physiological measurements. The student will be required to present at the weekly lab meeting.

**Mentors:** Tomoki Hashimoto, MD

**Research Type:** Translational

**Project Topic:** Adaptive responses of human neurons to lack of oxygen and low temperature

**Overview:** Brain damage from hypoxia or ischemia remains an important clinical problem that lacks effective therapy. For many years the Bickler laboratory has studied the processes by which neurons adapt to lack of oxygen; this knowledge will ultimately be useful in designing more effective neuroprotection. The current focus of the research is on using human embryonic brain progenitor cells as a model for understanding hypoxia adaptation and injury. We are developing a new 3-dimensional culture approach that we believe will be superior to previous models. Injury and protection afforded by hypothermia is another area of research with this model.

**Student Role:** The student’s project will be to test the effectiveness of specific types of potentially neuroprotective compounds against cell injury caused by lack of oxygen. The student will analyze expression of neuroprotective genes and proteins involved. Cell culture, microscopy and basic biochemistry will be involved. The student will be encouraged to present the results at a major scientific conference.

**Mentors:** Philip E. Bickler, MD, PhD

**Research Type:** Basic Science

**Project Topic:** Perioperative sleep changes in Obstructive Apnea Patients
Overview: This clinical research project is aimed to investigate changes in cognition associated with sleep patterns in patients with sleep apnea undergoing surgery.

Student Role: The student will be closely supervised by the PI and will attend the weekly lab meeting. Student’s role may include:

1. The student will be actively involved in the on-going project, screening potential study patients, interviewing patients to obtain informed consent to participate in the research project.
2. Learn how to use research equipment, sleep architecture and its interpretation and data analysis.
3. Learn various neurocognitive tests to assess brain function such as attention, memory.
4. Literature review and writing an abstract.

Mentors: Sakura Kinjo, MD

Research Type: Clinical

Project Topic:
Audiovisual Detection of Respiration and Heart Rate

Overview: The Audio-Visual Detection of Respiration (AVD-R) Study will develop and then test a computerized, non-invasive, optical imaging system that will detect respiration, identify apnea, and notify nursing staff for patients with respiratory depression, apnea, or respiratory arrest. Narcotic pain relief causes respiratory depression and may lead to apnea, respiratory and cardiac arrest, and death. Hospitals have identified this problem as the “Dead in Bed” phenomena. At the present time, there is no easy to use, inexpensive, reliable, remote system that patients will tolerate for continuous monitoring of respiration in hospitals. The AVD-R system has a computerized vision system that provides an RGB camera, an Infrared Camera, a Depth (3 D Vision) Camera, Acoustic Localization, Skeletal Tracking, Facial Tracking, and Speech Interpretation to detects patient respiration and apneic events.

Student Role: The student will work as a study coordinator to identify and consent patients as well as collect and analyze data.

Mentors: Arthur Wallace, M.D., Ph.D

Research Type: Clinical

University of Chicago

Project Topic: Current investigation in our laboratory focuses on the mechanisms of common anesthetics with current emphasis on the study of pharmacological agents that are able to accelerate emergence from anesthesia. The aim of the current research project will be th

Overview: Previous studies in our lab revealed that some inhaled and IV anesthetics can inhibit neurotransmitter release in a manner that contributes to their ability to induce anesthesia. Recently we found that agents that elevate intracellular levels of cAMP can both reverse the cellular effects of anesthetics on neurotransmitter release as well as accelerate emergence from anesthesia in rats. The most effective drug tested was caffeine, which in addition to elevating intracellular cAMP, also inhibits adenosine
receptors that have been implicated in caffeine-mediated arousal. This project will further characterize the
effects of caffeine on emergence and recovery in rats and mice in well-established behavioral assays. Dose
response curves will be created to quantify the effects of caffeine on emergence from a variety of inhaled
and IV anesthetics. Additionally, studies in adenosine receptor knockout animals will be performed to
elucidate the cellular mechanism of these effects.

**Student Role:** The student will be trained to work with rats and mice and directly perform experiments on
these animals such as those described above. These investigations will occupy the bulk of the student’s
daily research activity. Additionally, as the translational studies in anesthetized human volunteers will be
ongoing, the student will be able to accompany the PI’s to observe the conduct of these experiments.
Additional clinical exposure will be provided to the student in the form of a mini clinical anesthesia rotation
in which he/she will accompany one of the PI’s into the OR or other anesthetizing locations. The student will
have extensive exposure to the principal investigators that we anticipate will far exceed the minimum
requirements of the program. The investigators will work closely with the student to prepare an abstract for
presentation at a national meeting, and we anticipate that the results of these investigations will contribute
to publication in a peer-reviewed journal.

**Mentors:** Zheng (Jimmy) Xie, MD, PhD
Robert Fong, MD, PhD

**Research Type:** Translational

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**Project Topic:** MRI on Glioma Pseudoprogression

**Overview:** Most recently, we found that irradiated prostate and breast cancer xenografts have high iron
oxide nanoparticle uptake due to the presence of RT-induced inflammatory cells (macrophages) whose
biological function is metabolism of iron. Super-paramagnetic iron oxide (SPIO) nanoparticles are well
known MRI contrast agent due to their effect on T2 relaxation times (T2-RT). When accumulated by
macrophages at the site of inflammation, SPIO nanoparticles decrease the T2-RT producing negative (dark)
contrast in quantitative T2-weighted MRI (qT2-MRI maps). The goal of this study is to establish quantitative
T2-MRI for assessment of SPIO accumulation in mouse glioma models of PsP.

**Student Role:** (i) animal handling during MRI scans; (ii) MRI acquisitions on irradiated tumor-bearing mice;
(iii) quantitative T2-MRI analysis on mouse glioma tumors; (iv) statistical interpretation of data; (v)
participation in final manuscript preparation.

**Mentors:** Natalie J. Serkova, PhD, Associate Professor

**Research Type:** Basic Science

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**Project Topic:** Role of monocyte/macrophage phenotypes during early acute lung injury (ALI)

**Overview:** The goal of this study is to show that macrophage activation phenotypes modulate lung
inflammation in rats in vivo. We have preliminary studies suggesting that brief exposure to hyperoxia and/or
diet-induced obesity modify alveolar macrophage activation and alter future responses to ALI-inducing
stimuli in vivo. These responses are similar to those observed in critically ill humans exposed to high
concentrations of oxygen and/or obesity. The understanding of this mechanism(s) underlying macrophage
modulation on lung inflammation could lead to novel approaches for lung injury in humans, or ARDS, a disease that despite intense research still has no treatment and a high mortality.

**Student Role:** For the in vivo relevance of these findings the student will help with analysis and interpretation of physiology and laboratory data.

**Mentors:** Ana Fernandez-Bustamante, MD, PhD, Associate Professor

**Research Type:** Translational

**Project Topic:** Assessment of hypoventilation-preventive measures in the immediate postoperative period of surgical patients.

**Overview:** This study aims to measure the incidence of hypoventilation in the post-anesthesia care unit (PACU) and implement preventive measures with the goal of decreasing hypoventilation episodes in the immediate postoperative period.

**Student Role:** The student will participate in the collection, analysis and interpretation of data.

**Mentors:** Ana Fernandez-Bustamante, MD, PhD, Associate Professor

**Research Type:** Clinical

**Project Topic:** Database study on the incidence and risk factors for prolonged postoperative oxygen therapy.

**Overview:** The goal of this database study is to analyze retrospectively the incidence and risk factors for the prolonged use of postoperative oxygen therapy.

**Student Role:** The student will participate in the analysis, validation and interpretation of data.

**Mentors:** Ana Fernandez-Bustamante, MD, PhD, Associate Professor

**Research Type:** Clinical

**Project Topic:** Light in Cardio-protection & Hypoxia Treatment

**Overview:** Our research has been directed towards identifying cellular adaptive mechanisms during hypoxic conditions such as myocardial ischemia, one of the leading causes of morbidity and mortality worldwide. Based on current findings, we hypothesize that intense light therapy provides robust cardio-protection by stabilizing cardiac Per2, thereby leading to concomitant cardio-protection from ischemia by optimizing metabolism on a cellular level. The long-term goal of our studies is to introduce intense light therapy into the hospital to prevent or treat hypoxic conditions such as myocardial injury in patients, the leading cause of morbidity and mortality worldwide.

**Student Role:** The student’s role would involve help with animal work and human studies to elucidate light in organ protection.

**Mentors:** Tobias Eckle, MD PhD, Assistant Professor

**Research Type:** Translational

University of Florida
**Project Topic:** Role of prostaglandin D2 in stroke

**Overview:** Selective cyclooxygenase (COX) inhibitors, which are known to reduce inflammation following stroke, have cytoprotective effect, but have adverse cardiovascular risks. Data show that the protection and side effects are likely caused by the complex actions of the different prostanoids produced by COX. One key prostaglandin (PG) and the most abundant in the brain, PGD2, mediates various biological effects. Its levels are controlled by COX enzymes and PGD synthase (PGDS). **AIM:** Determine the levels of COX-1, COX-2, PGDS, and PGD2 levels in the brain after stroke in mice. We will use immunohistochemistry, Western blot and Elisa protocols to determine the localization and levels of these various components. This study is intended to further establish the neuroprotective role of PGD2 in stroke.

**Student Role:** The student will learn and use neurobehavioral, immunohistochemistry, Western blot, and Elisa protocols.

**Mentors:** Abdullah Ahmad, PhD; Assistant Professor

**Research Type:** Basic Science

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**Project Topic:** Role of pro- and anti-inflammatory cytokines and heme-related metabolites in subarachnoid hemorrhage (SAH).

**Overview:** SAH is characterized by a break in the blood brain barrier with bleeding and release of toxic hemoglobin metabolites into the subarachnoid space. Haptoglobin (Hp) and hemopexin (Hpx) are plasma proteins responsible for binding and neutralizing these metabolites and are upregulated in response to various interleukins. After SAH, the time profile and distribution of these hemoglobin/heme binding proteins and cytokines across the blood brain barrier is not well established and this information could be particularly useful in modifying the immune response to improve patient outcomes. **Aim:** We will determine the relative expression and distribution of these analytes in serum and CSF at different time points post-SAH by enzyme-linked immunosorbent assay and correlate them with clinical outcomes.

**Student Role:** The student will learn how to optimize and perform ELISAs in order to measure various cytokines and heme metabolites in biological specimens. Additionally, a retrospective review of radiological imaging and clinical outcomes will be performed.

**Mentors:** Sylvain Doré, PhD; Professor

**Research Type:** Clinical

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**Project Topic:** Haptoglobin genotype, bilirubin, and bilirubin oxidation products (BOXes) as predictors for poor outcomes following subarachnoid hemorrhage (SAH).

**Overview:** Haptoglobin (Hp) is an acute phase protein that is upregulated in response to injury and inflammation. Humans have three possible phenotypes: Hp1-1, Hp2-1, or Hp2-2. Hp1-1 is the most bioactive form permitting the fastest clearance of toxic heme metabolites. The Hp2-2 phenotype has been correlated with poor outcomes in several inflammatory diseases. Bilirubin is considered an antioxidant at low concentrations and toxic at high concentrations, where it may form vasoconstrictive BOXes. **Aim:** To determine the genetic predisposition of patients to cerebral vasoconstriction and poor outcomes following SAH and correlate with levels of bilirubin and BOXes in the CSF and serum.
**Student Role:** The student will learn/conduct DNA extraction, PCR, restriction digestions, gel electrophoresis, and HPLC. Additionally, a retrospective review of radiological imaging and clinical outcomes will be performed.

**Mentors:** Sylvain Doré, PhD; Professor

**Research Type:** Clinical

**Project Topic:** Developmental effects of neonatal anesthesia.

**Overview:** Human retrospective epidemiological studies along with the laboratory studies strongly support the possibility that general anesthesia affects brain development. We study the mechanisms of these developmental effects of general anesthetics using a variety of techniques from animal behavior to synaptic electrophysiology and molecular biology.

**Student Role:** The student will have opportunity to conduct the study by learning these techniques.

**Mentors:** Anatoly Martynyuk, PhD, DSc; Professor

**Research Type:** Basic Science

**University of Illinois College of Medicine at Chicago Program**

**Project Topic:** Understanding lung vascular mechanotransduction

**Overview:** Dr. Dull study how alterations in pulmonary capillary pressure and flow alter cellular physiology, specifically related to endothelial permeability. His laboratory discovered that heparan sulfate proteoglycans on the cell surface sense pressure and flow and respond to these mechanical forces by activating pathways that adversely affect barrier function. His research focuss on studying lung vascular mechanotransduction, acute lung injury and novel, glycoprotein-mediated mechanism(s) of vascular signaling. These studies utilize cells, isolated lungs and whole animal studies. Dr. Dull is interested in novel mechanism(s) regulating vascular permeability and the susceptibility of the lung to mechanical forces. This work challenges the long held Starling principle for understanding edema development and identifies novel targets for therapeutic intervention.

**Student Role:** Students will learn and participate in the uses cell culture models, the isolated perfused lung preparation, knock-out mice and whole animal models of lung injury.

**Mentors:** Dr. Randal Dull, MD PhD

**Research Type:** Basic Science

**Project Topic:** Comparison of Coumadin versus Dabigatran on development of brain inflammation

**Overview:** Investigate the effect of coumadin on brain functins due to the notion on its ability to pass blood brain barrier and the Vitamin K reduction effect. Vitamin K is needed for processes in the central nervous system (CNS), for example for synthesis of lipids needed to make myelin, and for activation of certain receptors on neurons. In pilot studies, we found that treating healthy adult mice with Coumadin which was provided in their water for 10 days increased inflammatory responses in the CNS, and caused changes in gene expression. In contrast to Coumadin, the anti-coagulant Dabigatran does not reduce Vitamin K, nor does it pass through the BBB, suggesting it should not cause inflammation or other effects in the CNS. The
The purpose of this study is to investigate neuroinflammatory effect of commonly used anticoagulation medications.

**Student Role:** Students will learn and participate in preparing mice brain slice for immunochemistry to detect inflammatory activation, PCR for mRNA levels of vitamin K dependent genes; western blots for protein levels, ELISA assays to quantify protein levels of cytokines; and preparing samples for HPLC analysis of specific lipids that need vitamin K.

**Mentors:** Guy Weinberg, MD; Douglas Feinstein, PhD

**Research Type:** Translational

**Project Topic:** Local Anesthetics and Inflammatory Cancer Signaling

**Overview:** The anti-inflammatory effects of local anesthetic (LA) and regional anesthesia in various epithelial and endothelial cell types are well known. The hypothesis, that LA might have anti-inflammatory properties in malignant cells, lead to our recent observation that amide-linked LA inhibited the activation of inflammatory Src tyrosine protein kinase (Src), a critical mediator of not only endothelial hyperpermeability but also of cancer cell extravasation and metastasis as well as migration. This observation suggested the existence of a direct effect of LA on cancer cells in the perioperative period in addition to the already mentioned indirect effects. We will therefore determine the molecular mechanism of amide-linked local anesthetic inhibition of TNF-induced inflammatory Src signaling and migration in cancer cells in vitro.

**Student Role:** Student will learn and participate in immunoprecipitation and Western blot for signaling protein such as the phosphorylation status of Akt (pThr308 and pSer473) and eNOS (pSer1177) as well as expression levels of inducible NO synthase (iNOS), the chemiluminescence measurement of NO2−accumulation, preparation and using the colon adenocarcinoma cell line and the use of a rodent model of liver metastasis following hepatic ischemia/reperfusion injury to mimic the circumstances of patients undergoing liver resection for metastatic colon cancer.

**Mentors:** Gina Votta-Velis, MD PhD; Richard Minshall, PhD

**Research Type:** Translational

**Project Topic:** The activation of S100B/RAGE pathway mediates subarchnoid hemorrhage associated delayed neurological deficit and cognitive dysfunction

**Overview:** Vasospasm is a leading cause of morbidity and mortality after subarachnoid hemorrhage (SAH). Increasing evidences suggest that inflammation is critical in the development of cerebral vasospasm and delayed neurological deficit. Recent clinical evidence points to an early release of the astrocyte-derived inflammatory protein, S100B, in CSF following SAH. We explored the mechanism of S100B, a ligand to the receptor for advanced glycation end-products (RAGE) as a triggering pathway, causes vasospasm, and results in neurological deficits. In this study, in collaboration with ONO pharmaceutical, Japan, we will investigate the effect of a novel S100B inhibitor, ONO2506. ONO 2506 will be given every 6hr for 72 hr after SAH. Rats will have a daily neurological examination for 2 weeks. The cognitive function will be measured by the water maze exam and fear anxiety exam. After the study periods end, the animals will be sacrificed and brain will be examined for brain staining.
**Student Role:** Student will learn a subarachnoid hemorrhage model (perforation model) in rats and learn how to evaluate neurological functions and cognitive function (water maze and fear anxiety model) in rats. Student will be involved in a weekly lab meeting, does the literature search in relating topic. He or she is expected to do a presentation about the topic related to inflammation and brain injury once during the summer fellowship time.

**Mentors:** Chanannait Paisansathan, MD

**Research Type:** Basic Science

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**Project Topic:** Pediatric dental surgery Peri-operative outcomes.

**Overview:** Cavities is the most common chronic disease of childhood. Childhood cavities are seven times more common than childhood asthma. Vulnerable populations (poor, racial/ethnic minority, rural/urban resident) experience the greatest burden of severe disease. Severe disease impacts the child and household on multiple levels including: finances, educational development, sleep quality, and chronic pain. Surgery represents an ineffective use of scarce and expensive resources. The majority of this patient population will experience recurrent disease within 6-12 months of the post-operative period. This work aims to understand factors that contribute to severe disease and demand for surgery. The first aim utilizes Medicaid and American Dental Association databases to measure the impact of Medicaid reimbursement policies on surgical volume. The second aim employs qualitative methodologies to understand barriers and facilitators to care from patient and provider perspectives.

**Student Role:** Student involvement in Aim 1 will depend upon the availability of data as well as experience using a statistical program (STATA). Aim 2 will involve recruitment and enrollment of subjects as well as data management (transcription of interviews).

**Mentors:** Helen H. Lee, MD, MPH

**Research Type:** Health Services

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**University of Iowa**

**Project Topic:** The object of the study is to map vascular rather than chronological age as a predictor of adverse cardiovascular events and mortality from coronary insufficiency, ischemia, myocardial infarction, heart failure, cerebrovascular insufficiency or stroke, an

**Overview:** Prior to surgery, consented subjects will undergo a noninvasive study of PWV and central aortic BP will be performed in supine position using the SphygmoCor sensor, along with 3-lead. The vascular aging measurements will not be used to guide or alter medical decision making in the study. Each study will take approximately 30 min. The peripheral and central aortic pulse waveform, BP and PWV data will be recorded as de-identified on a password protected research computer. Additional supplemental pre, intra, and post operative data will be recorded to supplement PWV values for multivariate analysis. We also plan to call enrolled subjects at 1 and 12 months after surgery to ask them whether they have experienced postoperative complications such as a stroke, memory loss, chest pain, heart attack or MI, need for a coronary artery stent or CABG, abnormal heart rhythm such as atrial fibrillation or need for a pacemaker, heart failure, kidney function problem, renal failure or death.

**Student Role:** • Patient enrollment
• Data collection and analysis
• Manuscript preparation
• Present project

**Mentors:** Kenichi Ueda, MD

**Research Type:** Clinical

**Project Topic:** Attenuation of Intraoperative Bacterial Transmission and Postoperative Healthcare-Associated Infection (HCAI) Development.

HCAIs are a significant healthcare problem associated with increased patient morbidity/mortality and economic burden. Surgical site

**Overview:** Bacterial transmission in the operating room anesthesia work area has been directly linked to postop infection and strongly associated with increased patient mortality. Hyper transmissible, virulent, and/or antibiotic resistant strains of S. aureus, Enterococcus, and gram negative pathogens (top 3 classes of pathogens for SSIs) have been identified across 3 academic medical centers and archived for further analysis. Our primary aims are to 1) Develop and implement an innovative, prospective, laboratory-based surveillance system that will detect intraoperative transmission of these pathogens and guide continual, proactive improvements in basic quality improvement measures and 2) Develop in vitro, rapid, point-of-care diagnostics for these pathogens for SSI reduction and attenuation of antibiotic resistance. We hypothesize that these combined interventions will generate sustained reductions in intraop spread, resistance of major bacterial pathogens and subsequent 30-day postop HCAIs.

**Student Role:** Student Role: The student will undergo all necessary training for laboratory work (IRB/ethics of research and safety-chemical and biological). The student will be asked to identify one of three classes of major bacterial pathogens (previously described) as their primary area of interest. The student will work with the PI (Dr. Randy Loftus) and research assistant(s) to execute on one of the primary aims pertaining to their area of interest. This work will require the acquisition and utilization of basic laboratory skills, critical thinking, trouble shooting, and data analysis/presentation. The student will prepare an abstract and poster and also participate in manuscript preparation.

**Mentors:** Randy Loftus, MD

**Research Type:** Translational

University of Maryland School of Medicine

**Project Topic:** Genetics of Spinal Cord Injury (Sci) Induced Chronic Pain and Depression

**Overview:** There is a critical need for the development of genetic approaches to understand pain-generating and pain-maintaining mechanisms, therefore, to reduce or eliminate SCI-PAIN. The ultimate goal of the proposed research is to characterize behavioral changes of allostynia, locomotion, and depression across several strains of mice commonly used in SCI research and to test our hypothesis that differential gene expression across these three mouse strains would provide mechanistic insight into alterations in transcriptional pathways that control SCI-PAIN. In this summer research project, we will systematically
evaluate differential development of nocifensive, locomotion, and depression behavior in three common mouse strains after spinal cord contusion.

**Student Role:** The student will learn to assess pain behavior (mechanical and thermal stimulation, spontaneous pain), depressive-like behavior (forced swim test, tail suspension, sucrose preference), as well as locomotor function in contusive spinal cord injury mice.

**Mentors:** Junfang Wu, B.M., Ph.D.

**Research Type:** Basic Science

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**Project Topic:** Effects of Aeromedical Evacuation-Relevant Hypobaria on Survival and Neurologic Outcome Using a Rat Polytrauma Model of Traumatic Brain Injury plus Hemorrhagic Shock

**Overview:** Ongoing research indicates that exposure of rats within a few days after traumatic brain injury (TBI) to hypobaria equivalent to a normal airplane cruising cabin pressure equivalent to 8000 ft worsens neurologic outcomes. This study tests the hypothesis that exposure to hypobaria also worsens neurologic injury and increases mortality in a rat polytrauma model. The study also tests the hypothesis that treatment of rats with sulforaphane, a compound that increases expression of genes coding for antioxidant enzymes, will mitigate the deleterious effects of hypobaria.

**Student Role:** The student will learn to process brain tissue for immunohistochemistry and will use stereologic techniques with light microscopy to quantify extent of neuronal death, protein nitration, DNA/RNA oxidation, and cellular inflammatory reactions. The student will also become familiar with animal physiology and with critical care for hemorrhagic shock.

**Mentors:** Gary Fiskum, Ph.D.

**Research Type:** Basic Science

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**Project Topic:** Effect of Age on NADPH Oxidase Expression and Cellular Neuroinflammation after Experimental Traumatic Brain Injury (TBI)

**Overview:** The goal of the proposed research is to investigate the underlying molecular mechanisms that contribute to increased microglial activation and associated neurotoxicity in the aged brain following TBI. We hypothesis that increased NADPH oxidase activity during aging tips the M1/M2 microglia balance from favoring an anti-inflammatory M2 state in young, to a pro-inflammatory M1 state in aged brain after TBI. This shift towards an M1 state will result in increased neurodegeneration and worse neurological outcomes in the aged population. In this summer research project fixed brains from 3 month-old (young), 15 month-old (middle-aged), and 22 month-old (aged) mice subjected to TBI will be analyzed histologically for markers of NADPH oxidase expression, oxidative stress (protein nitration and DNA/RNA oxidation) and microglial activation.

**Student Role:** The student will learn to process brain tissue for immunohistochemistry and will use stereological techniques to quantify NADPH oxidase expression, protein nitration, DNA/RNA oxidation, and cellular inflammatory responses.

**Mentors:** David Loane, Ph.D.

**Research Type:** Basic Science
Project Topic: Mechanical Ventilation Increases Sur1/Trpm4 Expression and Increases Pulmonary Edema

Overview: We aim to demonstrate the association of SUR1 and TRPM4 and the possible mechanism of this ion channel in ventilator-induced lung injury (VILI). The results of this study will provide the basis of a novel discovery of the role of this channel and an innovative therapeutic model of treatment for VILI.

Student Role: Assist in animal procedures and data collection for the specified project. This may include blood collection and analysis as well as other basic science applications (i.e. immunohistochemistry and protein analysis)

Mentors: Caron M. Hong, M.D., M.Sc.

Research Type: Basic Science

Project Topic: Management and Outcomes of Cardiac Arrest after Cardiac Surgery

Overview: Cardiac arrest after cardiac surgery is an uncommon, but life threatening event. Cardiac surgery patients have special considerations during resuscitation because of their unstable sternum, possible CABG grafts, and or suture lines in the heart or great vessels. At the current time, the management of post-cardiac surgery cardiac arrest is variable with some patients receiving external CPR, others having rapid chest reopening with internal cardiac massage, and other being placed on emergent ECMO. This study will review all cardiac arrests that happened in the cardiac surgery ICU during a 5-year period. Statistical methods will be used to determine what factors were associated with improved survival.

Student Role: Assist in data collection, literature review, and statistical analysis.

Mentors: Michael Mazzeffi MD MPH

Research Type: Outcomes

Project Topic: Determining Long Term Needs of Patients Following Mild Complicated Traumatic Brain Injury

Overview: IRB approved and funded study investigating functional outcome of patients with mild traumatic brain injury.

Student Role: Collating data from several survey instruments, literature review, abstract and manuscript preparation

Mentors: Maureen McCunn, MD, MIPP, FCCM

Research Type: Outcomes

University of Michigan Hospitals and Health Centers

Project Topic: Cerebral Network Mechanisms of General Anesthesia

Overview: Understanding the neuronal mechanism of general anesthesia with respect to the loss and return of consciousness is a major focus of current neuroscience research due to its high translational significance and its potential impact on revealing the fundamental basis of human consciousness. This project focuses on large-scale and local circuit mechanisms that support the conscious state and their alteration in anesthesia. Behavioral assessment of the state of consciousness is conducted in parallel with electrophysiological recordings in chronically instrumented, freely moving animals in vivo. The hypotheses
currently tested relate to the causal roles of neuronal communication and information integration underlying anesthetic-induced loss and return of consciousness. The ultimate goal of research is to better understand the neurobiological basis of human consciousness via the application of anesthetic manipulation.

**Student Role:** During the summer, the student will be expected to (1) learn the principles of recording neuronal activity using chronically implanted electrodes in the rodent brain in vivo, (2) learn to use methods of data analysis as applied to the measured neuronal signals, (3) learn techniques of behavioral assessment of the state of consciousness in rodents, and (4) learn to interpret neuroscientific data in the context of anesthetic mechanisms and consciousness. The student will be assigned to the primary mentor (Hudetz), a neuroscientist, and assisted by other laboratory research team members. It is anticipated that the student’s work will result in co-authorship on a peer-reviewed article published in an outstanding anesthesiology or neuroscience journal; the student will be actively involved in the process of manuscript preparation.

**Mentors:** Anthony G Hudetz, DBM, PhD

**Research Type:** Translational

**Project Topic:** Phenotyping Perioperative Cardiopulmonary Complications using Polysomnographic Time-Series Data. The objective of the proposed studies is to demonstrate that specific sleep-related measures of cardiopulmonary regulation are reliable predictors of postoperative complications.

**Overview:** Our central hypothesis is that several phenotypic markers of sympathovagal imbalance manifest during sleep, and that their presence carries modifiable postoperative outcome implications. The rationale for the proposed research is that data from polysomnography can direct clinical interventions to prevent catastrophic postoperative events, as well as help us develop a better understanding of how sympathovagal tone may modulate similar outcomes in individuals without sleep apnea. We plan to accomplish the study objectives through two specific aims: 1) To determine whether specific sleep-related measures of sympathovagal imbalance captured during PSG, independent of comorbid conditions, anesthetic and surgical factors, explain a significant proportion of the variance in postoperative cardiopulmonary complications, 2) To determine the impact of applying effective titration pressure during continuous positive airway pressure initiation on sympathovagal balance.

**Student Role:** During the summer, the student will be expected to: 1) Participate in a didactic learning program for the proposed research methodology 2) Assist in data extraction from the sleep laboratory database; 3) Assist the post-doctoral fellows in executing the MATLAB analyses. The student will be expected to shadow the P.I. and other anesthesiologists both in the operating room and the post anesthesia care unit to further their clinical implications of the research project. In addition, successful students will participate in a didactic research lecture program focused on clinical research methodology.

**Mentors:** Satya Krishna Ramachandran, MBBS, FRCA

**Research Type:** Outcomes

**Project Topic:** Shared Central Neurobiological Correlates of Ketamine and Nitrous Analgesia

**Overview:** Chronic pain is prevalent within the United States, affecting over 100 million individuals, exceeding cancer, heart disease & diabetes combined. However, there are few treatment options for these patients. This study will explore the underlying brain correlates of two known analgesics: ketamine and
nitrous oxide from a network prospective. Recent data from our laboratory suggests that centrally acting analgesics work by either increasing anti-nociceptive or decreasing pro-nociceptive connectivity patterns within the brain. As such, we propose that ketamine and nitrous will have mechanistic similarities at the level of brain networks despite differing molecular actions. The goal of this study is to identify changes in brain networks associated with analgesia using combined fMRI/EEG studies in healthy volunteers receiving ketamine or nitrous oxide. In the proposed studies we will assess brain responses to ketamine or nitrous oxide at analgesic doses, with a focus on network connectivity.

**Student Role:** During the summer, the student will be expected to (1) learn the principles of multimodal neuroimaging, (2) execute codes related to EEG analysis, and (3) contribute to studies in healthy volunteers. The student will be exposed to multiple aspects of pain research: basic biology, sensory testing, clinical trials, and brain neuroimaging. It is anticipated that the student’s work will result in co-authorship on a peer-reviewed article published in an outstanding pain journal; the student will also be actively involved in the process of manuscript preparation.

**Mentors:** Richard E. Harris, PhD

**Research Type:** Translational

**Project Topic:** Pain Vulnerable Phenotype and Persistent Postoperative Pain in Children. Many children experience poor postoperative pain control with recurrent or persistent pain for years. Symptom patterns consistent with centralized pain syndromes (e.g., fibromyalgia)

**Overview:** We hypothesize that similar symptom patterns consistent with centralized pain (and measured by FMC) are present to varying degrees in children with musculoskeletal defects and will differentiate a pain vulnerable group at risk for poor pain outcomes. Our cross-sectional survey and longitudinal study will include 345 children with underlying musculoskeletal disorders to: 1) differentiate the phenotypic traits of children who report baseline symptoms characteristic of centralized pain; 2) demonstrate that a pediatric measure of these symptoms (pFMC) will predict the acute and long-term postoperative pain responses in children who undergo a variety of orthopedic procedures.

**Student Role:** The student will be expected to: 1) Learn the principles of ethical conduct of human subject research, strategies to improve recruitment and retention of children/families in a longitudinal clinical study, and common and newly developed clinical pain assessment and management strategies; 2) Participate in the recruitment and interview of children (and parents) undergoing spine fusion or knee surgery in our busy pediatric setting; 3) Collect data throughout the perioperative and postoperative course, gaining an understanding of the pain and analgesic response trajectory. The student will also have an opportunity to: 1) Shadow anesthesiologists in the operating room (gaining an understanding of intraoperative analgesic techniques) and during acute pain rounds (gaining an understanding of acute postoperative pain management); and 2) attend orthopedic clinic visits for children who return with complaints of persistent, poorly managed pain after surgery.

**Mentors:** Terri Voepel-Lewis, PhD; Shobha Malviya, MD

**Research Type:** Clinical

*University of North Carolina Hospitals Program*
**Project Topic:** The research topic will be to examine the efficacy of a cognitive aid for feedback in clinical anesthesia education.

**Overview:** Feedback is essential in clinical education. In-time effective feedback is a cognitive strategy that can be used to identify misconception, reduce diagnostic error, and improve learning (Croskerry, 2003). Yet feedback can be challenging in clinical situations due to multiple barriers, including time constraint. The fact that medical school faculty members often feel uncomfortable or do not have skills to provide feedback further contributes to the infrequency of feedback in clinical practice (Brukner et al., 1999; van de Ridder et al., 2008).

Despite the critical role of feedback in learning, literature on feedback in medical education is mostly theoretical (Branch & Paranjape, 2002; Ende, 1983; Rudolph et al., 2007, 2008) and research on the use of cognitive aids to assist with feedback is minimal. This study aims to examine the efficacy of a cognitive aid for feedback in facilitating the provision of consistent, formative feedback from faculty to residents in clinical education.

**Student Role:** The student will be responsible for data collection, data analysis and results write-up (including an abstract to be submitted to the American Society of Anesthesiology annual meeting). Methods for data collection include one-on-one interview with participating faculty and residents, facilitation of focus groups, clinical/educational observations, and resident and faculty surveys. Based on the interest of the student, the data analysis can be conducted using qualitative and/or quantitative approaches. The student will also develop his/her research hypothesis and contribute to the refinement of the cognitive aid.

**Mentors:** Susan Martinelli, MD; Fei Chen, PhD

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**Project Topic:** The summer research topic will be to gain understanding of how RNA transcriptional profiles circulating in blood at the time of trauma exposure might a) predict who is at risk for persistent pain and b) mediate pathogenic mechanisms of pain development.

**Overview:** Each year, more than 11 million Americans experience motor vehicle collision and 700,000 women are sexually assaulted. Persistent pain is a common sequela of such traumatic/stressful events, however little is known regarding which individuals are at risk for persistent pain and how persistent pain develops in at-risk individuals. Increased understanding of these parameters could lead to new diagnostic tests and improved interventions.

**Student Role:** The student will be responsible for conducting his/her own hypothesis driven research project that falls within the scope of the lab’s interests. The specific project can be chosen by the student based on his/her interest, but is likely to include techniques such as RNA isolation from blood samples, RNA sequencing, bioinformatics and statistical analyses of large datasets, and molecular and cellular assays.

An example of a summer research project recently completed by a medical student intern includes RNA isolation from 40 participants in a study assessing persistent pain development following motor vehicle collision, preparation of these samples for RNA sequencing, and analysis of sequencing results (i.e. determine whether there are statistical associations between RNA expression levels and pain development 6 weeks, 6 months, or 1 year following trauma).

**Mentors:** Sarah Linnstaedt, PhD
Research Type: Translational

Project Topic: This summer we will work towards a better understanding of why some patients develop persistent, life-long pain after traumatic injury. We will explore clinical predictors and molecular mechanisms that are important in the development of persistent pain.

Overview: Persistent pain and itch after burn injury is a major public health problem. Approximately 50,000 patients each year sustain a major thermal burn injury and many of these patients develop significant pain that causes disability and suffering. Despite the magnitude of this problem, there is little known about predictors and molecular signatures associated with the development of persistent pain and itch after burn injury. We currently have a high quality pilot dataset that includes 96 patients who underwent skin grafting after major thermal burn injury and were followed longitudinally for 1 year after their burn. In addition to serial pain severity scores, itch severity scores and measures of pre-burn mental and physical health, we collected serum samples, skin biopsies, DNA and RNA samples. Based on previous work, we hypothesize that there is an unequal burden of persistent pain and itch among African American patients in comparison to European Americans after burn injury.

Student Role: This summer the student will work towards understanding why patients develop persistent pain after burn injury and why African Americans have more severe pain and itch after burn injury than European Americans. We will teach the student a systematic, hypothesis-driven approach to the clinical problem of persistent pain as it relates to perioperative physicians. With close mentoring, the student will perform analysis of our dataset to identify clinical predictors that are important in the development of persistent pain after burn injury. This will be developed into an abstract to be submitted to the American Society of Anesthesiology annual meeting. We will help the student learn appropriate statistical modeling and techniques important in clinical research. We will also work towards understanding the molecular mechanisms that are responsible for the development of persistent pain in this patient population.

Mentors: Matthew Mauck, MD, PhD

Research Type: Clinical

University of Pennsylvania

Project Topic: perioperative neurotoxicity

Overview: We hypothesize that elements of the perioperative period (anesthetics, surgery, inflammation, pain) interact with the neuropathology of neurodegenerative diseases (like Alzheimer's) to accelerate the onset of cognitive symptoms. Under NIH support, we use protein assays, cell culture, transgenic animals, behavioral assays and other approaches to determine the magnitude of each influence in order to assist the design and interpretation of future and ongoing patient-oriented studies.

Student Role: The student will identify areas of particular interest, and be assigned a task or tasks in support of the ongoing work. Every attempt is made to give students "ownership" of their particular project. The students will be expected to collect and analyze their own data, understand the context of their experiments to the entire project, and summarize their work in a presentation to the entire group at the conclusion of their summer work.

Mentors: Roderic G Eckenhoff, M.D.; Huafeng Wei, M.D., Ph.D.; Maryellen Eckenhoff, PhD
**Research Type:** Basic Science

**Project Topic:** Anesthetic Drug Discovery

**Overview:** This NIH funded project has involved a high throughput screen of 500,000 compounds, and is now engaged in validation-screens, medicinal chemistry and in vivo testing. The goal is to identify novel chemotypes with anesthetic potency and fewer side effects.

**Student Role:** The summer student will be assigned a group of compounds and a particular assay. Assays include in vivo potency using tadpoles, cell-based receptor assays, calorimetric binding assays, fluorescence assays, and in silico docking assays. He/she will be expected to understand their role within the whole project, and to deliver a presentation on their work at the conclusion of the summer.

**Mentors:** Roderic G. Eckenhoff, M.D.

**Research Type:** Basic Science

**Project Topic:** Monocyte to dendritic cell transformation after sepsis and cardiac surgery

**Overview:** Both sepsis and cardiac surgery have considerable and poorly characterized effects on innate and acquired immunity. We hypothesize that differentiation of dendritic cells from monocytes after these major stressors is impaired both acutely and chronically, leading to early and late complications. We have IRB-approved protocols to draw blood samples and using flow cytometry, characterize the different cellular populations over time.

**Student Role:** The student will assist in the screening and enrollment of patients, and prepare blood samples for FACS and for ELISAs. They will assist in the analysis of FACS and ELISA data and organize it into databases.

**Mentors:** Krzysztof Laudanski, M.D., Ph.D.

**Research Type:** Translational

**Project Topic:** Opioid and opioid receptor pharmacology

**Overview:** Dr. Liu’s lab focuses on opioid and opioid receptor pharmacology. The prospective student could become involved in the characterization of engineered water soluble mu receptors using various biophysical or biochemical approaches, or assist in animal studies to determine the potential neurological protective effects of a highly selective kappa opioid agonist.

**Student Role:** 1) Assist experiments under direct supervision of lab staff

2) Data analysis

3) It is possible that the student could have a relative independent small project to finish during the time frame if he/she has previous related experiences and is highly motivated.

**Mentors:** Renyu Liu, M.D., Ph.D.

**Research Type:** Basic Science

**Project Topic:** Glycocalyx Disruption and Interstitial Edema In Pediatric Cardiopulmonary Bypass
Overview: The central hypothesis of this project is that disruption of the endothelial glycocalyx is a major cause of tissue edema accumulation and consequent organ dysfunction during and after pediatric cardiac surgery that requires cardiopulmonary bypass (CPB). The studies will take place primarily in infants and young children undergoing CPB where we will serially measure 1) glycocalyx thickness and integrity in vivo using a novel light microscopic imaging and quantitation method; 2) plasma biomarkers of glycocalyx disruption, inflammation, and endothelial injury; 3) circulating blood volume and tissue water, plasma protein, and matrix fragment accumulation.

Student Role: The student will actively participate in all aspects of this project, including assisting with in vivo microscopic measurements and performing immunoblotting and ELISA assays on blood and tissue samples.

Mentors: Frank X. McGowan, MD

Research Type: Clinical

Project Topic: Making Infection-Resistant Endotracheal Tubes

Overview: Lung infection is a major cause of morbidity and mortality in intensive care units worldwide. Ventilator-associated pneumonia is characterized by bacterial adhesion on the endotracheal tube. Major bacterial offenders are staphylococcus aureus and pseudomonas aeruginosa biofilms. Our lab is working to produce infection-resistant coatings that confer both microbial anti-adhesive and microbicidal properties to the entire surface of the endotracheal tube to reduce mechanical ventilation related infections. We bind complex and multicomponent ultrathin films onto the surface using novel synthetic and attachment chemistries to biofunctionalize the surfaces to be anti-adhesive and microbicidal

Student Role: Participate directly in laboratory work to graft polymer coatings onto biomaterials, characterize surface structure and assess bacterial adhesion to grafted surfaces.

Mentors: David M. Eckmann, Ph.D., M.D.

Research Type: Translational

Project Topic: Neuronal mechanisms of anesthetic-induced unconsciousness

Overview: Using the fruit fly, Drosophila melanogaster, as a model organism, we have demonstrated that the forward and reverse paths through which the state of general anesthesia arises and dissipates are not identical. By changing the membrane potential in distinct neuronal circuits, we can shift an organism's propensity to enter or exit the anesthetized state. Often times, we show an isolated effect only on anesthetic emergence without any corresponding change in anesthetic induction. The goal of this summer project would be to learn drosophila genetics and help screen candidate as well as novel genes to determine whether the effects of mutations targeted to specific neural circuits.

Student Role: The student would assist in loading individual flies into activity chambers and would also learn to titrate an anesthetic to the desired endpoints, while understanding gas flow, anesthetic uptake, and
measuring delivered anesthetic concentration. The student would then learn to analyze the data performing population fits to assess the effects of genetic engineering on entry into and exit from the anesthetized state.

**Mentors:** Max Kelz, M.D., Ph.D

**Research Type:** Basic Science

**Project Topic:** Regional assessment of ventilator induced lung injury using functional imaging

**Overview:** Acute lung injury has a high mortality and is worsened by ventilator induced lung injury. The mechanisms are thought to be atelectasis and overdistension, We use hyperpolarized MR imaging to address the global hypothesis that atelectasis permits over expansion and mechanical injury of ventilated areas even when low tidal volumes are used. The imaging approaches allow high resolution measurements of air space to assess in real time the optimal ventilator approach.

**Student Role:** The student will assist in setting up and studying animal models of ventilator induced lung injury, and assist the PI with imaging studies, and then the post-mortem lung histology. The student will assist in organizing data and figures for draft manuscript

**Mentors:** Maurizio Cereda, M.D.

**Research Type:** Basic Science

**Project Topic:** Light induced anesthesia using novel photo-activated anesthetics.

**Overview:** Novel chemical probes, combined with stereotactic implantation of laser microfibers are used to map out areas of the mammalian brain that contribute to anesthetic senstitivity.

**Student Role:** The student will assist with animal preparation and monitoring during procedures. He/she will assistant with post-procedure biochemistry and immunohistology, and EEG recording analysis.

**Mentors:** Andrew McKinstry-Wu, M.D.

**Research Type:** Basic Science

**University of Pittsburgh**

**Project Topic:** The North American Malignant Hyperthermia Registry

**Overview:** Dr. Brandom’s group maintains the North American Malignant Hyperthermia (MH) Registry, which now contributes to the Global Rare Disease Registry. Research will focus on measures of muscular function that could document the sub-clinical chronic myopathy that is one of the manifestations of some mutations in the ryanodine receptor gene. Studies into the genetics of MH susceptibility and the phenotype of MH susceptibility are ongoing.

**Student Role:** Trainees will participate in research projects involving de-identified data already acquired by the North American Malignant Hyperthermia Registry (over 4,000 cases). They will develop and execute projects involving patients diagnosed as malignant hyperthermia (MH) susceptible or MH negative, and may prepare data for analysis, perform descriptive statistical analysis, and present the data at a research meeting.
**Mentors:** Barbara W. Brandom, M.D., Professor of Anesthesiology; Jerome Parness, M.D., PhD., Professor of Anesthesiology

**Research Type:** Clinical

**Project Topic:** Preliminary Studies for Whole Genome Association Study (WGAS) in Acute Perioperative Pain

**Overview:** This preliminary, developmental, prospective genome-wide association study will explore genetic mechanisms responsible for variation in pain perception. The study will attempt to correlate markers on genes & single nucleotide polymorphisms w/ patient phenotypes (quantitative sensory/motor testing, psychometric questionnaires & other clinical variables). The aim is to devise a method for defining a pain phenotype sensitive enough to detect differences in genotype between subjects who undergo a standard surgical procedure. Subjects undergoing total knee arthroplasty will be genotyped for genes associated with pain & single nucleotide polymorphisms (SNPs), and phenotyped in the perioperative period. Fluids will be collected for biomarkers of inflammation analysis using multiplex immunoassay.

**Student Role:** Trainees will be responsible for all clinical research duties including, but not limited to, enrolling subjects, phenotyping using quantitative sensory/motor testing, administering psychometric questionnaires, processing of biological specimens, and data analysis. Laboratory interest can also be accommodated to include DNA extraction/genotyping and multiplex immunoassay.

**Mentors:** Jacques E. Chelly, M.D., Ph.D., M.B.A., Professor of Anesthesiology and Orthopedic Surgery, Vice Chair of Clinical Research

**Research Type:** Clinical

**Project Topic:** Hemoadsorption after Extracorporeal Cardiopulmonary Resuscitation from Ventricular Fibrillation Cardiac Arrest in Rats

**Overview:** Cardiac arrest (CA) followed by reperfusion results in hemodynamic, neurobehavioral and metabolic impairment. The complex pathophysiological mechanisms operating after CA including systemic cytokine response were approximated to «sepsis-like syndrome».

Early results from experimental sepsis models using hemoadsorption showed effective removal of circulating cytokines and improved survival. Both standard resuscitation and extracorporeal cardiopulmonary resuscitation (E-CPR) could be combined with hemoadsorption.

Our hypothesis is that the systemic cytokine response occurs early after CA and mediates secondary hemodynamic and metabolic derangements and functional impairment. Our objective is to hemoadsorption to remove systemic cytokines after prolonged CA in rats, thus improving outcome.

**Student Role:** The role of the student would be assisting during rodent experiments involving CPR and E-CPR, assessment of neurobehavioral outcome after prolonged CA, evaluation of neurohistochemistry, and magnetic resonance imaging (in cooperation with Carnegie Mellon University).

**Mentors:** Tomas Drabek, M.D., Ph.D. Associate Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Mechanisms of Migraine
**Overview:** Migraine is a debilitating episodic pain disorder for which there are no consistently effective therapeutic interventions. It is also one of the most prevalent pain disorders afflicting as many as 10% of the general adult population and 18% of women. The prevailing weight of evidence indicates that the primary afferent neurons innervating the dura and dural vasculature are the source of the pain of a migraine attack. The present project is therefore focused on components of the dura that can influence afferent activity. These components include resident and recruited immune cells in the dura and the dural vasculature.

**Student Role:** Two unique features of migraine will be exploited as a means to identify mechanisms that enable the initiation of a migraine attack. One is that stress is the most common trigger of a migraine attack. A second is that migraine attacks occur during relaxation phase after stress has ended. The student role will vary depending on student interests, but can involve anything between the flow cytometric analysis of isolated dural cells, biochemical and/or physiological analysis of isolated dural cells to two-photon imaging of the dural vasculature.

**Mentors:** Michael S. Gold, Ph.D., Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Injury-induced Changes in the Regulation of Intracellular Ca2+

**Overview:** Ca2+ is plays a critical role in mediating an array of physiological as well as pathophysiological processes in peripheral neurons. We have evidence that changes in the regulation of intracellular Ca2+ contribute to the manifestation of persistent pain states. Interestingly, the type of tissue injury appears to influence the specific pattern of changes in intracellular Ca2+, suggesting that the pattern of changes may also contribute to the unique qualities of the pain state specific to particular types of injury. To tease out the basis for these differences as well as the underlying mechanisms, we have been studying changes in the regulation of intracellular Ca2+ in models of persistent inflammation and more recently, nerve injury.

**Student Role:** Trainees will participate in research projects involving the function and biochemical analysis of Ca2+ regulation in sensory neurons from rat and human donors.

**Mentors:** Michael S. Gold, Ph.D., Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Inflammation-induced Changes in the Actions of Local Anesthetics

**Overview:** Regional nerve blocks are now a standard component of post-operative pain management. However, we have recently obtained data indicating that there are a number of conditions in which there is not only a loss of local anesthetic potency, but where the use of local anesthetics may even have deleterious consequences. The goal of this project is to determine the mechanisms underlying the loss of local anesthetic potency as well as an increase in local anesthetic toxicity.

**Student Role:** Will vary depending on student interests, but can involve anything between behavioral pharmacology using pre-clinical models, to biochemical and/or physiological analysis in isolated tissues.

**Mentors:** Gregg E. Homanics, Ph.D., Professor of Anesthesiology

**Research Type:** Basic Science
Project Topic: Epigenetic Effects of Ethanol

Overview: Recent research in the lab suggests that an individual’s ethanol phenotype is dictated in part by his father’s history of ethanol exposure prior to conceiving that individual. Remarkably, these transgenerational effects of ethanol appear to only affect male offspring. These exciting observations suggest that ethanol is an epimutagen (ie, alters the epigenetic program) that impacts germ cells in an enduring fashion. To further investigate the hypothesis that an individual’s drinking and neurobiological sensitivity to ethanol are due in part to preconception ethanol exposure, we will 1) characterize the model in greater detail, 2) undertake studies to reveal the mechanism(s) that mediate these effects, and 3) examine if these effects represent true transgenerational epigenetic inheritance.


Mentors: Gregg E. Homanics, Ph.D., Professor of Anesthesiology

Research Type: Basic Science

Project Topic: The Interaction of Sustained Inflammation and Insulin Signaling Pathways in a Drosophila Model of Sepsis

Overview: Sustained inflammation following recovery from sepsis is a major factor for increased morbidity (dementia, neuro-muscular dysfunction, accelerated atherosclerosis) and mortality in critically ill patients. Our laboratory developed a Drosophila model of surviving sepsis, where we infect flies with S. aureus and treat in a delayed fashion with linezolid. Despite survival advantage, the antibiotic treated survivors had sustained inflammation as shown by NF-kB expression compared to sham controls. The survivors also had decreased glucose/glycogen storage. We are exploring the Insulin Receptor pathways to modify the sustained inflammation.

Student Role: Perform infection assays, interrogate the insulin signaling pathways, and measure survival and metabolic state.

Mentors: A. Murat Kaynar, M.D. M.P.H., Associate Professor of Critical Care Medicine and Anesthesiology

Research Type: Basic Science

Project Topic: The Impact of Regional vs. General Anesthesia in the Outcome of Patients Undergoing Total Hip and Total Knee Replacements

Overview: Recovery from anesthetics, be it general or regional, after a total hip or knee replacement has non-significant differences. However, recent literature suggests a difference in the 90-day mortality in this patient population. Our group is interested in using large data (EMR) to explore the neurocognitive and one-year outcomes in this patient cohort.

Student Role: Perform data quality check of ~100,000 cases, perform regression analyses, and review the relevant literature

Mentors: A. Murat Kaynar, M.D. M.P.H., Associate Professor of Critical Care Medicine and Anesthesiology
**Research Type:** Outcomes

**Project Topic:** Molecular Mechanisms of General Anesthesia: an Experimental Approach

**Overview:** The research is designed to determine high-resolution structures and dynamics of proteins in the central nervous system and to investigate the interactions between proteins and general anesthetic drugs. State-of-the-art experimental tools, particularly multidimensional NMR spectroscopy, will be used to provide protein structural and dynamical information as well as anesthetic binding properties. The ultimate goal is to understand molecular mechanisms of general anesthetic action.

**Student Role:** Students will gain hands-on experience with our state-of-the-art instruments, including high-field NMR spectrometers, to (1) determine high resolution structures of proteins that have been recognized as potential anesthetic targets; (2) characterize interaction sites of anesthetic drugs on proteins and the impact of anesthetic interaction to protein structure and dynamics; (3) evaluate potential factors that contribute to protein aggregations and the aggregation related diseases.

**Mentors:** Pei Tang, Ph.D., Professor of Anesthesiology

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**Research Type:** Basic Science

**Project Topic:** Molecular Mechanisms of General Anesthesia: a Computational Approach

**Overview:** Students will receive training in computational approaches to biomedical research. They will be exposed to the computational facility at the Pittsburgh Supercomputer Center and learn various computational methods, including (1) parameterizations of drug molecules for further use in molecular dynamics simulations; (2) all-atom molecular dynamics simulations of proteins in the absence and presence of anesthetic drugs; (3) simulations of collective protein motions using coarse-grained models.

**Student Role:** This project focuses on computational investigations of the anesthetic action on ion channels with the long-term goal of determining the molecular mechanism of general anesthesia.

**Mentors:** Pei Tang, Ph.D., Professor of Anesthesiology

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**Research Type:** Basic Science

**Project Topic:** Modification of Shear Induced Hemolysis by Anesthetic Agents

**Overview:** Trainees will help with patient consenting, blood drawing, inducing hemolysis utilizing a validated shear model, blood centrifugation, measurement of hemolysis through spectrophotometry.

**Student Role:** The aim is to determine if red blood cell exposure to commonly used anesthetic agents will alter the cells’ ability to withstand mechanical stress & shear forces. Subjects are non-pregnant adults, w/ no known hemoglobinopathy, coagulopathy, or anemia, and scheduled to receive general anesthesia. A blood sample (control) is collected from the IV line prior to the operation. After patient induction with propofol, another blood sample (experimental) will be obtained by venipuncture. A control sample will be used to perform ABO typing & measure total hemoglobin. 4 samples from will be tested w/ standard protocol to determine the mechanical fragility index. Comparisons will be made using 1-way analysis of variance.
**Mentors:** Jonathan Waters, M.D., Professor & Chief of Anesthesiology at Magee Women’s Hospital

**Research Type:** Translational

**Project Topic:** Development of a Patient Blood Management Program

**Overview:** Trainees will help with a wide variety of projects (which may include database management, consenting patients, etc.) which change as the PBM program develops and evolves.

**Student Role:** Blood transfusion occurs in 11% of hospitalized patients and is the most common hospital therapy. While transfusion can be life-saving, overuse of blood products has been identified by the AMA, the Joint Commission and the British National Health System as one of the most commonly overused therapies. Patient blood management (PBM) is a developing discipline aimed at optimizing a patient’s hospital outcome and minimizing exposure to allogeneic blood products, using them only when the evidence best supports it. The UPMC patient blood management program is the leading program in the US. Since this program is pioneering, research questions arise constantly. These questions arise in how best to use computerized physician order entry systems; how to present data in order to influence transfusion decisions; how to structure electronic alerting systems; how to reduce waste in the healthcare system, etc. As such there are multiple research questions which arise as the program develops.

**Mentors:** Jonathan Waters, M.D., Professor & Chief of Anesthesiology at Magee Women’s Hospital

**Research Type:** Clinical

**Project Topic:** Volatile Anesthetic Interactions with Membrane Proteins

**Overview:** Experimental and theoretical approaches are combined to study how low affinity neurological agents, particularly general anesthetics and alcohols, exert their effects on the central nervous system at the molecular level. The goal is to understand the molecular mechanisms of general anesthesia.

**Student Role:** Trainees will have the opportunity to learn a variety of modern techniques, including expression and purification of membrane proteins, immunohistochemistry, high-resolution nuclear magnetic resonance imaging and spectroscopy, imaging reconstruction, 3-D protein structure calculation, and molecular dynamics simulations.

**Mentors:** Yan Xu, Ph.D., Professor of Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Membrane Protein Structural and Dynamical Studies by NMR

**Overview:** NMR is used to determine the transmembrane domain structures of the human glycine receptor, which is the primary inhibitory receptor in the spinal cord and brainstem and responsible for a wide range of diseases. The long-term goal is to provide the structural basis for novel design of drugs that are disease specific and devoid of side effects.

**Student Role:** Trainees will have the opportunity to learn a variety of modern techniques, including expression and purification of membrane proteins, immunohistochemistry, high-resolution nuclear magnetic resonance imaging and spectroscopy, imaging reconstruction, 3-D protein structure calculation, and molecular dynamics simulations.
Mentors: Yan Xu, Ph.D., Professor of Anesthesiology

Research Type: Basic Science

Project Topic: Gene and Stem Cell Therapy for Brain Protection and Revitalization After Cardiac Arrest and Resuscitation

Overview: New therapy strategies are being developed to target reperfusion injury after cardiac arrest and resuscitation. Recently, Dr. Xu’s group used umbilical cord matrix stem cells in an effort to stop and reverse the neuronal loss after reperfusion from prolonged cardiac arrest or stroke. A novel mechanism of extracellular signaling between stem cells and host cells are being explored.

Student Role: Trainees will have the opportunity to learn stem cell transplantation, various stroke models, high-resolution magnetic resonance imaging (MRI), image reconstruction, and confocal microscopy.

Mentors: Yan Xu, Ph.D., Professor of Anesthesiology

Research Type: Basic Science

University of Rochester

Project Topic: Optogenetic control of mitochondrial reactive oxygen species. Reactive oxygen species (ROS) contribute to cellular damage in many pathologic processes, such as stroke. Mitochondria are a main site of ROS production and are central mediators of cell death.

Overview: Oxidative damage is a major contributor to many diseases. However, in some situations reactive oxygen species (ROS) can help to protect the cell. We will take an optogenetic approach and utilize novel proteins that can generate ROS in response to light to determine what factors make some ROS beneficial and other ROS toxic. These new tools will be expressed as protein fusions using CRISPR/Cas9 technology with genes that encode known sites of ROS production. Using the genetic model organism C. elegans will further allow us to integrate our results with conserved stress response pathways and determine the role of ROS signaling in the context of neuronal ischemic sensitivity. This approach could potentially yield new therapeutic strategies for diseases in which ROS homeostasis has been disrupted.

Student Role: The student would be involved in C. elegans and cell culture, designing of experiments and collection of data. In addition, the student will learn how to isolate mitochondria and measure mitochondrial function. The student will be expected to keep accurate lab records and present at lab meetings.

Mentors: Andrew P. Wojtovich, PhD, Assistant Professor of Anesthesiology and of Pharmacology & Physiology

Research Type: Basic Science

Project Topic: Neuroprotective effects of Nrf2 agonists in a cell model of Alzheimer disease. It has recently been reported that Nrf2 agonists (which are often phytochemicals) may be neuroprotective, in part by reducing protein aggregation. We have recently found that

Overview: The focus of this study will be to determine if Nrf2 agonists can protect neurons expressing this mutant form of tau against cell death and if so, is it due to its effects on the conformation of tau or on
mitochondrial function, or both. This is an important project because Nrf2 agonists are already being considered as therapeutics for the treatment of neurodegenerative conditions and limited clinical trials are already underway. Therefore, Nrf2 agonists can be considered promising therapeutics for the treatment of Alzheimer disease.

**Student Role:** The student would learn cell culture, immunoblotting, immunocytochemistry, and chemiluminescent oligomerization assays. In addition, the student will also learn how to measure mitochondrial status both biochemical and by using microscopic approaches.

**Mentors:** Gail W. Johnson, PhD, Professor of Anesthesiology and of Pharmacology & Physiology with Tenure, Professor, Center for Neural Development & Disease

**Research Type:** Basic Science

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**Project Topic:** Managing postoperative pain in patients that chronically consume opioids is a challenge. In the presence of similar painful stimuli (i.e. same surgical procedure), post-operative pain is often more intense in this group than in opioid naïve patients and their response to conventional pain management techniques is often inadequate. It is as if they are wired up different! The use of opioids for the treatment of chronic pain has escalated in recent years; they are one of the most commonly prescribed medications in the United States. One implication of this escalation is that patients on high doses of long-term opioid pharmacotherapy suffer exaggerated acute pain after surgery and often require escalating doses in chronic opioid therapy. The aim of this study is to explore differences between opioid consuming and opioid naïve patients in the expression of mRNA that code for selected protein receptors that play a role in transmitting pain.

**Overview:** We will measure perioperative changes in mRNA expression of mu3, metabolite-detecting, adrenergic, and immune gene receptors on white blood cells between chronic opioid consuming and opioid naïve patients undergoing elective surgery. The expression of mRNA in white blood cells is a surrogate of what is expressed at neural junctions that transmit pain.

**Student Role:** The student will identify prospective patients from the surgery schedule, participate in the consent process, and visit the OR when studies are performed by anesthesiology faculty. The student may also contribute to other aspects, including: literature updates, preparation of and assay for mRNA expression, data analysis, interpretation, manuscript preparation, and presentation.

**Mentors:** Ken B. Johnson, M.D., M.S.

**Research Type:** Clinical

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**Project Topic:** Development of a device to improve the estimate of blood loss during surgery based on an evaluation of suctioned fluid that is collected during the surgery.

**Overview:** The goal is to improve estimates of surgical blood loss through analysis of suction fluid. The suction fluid may contain a mixture of blood, irrigation fluid, and ascites, urine, and other fluids, so it is difficult to estimate how much fluid and blood replacement products should be administered. Accurate determination is essential for accurate volume replacement. A device has been developed to measure the
concentration and volume of blood in the suction canister. Further testing and improvement of the device is needed.

**Student Role:** The medical student will work with biomedical engineers to collect and analyze data obtained in the operating room from a prototype fluid canister evaluation device. Data from prototype device will include hemoglobin concentration and blood volume. The student will test the prototype device to learn how accurate it is for blood concentration and volume measurement.

**Mentors:** Lara Brewer, PhD

**Research Type:** Translational

**Project Topic:** Development of a clinical data mining visualization and navigation tool.

**Overview:** The department has high resolution data and information (incl. clinical notes, intraoperative physiological measurements, beginning and end of surgical and anesthesia process steps, etc.) from more than 100,000 surgical cases in its database. The database architecture is designed for easy scaling to the national MPOG database, which has well over 3 million cases. Accessing this database requires substantial affinity and familiarity with database tools to program advanced SQL queries etc. For many clinicians this represents a formidable barrier, preventing them from using this data to answer important clinical research questions. We will be developing a tool, which allows an initial visualization and navigation through the data, to detect patterns and do preliminary analyses. The software development will be undertaken by engineering and computer science graduate students. However, the design of this tool will need to incorporate the clinical perspective.

**Student Role:** The medical student, in collaboration with an engineering or computer science graduate student, will be developing the first one or two iterations of the visualization and navigation tool. This will involve familiarization with the database and its potential to answer clinical research questions, working with clinicians to understand how to design the visualization tool to support them best.

**Mentors:** Kai Kuck, Ph.D.

**Research Type:** Translational

**Project Topic:** Background: Right heart failure is a leading cause of mortality and morbidity in cardiac surgery patients. Early detection of RV failure will identify patients who may benefit from immediate interventions in the OR and ICU for treatment of elevated pulm

**Overview:** Intraoperative and ICU data collection of echo parameters of flow in the pulmonary artery. There is emerging evidence that rapid pulmonary artery acceleration time correlates with high pulmonary vascular resistance. Prior to bypass and early in the ICU admission we are measuring PAAT by TEE and TTE. We are also collecting PA catheter data on cardiac output, directly transduced PA pressure, CVP, and collecting data on vasoactive medications, ventilator settings, and ICU course. The ICU database is being used to track outcomes such as renal failure, prolonged ventilator dependency, need for mechanical circulatory support of the RV, and death.

**Student Role:** The FAER student will learn about the method to use Doppler ultrasound to measure flow in the pulmonary artery, and will participate in data collection of the pulmonary artery catheter parameters, patient demographics, inotropic and vasopressor support, and will be familiar with outcome data categories.
Preliminary analysis includes comparison of PAAT with pulmonary resistance and exploratory data analysis for novel markers of incipient RV failure, such as using a combination of PAAT and RV stroke volume instead of PAAT alone to identify patients with increased needs for RV support in the post-cardiac surgery ICU.

**Mentors:** Josh Zimmerman, M.D.; Matthew Griffee, M.D.

**Research Type:** Translational

**Project Topic:** Can we characterize and measure a biological substrate (biomarker) associated with major depressive disorder (MDD)? Unlike many medical disorders, functional disorders such as major depression are diagnosed primarily by subjective clinical criteria. No blood tests are available to characterize the disease or its treatment.

**Overview:** In this study we characterize the expression of selected genes on white blood cells (WBC) of patients in an effort to better understand and characterize MDD and its biological effects. Volunteer patients are enrolled in a clinical trial assessing the efficacy of a novel anesthetic therapy relative to electroconvulsive therapy (ECT) for the treatment of severe refractory depression. Baseline measurements will be compared with post-treatment and follow-up samples. Additionally, such information will prove useful to compare with that of CNS gene expression and WBC gene expression obtained from mice used in preclinical studies of treatment and mechanisms of effect of this and other novel treatments for depression.

**Student Role:** The medical student may participate in all phases of experimentation including: literature updates, participation in laboratory protocol development and group meetings, blood collection, preparation of and assay for gene expression using real time polymerase chain reaction, data analysis, interpretation, manuscript preparation and presentation.

**Mentors:** Scott Tadler, MD. This exciting project involves collaboration with Drs. Alan and Kathleen Light who recently published similar biomarker work as pertains to fibromyalgia and chronic fatigue syndrome and Dr. Howard Weeks of the Department of Psychiatry.

**Research Type:** Translational

**Project Topic:** What molecular receptors encode muscle fatigue and muscle pain caused by mild to ischemic muscle contraction? We are using RNASeq, calcium imaging, and advanced recording methods to determine the receptors involved.

**Overview:** In this study we will use RNAseq along with micro capture of physiologically identified sensory neurons from mice to determine which molecular receptors are expressed by muscle innervating sensory neurons. Once we know which receptors are expressed, we will determine the function by applying agonists and antagonists for these receptors in single fiber recording experiments in our own lab.

**Student Role:** The medical student may participate in all phases of experimentation including: literature updates, participation in laboratory protocol development and group meetings, cell collection, preparation of and assay for gene expression using next generation quantitative RNA sequencing, data analysis, interpretation, manuscript preparation and presentation.

**Mentors:** Alan R. Light, PhD. This project involves collaborations with exercise scientists here at University of Utah, and at the Salt Lake VA.
Research Type: Basic Science

Project Topic: Correlation of tricuspid annular measurements between awake transthoracic echocardiograms (TTE) and anesthetized transesophageal echocardiograms (TEE).

Overview: There is increasing recognition that tricuspid regurgitation and annular dilation identified at the time of left heart surgery (particularly mitral valve repair) is associated with subsequent development of right heart failure. Surgery for this late complication is associated with significant perioperative mortality and therefore appropriate measures should be undertaken to avoid development of postoperative tricuspid regurgitation. A preoperative TTE measurement of tricuspid annular dimension of 4.0 cm or above is an indication for tricuspid annuloplasty. The recommendation is specifically not to use intraoperative TEE measurements to make these important decisions. This is because no study has addressed the association between these two measurements.

Student Role: The student will identify prospective patients from the surgery schedule, participate in the consent process, and visit the OR when studies are performed by anesthesiology faculty. The student will participate in the measurement of preoperative and intraoperative tricuspid annular dimensions and the identification of the correlation between the values. The student will be responsible, with supervision, for collecting data, data entry and analysis, and manuscript preparation.

Mentors: Joshua Zimmerman, MD, FASE

Research Type: Clinical

Project Topic: Clinical validation of models to predict oxygen desaturation

Overview: We have built models that predict how fast people desaturate once apneic following induction of anesthesia. As you may know, some people desaturate really quickly while others can go for a long time. We've used physiologic models and pharmacologic models to predict how long patients won't breathe following induction and whether or not they will desaturate. We'd like to validate these models in real patients. This is a collaboration with our bioengineering department. They have considerable expertise in modeling pulmonary physiology and anesthetic drug behavior.

Student Role: Conduct a sensitivity analysis of the pulmonary models used to predict desaturation to identify high impact parameters on model predictions. Assist in conducting a clinical observation study to evaluate model predictions.

Mentors: Lara Brewer, PhD, and Ken Johnson, MD

Research Type: Translational

Project Topic: Does isoflurane anesthesia have an antidepressant effect equivalent to that of electroconvulsive therapy (ECT)? Do other anesthetics (e.g. ketamine, propofol) have similar effects? If so by what mechanisms and how can such therapy be optimized?

Overview: Preliminary clinical studies suggest that isoflurane has an antidepressant effect at least as effective as ECT without associated cognitive decline. Nevertheless the mechanism is little understood as are optimal dosing and treatment strategies. Pilot work in our laboratory used a mouse model to confirm this antidepressant effect and suggests a novel central nervous system mechanism. This ongoing preclinical
project is working to further elucidate mechanisms involved in this treatment as well as optimize therapy to facilitate successful clinical trial and implementation.

**Student Role:** The medical student will participate in all phases of experimentation including: literature review, successful experimental design and implementation to include: mouse behavioral studies, tissue procurement and dissection, preparation of and assay for gene expression using real time polymerase chain retain, imaging modalities, data analysis, interpretation, manuscript preparation and presentation.

**Mentors:** Scott Tadler, MD. This exciting project involves collaboration with Drs. Alan and Kathleen Light as well as members of the Department of Neurology.

**Research Type:** Clinical

**Project Topic:** Clinically Aligned Assessment of Pain (CAPA©) in a Computerized Adaptive Web-Based System

**Overview:** Clinically Aligned Assessment of Pain (CAPA©) was developed at the University of Utah as a more natural, conversation-based system for recording clinical states of pain, particularly as these relate to monitoring and management. This project will extend the framework by recruiting, via the Internet, a large convenience sample of volunteers who may be experiencing a wide range of pain types and magnitudes. The data from this sample will be analyzed by specialized psychometric procedures that assign numeric weights to the CAPA© response categories and underlying dimensions. This weighting can then be used by providers and researchers in future studies to score pain responses directly. The project will also provide a simple computerized adaptive scoring algorithm that will reduce the number of questions required interactively for rapid convergence to an accurate pain score.

**Student Role:** Under the supervision of Dr. Donaldson, the student will organize the website recruitment (three weeks), collect the response surveys (one week), and run the statistical software to produce the basic analyses (two weeks). In the final two weeks, the student will work interactively with Dr. Donaldson to interpret the findings, draft the simple adaptive scoring logic, and begin manuscript preparation. It is assumed that the student will be familiar with basic statistical concepts, but no advanced expertise is required. During the supervised training, Dr. Donaldson will provide the student with techniques and concepts needed to interpret the analytical findings.

**Mentors:** Gary Donaldson, Ph.D

**Research Type:** Translational

University of Vermont Medical Center

**Project Topic:** Are multiple exposures to surgery and anesthesia associated with diminished academic achievement testing?

We will attempt to determine if exposure to surgery and anesthesia on one or more occasions in the first four years of life is associated with posto

**Overview:** To examine the potential of postoperative cognitive dysfunction in young children exposed to anesthesia, we will search our anesthetic records for type of surgery, type of anesthesia exposure, duration of anesthesia exposure and number of anesthetic exposures in children under four. For each child exposed to surgery and anesthesia prior to the age of four, we will obtain education data from the Vermont Agency
on Education. Test data will be compared to a control group of students matched by age, gender and socioeconomic status.

**Student Role:** The student will conduct a review of patient medical records that date back 20+ years, extract data, and participate in data analysis.

**Mentors:** Emily Stebbins, MD

**Research Type:** Outcomes

**Project Topic:** Title: A Natural History of Perioperative Metabolism.

Altered metabolic function, especially hyperglycemia, has been associated with increased post-operative mortality. The stress response to surgery induces a hypermetabolic state which has been characterized.

**Overview:** We are conducting a cross-sectional study of metabolism in subjects undergoing spinal surgery. The study entails recruitment and obtaining of informed consent in pre-operative hold. Subjects will then have a dedicated peripheral IV placed for blood drawing. Samples will be drawn before, during, and after the surgical procedure. Clinical, laboratory, and anthropometric data will be collected from the medical record and intra-operative data will be collected from the anesthesia record. Blood samples will be assayed for glucose, insulin, c-peptide, and free fatty acids using standard enzymatic assays and enzyme-linked immunoassays. Metabolomic data will be derived from blood samples using mass spectrometry. The advantage of metabolomic assays is that they examine several hundred metabolites in each sample. This allows for study of metabolic patterns that may not have been previously understood using single analyte techniques.

**Student Role:** Assist the principal investigator and research staff with all aspects of clinical data collection: Recruitment of subjects, obtaining informed consent from subjects, collection of samples in the operating room, maintenance of IV lines, pipetting, centrifuging, and freezing samples in the lab, and ensuring that good clinical practice is followed, including required human subjects research practices.

**Mentors:** S. Patrick Bender, MD

**Research Type:** Clinical

**Project Topic:** Optimization of Perioperative Processes Using a Systems-based Approach

**Overview:** The ACGME requires that anesthesiology residents must demonstrate medical knowledge in practice management to address issues such as OR management, fiscal stewardship, and legislative and regulatory issues. Anesthesiology departments may find it difficult to incorporate these topics in educating future physicians. Our department has shown basic principles in OR management can be taught as part of a 3-year curriculum, including scheduling, accounting, and statistical process control. With our research efforts and collaboration with our institution's Center for Health Care Management, we have shown that we can teach medical students and residents in other specialties the same material. As future leaders of the Perioperative Surgical Home, anesthesiologists will need those management skills.

**Student Role:** The student will complete an 8-week health care delivery capstone project examining and implementing change in perioperative processes using a systems-based multidisciplinary approach. The student will have the opportunity to explore operational and tactical issues directly affecting patient care
and learn to understand the barriers and mechanisms to create change. The student will use a variety of resources to gather information, incorporate changes, and track outcomes, including database extraction tools and direct observation in anesthesia settings. Data will be abstracted from WiseOR and Extelligence, and analyzed and presented with Microsoft Excel.

**Mentors:** Mitchell Tsai, MD, MMM

**Research Type:** Health Services

**University of Washington**

**Project Topic:** Trends in anesthesia injury and liability using the ASA Closed Claims Project Database

**Overview:** The Closed Claims Project database has been funded since 1985 to improve patient safety and reduce liability. The project investigates closed anesthesia malpractice claims to identify patterns of injury related to anesthesia and strategies for prevention. The database contains detailed information on over 10,000 severe anesthetic injuries collected from liability insurers around the U.S. The project has resulted in over 25 manuscripts elucidating patterns of injuries during anesthesia and it is the most prominent safety project for the specialty of anesthesia.

**Student Role:** In consultation with mentors, choose focused clinical or liability issue for study, conduct literature review, identify important factors from the database to include in statistical analysis, review malpractice claim narrative summaries to identify additional factors to analyze, write and present scientific abstract of project results. Examples of possible topics include chronic pain management, bronchospasm, or complications associated with selected procedures or types of patients.

**Mentors:** Karen B. Domino, M.D.

Karen L. Posner, Ph.D.

**Research Type:** Outcomes

**Project Topic:** Internet Intervention for Pediatric Chronic Pain and Disability

**Overview:** The aim of this project is to evaluate the efficacy of an internet-based behavioral intervention in a randomized controlled trial involving a multicenter sample of 300 children and adolescents, ages 11 to 16 years, with chronic pain and their parents recruited from pain centers across the U.S. and Canada. Children (and their parents) are randomized to receive either internet behavioral intervention or internet patient education. Outcomes include pain, physical functioning, sleep, emotional functioning, service use, and parental behaviors.

**Student Role:** The student role would involve data entry, coding data, preliminary data analysis, and preparation of result summaries. There are opportunities to contribute to dissemination of findings in abstracts and manuscripts.

**Mentors:** Tonya M. Palermo, PhD

**Research Type:** Clinical

**Project Topic:** Cardiac Dysfunction after Traumatic Brain Injury
Overview: Using a prospective observational cohort study design, we will enroll patients with a diagnosis of traumatic brain injury. Transthoracic echocardiography (TTE) will be performed to assess systolic function, diastolic function, and myocardial strain on these patients. Furthermore, cardiac, catecholamine, and inflammatory biomarkers will be collected. Main outcomes are the incidence of cardiac dysfunction after TBI, the change in cardiac function over time, correlation of biomarker elevation and cardiac dysfunction, and impact of cardiac dysfunction on cerebral perfusion. Statistical analysis will be both descriptive and inferential.

Student Role: 1. Prospective data collection: Student (under direction of mentors) will assist in patient recruitment, data collection, and will be present for echocardiographic assessment of the patient in order to learn the principles of basic transthoracic echocardiography.

2. Learning: Student (under direction of mentors) will learn pathophysiology, principles of management, and active research questions in traumatic brain injury and neurocritical care. In addition, student will learn the basics of cardiac physiology/pathophysiology, with special emphasis on echocardiography.

3. Analysis: Student (under direction of mentors) will learn the principles of research design, methodology, and data analysis (using STATA software).

4. Poster and manuscript preparation: Student will have prepared a poster based on a subset of research findings for presentation at a national conference by the end of the summer. Student will assist research team in overall manuscript preparation.

Mentors: Vijay Krishnamoorthy, M.D.; Monica Vavilala, M.D.; G. Burkhard Mackensen, M.D., Ph.D.

Research Type: Clinical

Project Topic: Patient and Family Centered Definitions of Quality in Traumatic Brain Injury Care: A Pilot Study

Overview: The quality of acute care may impact long term outcomes of traumatic brain injury. The aims are to examine definitions of quality of care from the perspective of TBI patients and TBI caregivers. Semi-structured interviews will be conducted of TBI patients and their primary care giver who were discharged from Harborview Medical Center. Data will be examined for themes of quality in select domains: timeliness of provider responses, quality of physician communication, quality of nursing communication, and errors and response to medical errors. Open ended questions will administered to examine what care aspects are important to TBI patients in hospital and these themes will be analyzed using N Vivo software. Quantitative and qualitative methods will be used to examine data.

Student Role: The student will participate in patient recruitment, refining and administering a semi-structured interview and data analysis, as well as participating in work in progress sessions. It is expected that the student will be active in preparation of the final manuscript.

Mentors: Monica S. Vavilala, M.D.; Deepak Sharma, MBBS, DM

Research Type: Outcomes

Project Topic: Sleep, Cytokines and Infection
Overview: Infection negatively impacts mental health. Sleep is altered during infection. Whether altered sleep aids recovery is not known. The cytokines IL-1, TNF, and IL-6 are involved in sleep regulation and are upregulated during infection. We hypothesize that altered sleep during infection is mediated by cytokine actions in brain. We will use the clinically-relevant murine model of cecal ligation and puncture to induce sepsis. In this project we focus on the impact of sepsis on neurotransmitter systems and cytokines and their receptors in brain regions involved in sleep regulation. This information will provide the biologic basis for beginning to answer the question of whether or not altered sleep facilitates recovery from infection.

Student Role: The student will assist in processing tissue for immunohistochemical assessment of neurotransmitter identification, learn to process data to determine sleep-wake behavior from freely behaving animals, and assist in preparing summaries and/or abstracts.

Mentors: Mark R. Opp, Ph.D.

Research Type: Basic Science

University of Wisconsin

Project Topic: ANESTHETIC EFFECTS ON MORTALITY IN A DROSOPHILA MODEL OF POLYTRAUMA

Overview: An ongoing collaboration between Dr. Misha Perouansky MD (Dept. of Anesthesiology) and Dr. Wassarman PhD (Department of Genetics) investigates the effect of general anesthetics on the outcome of traumatic brain injury in a fruit fly model. Part of the project is oriented towards testing flies of various genetic backgrounds. In order to be able to compare anesthetic sensitivity between genetically different fly strains we are developing robust behavioral measures of anesthetic depth.

Student Role: The student would test one or more strains of flies with respect to one or more behavioral measures. Testing of one strain with one drug can be accomplished within two to three weeks.

In addition to conducting experiments, analyzing and graphically presenting the results, the student will be encouraged to familiarize her/himself with literature pertinent to models of anesthetic mechanisms, models of traumatic brain injury, non-canonical actions of anesthetic agents and with the potential of flies as genetically accessible models of human disease.

Mentors: Misha Perouansky, MD

Research Type: Basic Science

Project Topic: Title: Comparison of Use of a Shortened air-Q SP versus the Williams Intubating Airway for Single-Operator Flexible Bronchoscopic Intubation: A Randomized Trial

Overview: Despite the introduction of videolaryngoscopic devices, flexible bronchoscopic intubation remains a critical method for achieving tracheal intubation in patients with difficult airways. Unfortunately, FOI often requires two-operators for success. One operator is required to manipulate the flexible bronchoscope through the patient's upper airway and into their trachea, while the second operator applies one or more maneuvers with or without the use of a commercially-available fiberoptic intubating airway.
The air-Q SP is a commercially-available supraglottic airway (SGA) that can be used as a primary airway device or as a conduit for intubation. The purpose of this study is to compare a shortened version of the air-Q SP against the Williams airway for FOI requiring a single operator.

**Student Role:** For this study, the student would be involved in (1) subject screening, selection, and consent, (2) study equipment management, (3) data collection, (4) data analysis, and (5) abstract/manuscript preparation. Given the proposed inclusion/exclusion criteria of the study and sample size, the study enrollment with the help of the student should be able to be completed within 4-6 weeks.

**Mentors:** Rick Galgon, MD

**Research Type:** Clinical

**Project Topic:** Radiofrequency ablation of facial nerves on improvement of headache conditions

**Overview:** This will be a retrospective analysis to detect the efficacy of radiofrequency ablation of facial nerves on improvement of headache conditions. This is a very unique procedure with lack of enough literature to test efficacy of this treatment.

**Student Role:** ?

**Mentors:** Alaa Abd-Elsayed, MD MPH

**Research Type:** Clinical

**Project Topic:** Interdisciplinary Development of Perioperative Best Practices in Urology and Gynecology Oncology Surgery

**Overview:** The Department of Anesthesiology, Urology, and Gynecology are undertaking a collaborative effort to determine interdisciplinary “best practices” or clinical perioperative protocols for complex cancer operations. These best practice protocols will focus on preoperative workup, intraoperative management, and PACU treatment. It is hypothesized that standardization and uniformity in perioperative care of these patients will lead to improved communication and outcomes. Surgeries of focus include cystectomy, nephrectomy, hysterectomy, ovarian cancer debulking, and HIPEC chemotherapy.

**Student Role:** The student will perform an interdisciplinary literature review focusing on two of the surgeries listed above. Then, the student will collaborate with Gynecology and Urology colleagues to elucidate each specialty’s view on perioperative management and determine a preliminary draft of a best practice protocol. Retrospective chart review will be performed to collect data regarding key factors and outcomes in order to provide initial evidence for these collaborative “best practice” or clinical perioperative “protocols” of these complex cancer operations. The student will have the opportunity to prospectively collect data, observe, and track outcomes on patients having operations during the fellowship, leading to a robust clinical experience.

**Mentors:** Michael Trawicki, MD

**Research Type:** Clinical

**UT Southwestern Medical Center**

Overview: Pelvic robotic-assisted laparoscopic surgeries expose patients to hours of peritoneal cavity insufflation and steep head-down positioning that decrease lung compliance and result in higher positive pressures during mechanical ventilation. This significantly shifts fluids from the lower extremities and impairs venous return and lymphatic drainage from the head and neck, yielding facial edema and conjunctival edema. A reliable technique to quantify interstitial fluid accumulation in the facial soft tissues of these surgical patients is important for future research. Quantification of facial tissue edema may be used in studies of protocols for intraoperative fluid administration and might also guide intraoperative levels of bed tilt and abdominal insufflation. There are no prior studies of ultrasound to assess changes in facial soft tissue thicknesses during surgery. This will be a pilot study of ultrasound use to quantify degree of facial edema during robotic-assisted pelvic surgery.

Student Role: The student will consent and enroll study patients. The student will be trained to use ultrasound to measure the thickness of facial soft tissues and will participate in obtaining intraoperative ultrasound measurements during robotic-assisted pelvic procedures. The student will collect data on patient demographics, comorbidities and intraoperative events. The student will help author any scientific abstracts of study findings. Soft tissue thicknesses will be measured by high frequency ultrasound at several points of the face (glabella, nasion, inferior eye orbit, zygomatic) at baseline, immediately after induction of anesthesia, and again immediately before emergence from anesthesia (after abdominal deflation and leveling of the surgical table). Baseline and pre-emergence measurements will be compared. Correlation between tissue thickness changes and airway pressures, amount of intraoperative fluids, duration of abdominal insufflation, and degree of bed tilt are secondary end points.

Mentors: Eric B. Rosero, MD, MSc

Research Type: Clinical

Project Topic: Reliability of OR to ICU Care Transfers

Overview: One in every three hospitalized patients in the United States suffers an unintended or adverse event. Perioperative transfers-of-care (TOC) or “handovers” are high-risk, error-prone events known to contribute to patient harm. Although the Joint Commission, ACGME and AAMC have all mandated the development of a structured handover process; successful implementation of a program capable of reducing unintended postoperative events has yet to be identified. We have been funded by the University of Texas Healthcare System to perform a hybrid implementation-effectiveness trial in patients undergoing perioperative care transfers. Our hypothesis is that improvements in communication and team work will increase information transfer during handovers and reduce unintended postoperative events.

Student Role: The student’s role would be to work as a member of our handover project team by playing a leading role in one quality improvement (PDCA-Plan, Do, Check, Act) cycle. The student will attend a Quality Improvement & Safety (QIS) Boot Camp the 1st week of the rotation (conducted by the Office of QIS Education). These classes will provide the student with the quality improvement tools needed to complete their project. The student will review best practices, create process maps, perform stakeholder, cause and effect, and failure modes and effects analyses, deploy an intervention, collect and analyze data and prepare a poster and abstract for presentation.
Mentors: Philip E. Greilich, MD

Research Type: Clinical

Project Topic: Reducing Perioperative Erythrocyte Transfusion

Overview: Blood transfusions can be life saving, yet wide variation and inappropriate use (in up to 50% of transfusion decisions) has been identified by the Choosing Wisely campaign (AMA), Institute for Healthcare Improvement (IHI) and the Joint Commission (TJC) as a national patient safety priority. Cardiac surgery is the biggest consumer of blood products in most tertiary care centers and transfuse between 20-25% of all blood products. Our project team is using advanced quality improvement and process control strategies to reduce erythrocyte transfusions, adverse events and direct costs associated with cardiac surgery.

Student Role: The student’s role would be to work as a member of our reducing transfusion project team by playing a leading role in one quality improvement (PDCA-Plan, Do, Check, Act) cycle. The student will attend a Quality Improvement & Safety (QIS) Boot Camp the 1st week of the rotation (conducted by the Office of QIS Education). These classes will provide the student with the quality improvement tools needed to complete their project. The student will review best practices, create process maps, perform stakeholder, cause and effect, and failure modes and effects analyses, deploy an intervention, collect and analyze data and prepare a poster and abstract for presentation.

Mentors: Philip E. Greilich, MD

Research Type: Clinical

Vanderbilt University Medical Center Program

Project Topic: Organ Protection by Anesthetics and Other Drugs

Overview: Various compounds and drugs frequently used in the Operating Room have been shown to attenuate myocardial infarction from ischemia/reperfusion injury, while others have antagonizing, or even detrimental, effects. Altered mitochondrial function plays a key role in many of the associated signaling pathways. Numerous comorbidities and chronic medications for their treatment modify these effects further. In several different cell culture and animal models, our laboratory focuses on translationally relevant projects to improve survival following myocardial infarction, stroke and/or cardiac arrest.

Student Role: Student/s will be fully integrated and actively participate in current research projects including in- and ex-vivo models of myocardial and/or cerebral ischemia/reperfusion, tissue and cell preparation for molecular and biochemical analyses, and/or specific mitochondrial assays. Student/s will work with team members such as research technologists, graduate students, fellows, and junior faculty on a daily basis. Student/s will acquire all necessary technical skills for the summer project, and will be mentored on data collection and analysis, as well as scientific writing. Subsequent local and national poster presentations are encouraged. This focused basic science experience will be complemented by frequent opportunities to shadow anesthesiologists in different clinical environments and simulation, and to network at a first-class academic institution.

Mentors: Matthias L. Riess, MD, PhD, Professor of Anesthesiology and Pharmacology

Research Type: Basic Science
**Project Topic**: Anesthesia Informatics & Quality / Outcomes Assessment: Impact of Intraoperative Notifications

**Overview**: Impact of Intraoperative Notifications – Vanderbilt has been a leader in the area of anesthesia information management systems (AIMS) development for the past decade. GasChart, the AIMS component of the Vanderbilt Perioperative Information Management System (VPIMS), is part of an integrated system that covers the entire perioperative process and extends to include instrument and supply management, scheduling and status displays. Vigilance and VigiVU are applications that allow anesthesiologists and other clinicians to remotely view real-time video, vital signs, and the accumulating AIMS record via either a desktop or mobile device on up to four patients simultaneously. We are formally studying these in a systematic fashion to understand their operational, safety, and usability impact.

**Student Role**: The student will be responsible for formulating a specific research hypothesis (with the guidance of his/her mentor), creating a data request, and performing data analysis. No programming or computer skills are required as we have a highly functional engineering team which can provide ready access to electronic patient data. Statistical support is available through our team biostatistician should this be required.

**Mentors**: Jesse M. Ehrenfeld, MD, MPH / Jonathan P. Wanderer, MD, MPhil

**Research Type**: Outcomes

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**Project Topic**: The Epidemiology of Crime, Trauma, Weather Patterns, and Emergency Surgery

**Overview**: It has been previously demonstrated that there are clear relationships between weather patterns and crime. We also know that certain types of trauma appear to have seasonal variation that is also likely related to weather patterns. We therefore hypothesize that there may be important relationships between weather, crime, trauma, and the number of patients presenting for emergency surgery. We have available ten years of historical weather and emergency surgery data for analysis.

**Student Role**: The student will be responsible for formulating a data analysis plan, interfacing with our trauma surgical colleagues, and identifying target variables to ascertain whether a set of relationships exist between weather patterns and emergency surgical volume. After understanding these relationships, the student will perform an analysis to determine if these data can be used prospectively in combination with weather forecasts to help optimize operating room staffing. No programming or computer skills are required as we have a highly functional engineering team which can provide ready access to electronic patient data. Statistical support is available through our team biostatistician should this be required.

**Mentors**: Jesse M. Ehrenfeld, MD, MPH / Jonathan P. Wanderer, MD, MPhil

**Research Type**: Health Services

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**Project Topic**: Innovation: Predicting Difficult Airways From Patient Images

**Overview**: Airway assessment traditionally has been performed by analysis of a few facial characteristics which has resulted in imperfect bedside assessment of airway difficulty. Recently researchers have developed tools to perform advanced facial-morphometric analysis, but the performance of those tools is currently unknown. We have assembled a dataset of hundreds of preoperative patient airway images from our preoperative assessment clinic, along with patient data regarding actual intraoperative airway
management. We hypothesize that we can successfully use the preoperative patient airway images to predict a patient’s likelihood of having a difficult airway.

**Student Role:** The student will be responsible for analyzing patient images, formulating a data request, and participating / performing the statistical analysis. No programming or computer skills are required as we have a highly functional engineering team which can provide ready access to electronic patient data. Statistical support is available through our team biostatistician should this be required.

**Mentors:** Jesse M. Ehrenfeld, MD, MPH / Jonathan P. Wanderer, MD, MPhil

**Research Type:** Clinical

**Project Topic:** Practice Patterns: National Survey On Pre-Operative Clinic Evaluation Practice

**Overview:** Currently there appears to be wide national variation in which patients are assessed in a preoperative anesthesia clinic prior to surgery. Additionally there are multiple reimbursement models that have been implemented in preoperative anesthesia clinics, but the success of those models has never been quantified. Furthermore, with the advent of bundled care payment methodologies, it is unclear how preoperative clinics can best operate and provide value to patients, departments, and the healthcare system in the future. We plan to perform a survey of U.S. preoperative anesthesia clinics to determine their characteristics, approach to reimbursement, and plans for adapting to new models of care.

**Student Role:** The student will be responsible for developing the survey instrument, validating the questions and methodology, enrolling preoperative clinics, and participating / performing the statistical analysis. We have an online survey tool available for use, and no computer skills are required. Statistical support is available through our team biostatistician should this be required.

**Mentors:** Jesse M. Ehrenfeld, MD, MPH / Jonathan P. Wanderer, MD, MPhil

**Research Type:** Health Services

**Project Topic:** Assessing Teach Perspectives of Anesthesia Providers in an Academic Center

**Overview:** Clinical educators are being asked to articulate and reflect on their approach to teaching. In addition, the Accreditation Council for Graduate Medical Education (ACGME) requires residents to have formal education on the topic of "residents as teachers." The Teaching Perspective Inventory (TPI) is a 45-item inventory that assesses an individual's orientation to teaching based upon their beliefs, intentions, and actions. Very little data is published in the anesthesiology literature regarding clinical teaching perspectives. We plan to assess the individual teaching perspectives of faculty, certified nurse anesthetists, and residents in an academic anesthesiology department. Using the results of the TPI in conjunction with demographic data, we plan to assess similarities and differences within and between various anesthesia providers.

**Student Role:** The student will be responsible for developing the demographic survey instrument, validating the questions and methodology, and participating / performing the statistical analysis. We have an online survey tool available for use, and no computer skills are required. Statistical support is available through our team biostatistician should this be required. We also have a dedicated educational research coordinator to assist with the responsibilities.

**Mentors:** Amy Robertson, MD
**Research Type:** Educational

**Wake Forest Baptist Hospital**

**Project Topic:** Peripheral nerve blockade and intravenous dexamethasone dosing to evaluate duration of sensory blockade in inpatient total hip arthroplasty patients.

**Overview:** We have a study that is seeking to compare placebo to two different doses of intravenous dexamethasone in patients undergoing total hip arthroplasty. The aim is to determine the effect, if any, on duration of action of bupivacaine lumbar plexus nerve blockade in patients who receive intravenous dexamethasone as compared to randomized patients in the same group who have received only the nerve block without dexamethasone.

The procedure involves patients receiving a lumbar plexus nerve block and a spinal anesthetic for treatment of primary hip arthroplasty pain. Patients are followed postoperatively for up to 24 hours or until the nerve block is resolved by bi-hourly testing of skin sensation to sharp stimuli in the expected area of nerve block sensory changes. Other outcomes include incidence of opioid related side effects, pain scores, among other secondary endpoints.

**Student Role:** The student would be involved in enrolling patients, observing patients postoperatively for the effects of their nerve blockade, patient interviews acquiring pain scores, etc, recording data and if the study is completed, he or she may participate in the analysis of data and results.

The student will also have the opportunity to observe the function and roles of a regional anesthesiology and acute pain management service. Additional clinical opportunities to participate in clinical observation can be customized based on student interest. I.e, pediatric anesthesia, Obstetric anesthesiology, etc.

**Mentors:** Jonathan Douglas Jaffe, D.O.; Daryl Henshaw, MD; Sean Dobson, MD

**Research Type:** Clinical

**Project Topic:** Peripheral nerve blockade and perineural dexamethasone dosing to evaluate duration of sensory blockade in inpatient partial knee arthroplasty patients.

**Overview:** We have a study that is seeking to compare placebo to two different doses of perineural dexamethasone in patients undergoing partial knee arthroplasty. The aim is to determine the effect, if any, on duration of action of bupivacaine adductor canal nerve blockade in patients who receive perineural dexamethasone as compared to randomized patients in the same group who have received only the nerve blockade without dexamethasone.

The procedure involves patients receiving an adductor canal nerve block and a spinal anesthetic for treatment of primary partial knee arthroplasty pain. Patients are followed postoperatively for up to 24 hours or until the nerve block is resolved by bi-hourly testing of skin sensation to sharp stimuli in the expected area of nerve block sensory changes. Other outcomes include incidence of opioid related side effects, pain scores, among other secondary endpoints.

**Student Role:** The student would be involved in enrolling patients, observing patients postoperatively for the effects of their nerve blockade, patient interviews acquiring pain scores, etc, recording data and if the study is completed, he or she may participate in the analysis of data and results.
The student will also have the opportunity to observe the function and roles of a regional anesthesiology and acute pain management service. Additional clinical opportunities to participate in clinical observation can be customized based on student interest. I.e, pediatric anesthesia, Obstetric anesthesiology, etc.

**Mentors:** Jonathan Douglas Jaffe, D.O.; Daryl Henshaw, MD; Robert Weller, MD; Sean Dobson, MD; Jon Wellington Reynolds, MD

**Research Type:** Clinical

**Project Topic:** Outcomes research focused on perioperative care, including intraoperative awareness, long term psychological consequences of intraoperative awareness and of surgery, postoperative delirium and cognitive alteration, and postoperative medium-term outcomes

**Overview:** His research group completed two large, randomized clinical trials evaluating interventions including targeted education, structured protocols and automated intraoperative alerts. The studies advanced patient care by demonstrating effective interventions to decrease intraoperative awareness and identify risk factors for awareness and perioperative factors associated with adverse postoperative outcomes. Plans are for a large multi-center trial to investigate the potential of low dose ketamine to reduce postoperative delirium and acute pain. In collaboration with colleagues in the ADRC at WU, his research group found that surgery did not appear to be associated with accelerated cognitive decline or increased incident dementia. As Director of INQUIRI, he plans to improve the care and outcomes of surgical patients at WU through implementation of evidence-based best practices. INQUIRI is enrolling all surgical patients in a study to track health and well being up to 1-year postoperatively.

**Student Role:** Participate in outcomes-focused clinical research projects; lead a small project that can be accomplished during the summer.

**Mentors:** Michael Avidan, MD, MBBCh, Professor of Anesthesiology, Professor of Cardiothoracic Surgery, Chief Division of Cardiothoracic Anesthesiology and Cardiothoracic Intensive Care, and Director of the Institute of Quality Improvement, Research, and Informatics

**Research Type:** Outcomes

**Project Topic:** Sepsis.

Approximately 20 percent of septic patients present with hypothermia, rather than fever, at the onset of infection. These patients have twice the mortality of non-hypothermic patients, but there is limited data as to why these patients have worse outcomes.

**Overview:** We are performing a prospective clinical study to examine the immunological phenotypes of critically ill septic patients who present with and without hypothermia and to determine whether hypothermic septic patients have increased susceptibility to opportunistic infections and reactivation of latent viruses. We identify critically ill septic patients who present with and without hypothermia and measure cell surface receptor expression and cytokine secretion serially throughout the septic course. We also monitor the patients for acquisition of opportunistic infections and measure serial blood levels of commonly reactivated viruses.
**Student Role:** The student involved in this project would help screen the patient censuses of the medical and surgical ICUs to identify appropriate patients for inclusion and would approach patients and families to obtain consent for participation. The student would also assist with data collection from the electronic medical record and enter data into an online data management system. The student would also have the opportunity to observe and/or participate in performing cytokine secretion assays in the research laboratory.

**Mentors:** Anne M. Drewry, MD; Assistant Professor of Anesthesiology

**Research Type:** Clinical

**Project Topic:** Identification of sites to which anesthetics bind to produce their effects, with the particular focus on the protein chemistry of GABA-A receptors to identify and characterize drug binding sites.

**Overview:** The lab focuses on protein chemistry of GABA-A receptors to identify and characterize drug binding sites, sequence variants and post-translational modifications as well as define the protein complexes in which GABA-A receptors reside in vivo. His focus is on anesthetic neurosteroids, using neurosteroid analogue photolabeling reagents to label protein binding sites and identify sites of incorporation by protein mass spect. The lab pioneered methods for mass spect methods to sequence the transmembrane segments of native GABA-A receptor from picomole quantities of protein. Current directions include: Studies of dynamic regulation of protein phosphorylation in native brain using global mass spect techniques; and identification of GABA-A receptor-associated proteins in brain using immune purification coupled to mass spect with label-free quantitation. His clinical studies have been primarily focused on the incidence and detection of intraoperative awareness and on postop cognitive dysfunction.

**Student Role:** Participate in basic science research projects in the area of protein chemistry; lead a small project that can be accomplished during the summer.

**Mentors:** Alex Evers, M.D. is Henry Mallinckrodt Professor and Head of Anesthesiology, Professor of Medicine, Professor of Developmental Biology, and a DBBS faculty member in the Computational/Molecular Biophysics and Neurosciences Programs. Dr. Evers is also a mem

**Research Type:** Basic Science

**Project Topic:** Identify molecular targets for the development of new classes of pain relieving medications.

**Overview:** The lab is interested in determining the cellular and molecular changes that underlie the development of chronic pain conditions. Little progress has been made in the development of new types of medications to treat chronic pain. The lab utilizes a combination of behavioral studies, patch clamp electrophysiology, optogenetic, molecular and genetic approaches to understand the signaling pathways involved in nervous system plasticity that underlies pain sensitization. The goal is to identify molecular targets for the development of new classes of pain relieving medications. In collaboration with the Kharasch lab, ongoing clinical studies are aimed at translating findings from the Gereau lab into novel analgesic therapies for patients with pain. Active protocols include comparative studies of human physiology to preclinical models, as well as healthy human volunteer studies aimed at establishing proof of concept for novel analgesic therapies based on Gereau lab preclinical work.

**Student Role:** Participate in translational or basic research projects in the area of pain research; lead a small project that can be accomplished during the summer.
**Mentors:** Robert Gereau, Ph.D.  Professor of Anesthesiology, Professor of Anatomy and Neurobiology, Director of the Washington University Pain Center, and a DBBS faculty member in the Neurosciences and Molecular Cell Biology Programs.

**Research Type:** Translational

**Project Topic:** Defining new methods for the treatment of sepsis, a highly lethal disorder which occurs during severe overwhelming infection

**Overview:** The laboratory is defining new methods for the treatment of sepsis. Sepsis is the host response that occurs due to the presence of bacteria and/or their products within the bloodstream. His lab was one of the first to show sepsis-induced apoptosis of immune effector cells is a major cause of immunosuppression in sepsis. The lab has concentrated on identifying mechanisms of cell death in sepsis in rodent models and developing therapies to prevent this critical pathologic event and reverse immunosuppression. The current therapeutic approach includes administration of the pleuripotent cytokine IL-7 and modulation of negative co-stimulatory pathways that induce immunosuppression. One focus of the lab is on studies to help advance IL-7 and/or anti-PD-1 antibody into clinical trials in sepsis as rapidly as possible. Both drugs are in advanced clinical trials for other indications and could be approved for clinical use within 2 years which would greatly facilitate testing in septic patients.

**Student Role:** Participate in clinical/translational research projects; lead a small project that can be accomplished during the summer both in the laboratory or ICU.

**Mentors:** Richard Hotchkiss, M.D., Professor of Anesthesiology, Professor of Internal Medicine, and Professor of Developmental Biology

**Research Type:** Translational

**Project Topic:** Improve the use of opioids to treat cancer pain and drug abuse.

**Overview:** The goal is to understand the mechanisms of interindividual variability in the therapeutic response to anesthetic and nonanesthetic drugs, focusing on pharmacokinetics, pharmacodynamics and toxicity. Efforts focus on optimizing drug disposition, drug safety, clinical efficacy, patient satisfaction, and pharmaco-economics. Research encompasses laboratory investigations of drug metabolism using human tissues and enzymes, and clinical volunteer and patient studies to confirm laboratory findings. One major project addresses mechanisms of interindividual variability in opioid disposition and response, specifically with respect to hepatic and extra-hepatic metabolism, pharmacogenetic variation, stereochemistry, age and gender effects, drug interactions and dietary influences. In vitro models of opioid metabolism use human liver, intestinal and renal tissue to identify responsible P450s, and in vivo studies deliberately manipulate P450 activities to assess pharmacokinetic and pharmacodynamic consequences.

**Student Role:** Participate in prospective clinical research projects; lead a small project that can be accomplished during the summer.

**Mentors:** Evan Kharasch, M.D., Ph.D. is the Russell D. and Mary B. Shelden Professor of Anesthesiology, Chief of the Division of Clinical and Translational Research, Professor of Biochemistry/Molecular Biophysics, and a DBBS faculty member in the Biochemistry Program.

**Research Type:** Translational
**Project Topic**: A Simulation Based Curriculum for Cardiovascular and Respiratory Physiology

**Overview**: The simulation initiative at WUSM includes a number of simulation centers working collaboratively and engaged in all aspects of experiential learning for health care professionals. The number of simulation centers and programs have grown to include 4 centers (Saigh Peds Simulation Center, Surgical Skills Lab, Barnes Anes Simulation Center and the Howard & Joyce Wood Simulation Center). The primary research interest is the development of assessment methods that reflect skills essential for health care professional practice. The project goal is to develop a prospective competence standard used to judge the ‘readiness’ of health care professionals to make decisions in an ICU setting. The approach builds upon prior research and uses simulation and a standard-setting methodology to determine competence. The goals are to develop new scenarios and refine previously designed critical care training scenarios that will be used to assess interns, fellows and critical care nurse practitioners.

**Student Role**: Participate in simulation-oriented research projects; lead a small project that can be accomplished during the summer.

**Mentors**: David J Murray, M.D. Professor of Anesthesiology Carol B. and Jerome T. Loeb Professor, Director, Howard & Joyce Wood Simulation Center, Washington University School of Medicine

**Research Type**: Clinical

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**Project Topic**: Perioperative Myocardial Infarction

**Overview**: The research focus of Dr. Nagele’s group is on perioperative myocardial infarction. We pursue both mechanistic studies (how does periop. MI develop? What are the triggers?) as well as prospective clinical trials with the aim to lower the risk for periop. MI. We are very interested in the role of novel cardiac biomarkers such as high-sensitivity cardiac troponins and NT-proBNP in the prediction and risk stratification of patients. We are exploring innovative approaches in the area of periop. MI risk reduction, such as improved beta-blocker use, and other novel methods. Furthermore, we are interested in the role of pharmacogenetics in perioperative medicine and have several projects in this area.

**Student Role**: Participate in clinical research projects; lead a small project that can be accomplished during the summer.

**Mentors**: Peter Nagele, M.D., M.Sc. Clinical Investigation, M.Sc. Genetic Epidemiology, Assistant Professor of Anesthesiology, Assistant Professor of Genetics, and a DBBS faculty member in the Human and Statistical Genetics Program

**Research Type**: Clinical

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**Project Topic**: The Bruchas lab focuses on the genetic, pharmacological, and behavioral dissection of G-protein coupled receptor signal transduction in pain and neuropsychiatric disorders

**Overview**: 1. Neuropeptide and monoamine interactions in stress-induced anxiety, depression, and drug seeking

2. GPCR functional selectivity and signal transduction in pain, stress, and motivated behavior

3. Stress, kappa-opioids, and the modulation of reward
4. Developing and engineering novel tools to dissect neural circuits in affective behaviors and pain

**Student Role:** Participate in translational or basic research projects; lead a small project that can be accomplished during the summer.

**Mentors:** Michael Bruchas, PhD; Assistant Professor of Anesthesiology

**Research Type:** Basic Science

**Yale-New Haven Medical Center Program**

**Project Topic:** Vascular Regeneration in Vitro

**Overview:** This project studies the growth and remodeling of tissue engineered vessels that are cultured from differentiated vascular cells. The impact of discrete physical cues, growth factors, and cell source are studied for their impact on graft mechanics in vitro and host cell remodeling in vivo.

**Student Role:** Perform experiments in cell biology, biochemistry, and molecular biology to study events involved in vascular regeneration from differentiated and precursor cells in vitro.

**Mentors:** Laura E. Niklason MD, PhD - Professor & Vice Chair, Anesthesiology

**Research Type:** Translational

**Project Topic:** Detection of Gaseous Microbemoboli during adult ECMO.

**Overview:** Despite various improvements in extracorporeal circulation technology, numerous gaseous microemboli (GME) are still delivered to patients during cardiopulmonary bypass. Their role in ECMO is still undefined. In this observational study, we are attempting to quantify the number, size, and determinants of GME loads in adults being treated with ECMO.

**Student Role:** Recruitment, data collection, and analysis.

**Mentors:** Robert Brian Schonberger, MD - Assistant Professor, Anesthesiology

**Research Type:** Translational

**Project Topic:** Noninvasive Monitoring of Cardiovascular Waveforms

**Overview:** Assessment of cardiovascular status during surgery is a growing field, with an overarching goal of obtaining more patient information using less invasive means. Our laboratory is using advanced signal acquisition and data processing techniques on signals obtained from the pulse oximeter and the peripheral venous canula to glean information regarding patient volume status.

**Student Role:** Participate actively in studies of autonomic reactivity in patients and controls, as well as the non-invasive assessment of intravascular volume status.

**Mentors:** Kirk Shelley MD, PhD - Professor, Anesthesiology

**Research Type:** Clinical

**Project Topic:** Assessment of Pain Mechanisms
**Overview:** Peripheral nerve sensation of pain is complex, with multi-factorial influences such as co-stimuli, inflammation, and learning all impacting pain outcome. Our laboratory focuses on the basic mechanisms of pain signaling in peripheral and dorsal root ganglion neurons, to increase our understanding of acute and chronic pain syndromes.

**Student Role:** Participate in laboratory assessments of pain mechanisms in animals and humans, and study means of pain modulation.

**Mentors:** Robert LaMotte PhD - Professor, Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Assessment of Mechanisms of Cutaneous Itch

**Overview:** Cutaneous itch is an under-studied phenomenon that is associated with substantial discomfort and morbidity in some cases. Our laboratory is working as part of a consortium of investigators to tease out basic events that occur in the sensation and transduction of cutaneous itch.

**Student Role:** Participate in human and basic biochemical studies of the mechanisms of sensation of itch, and in the modulation of pathologies resulting in chronic sensation of itch.

**Mentors:** Robert LaMotte PhD - Professor, Anesthesiology

**Research Type:** Basic Science

**Project Topic:** Evaluation of safety and efficacy of antithrombin for preventing thrombosis in VAD patients

**Overview:** Antithrombin III is a natural anti-coagulant that works by activating endogenous heparin moieties to prevent the progression of the coagulation cascade. When complex with heparin, antithrombin III binds and inactivates both thrombin and factor Xa. This study will look at the efficacy of antithrombin III administration in the prevention of thrombosis in patients receiving ventricular assist devices (VADs). Antithrombin III is administered peri-operatively to patients enrolled in the study, and thrombotic events intra-operatively and post-operatively are tallied. Safety and effectiveness of the drug will be studied.

**Student Role:** Students will participate in various aspects of the clinical research, including patient recruitment and consent, and evaluation of medical records. In addition, students will assist in data collection and collation, as well as analysis in collaboration with statistical experts.

**Mentors:** Manuel Lopes Fontes MD - Professor, Anesthesiology

**Research Type:** Clinical

**Project Topic:** Studies of Neuroscience of Alcoholism

**Overview:** Alcoholism and other substance abuse disorders are often linked to abnormal cognitive behaviors and to alterations in brain function. We are utilizing magnetic resonance imaging techniques to examine the brain function and metabolism in patients with a history of alcohol abuse, as compared to normal subjects.
**Student Role:** Participate in clinical studies of alcoholic patients within the VA medical system, assist with imaging of brains of affected patients to understand neurocognitive abnormalities.

**Mentors:** Albert Perrino MD - Professor, Anesthesiology

**Research Type:** Clinical

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**Project Topic:** Peer-review model of quality of care in Anesthesia.

**Overview:** Measurement of performance and quality outcomes in Anesthesia is difficult and has not been implemented in most academic medical centers across the US. By quantifying quality of care and outcomes, we can provide guidance on how to improve physician care, and we can measure improvements over time and across centers.

**Student Role:** Medical students participating in this project will work with Dr. Lagasse on implementing a structured peer review model for subspecialty care in the Department of Anesthesiology, measure performance through statistical process control of adverse outcomes, analyze causal factors of adverse events, coordinate performance improvement through systematic changes, and quantify the effects of those system changes through continuous monitoring.

**Mentors:** Robert LaGasse MD - Associate Professor, Anesthesiology

**Research Type:** Outcomes
Institution: University of Alabama at Birmingham

Project Topic: Preliminary Validation of Checklists for Clinical Skills Teaching and Assessment

Overview: Dr. Riesenberg is the Director of Medical Education Outcomes and Research for UAB Department of Anesthesiology and Perioperative Medicine. She works directly with the residency education leadership. She has numerous projects:

- Anesthesiology Patient Handoffs—Implementation, assessment, and outcomes of several novel patient handoffs research projects
- Systematic Reviews of the Literature—Conduct of several systematic reviews of the literature on anesthesiology topics and medical education topics
- Implementation and Assessment of several Quality Improvement projects within the department

Student Role: The student would join a dedicated and enthusiastic team of researchers (including other medical students, residents and faculty). Teams meet at least weekly and include diverse collaboration efforts both in and outside of UAB. All projects to date have resulted in peer reviewed submission, publication and/or presentation. The student could join an existing team or lead a time with facilitation of his/her leadership skills.

Mentors: Lee Ann Riesenberg, Ph.D., R.N., C.M.Q., Director of Medical Education Outcomes & Research, Associate Professor

Research Type: Outcomes

Institution: University of Iowa

Project Topic: Effect of high dose Remifentanil on inflammation, endocrine stress response & coagulation profile compared to Fentanyl in elective cardiac surgery.

Opioids are routinely used in cardiac surgery to minimize the stress response and to avoid significant hemo

Overview: Our long-term goal is to determine whether high-dose remifentanil during CPB will shorten recovery time of cardiac surgical patients, and have beneficial effects on blood glucose, coagulation profile etc. To prepare for the planned definitive trial, we need to gather a sufficient body of preliminary data to aid us in a) determining whether there appears to a remifentanil effect, and if so, at what doses, and thereby b) permit us to define study doses and calculate sample sizes for the trial. We therefore intend to conduct prospective RCT pilot study in 20 patients in eligible adult cardiac surgical cases requiring CPB. We will attempt to establish the relationships between the use of remifentanil and suppression of inflammation as well as effective control of blood glucose irrespective of cardioplegia dose. Results from this pilot will be used to apply for external funding to support a larger clinical trial.

Student Role: With the mentor, the student will participate in enrolling eligible patients and data gathering. The student will understand the pathophysiology of CPB. After gathering adequate data student will get an
opportunity to perform common statistical methods and coordinate with mentor in preparing manuscript as well as abstract submission in the major meetings. The student will understand the limitations of a pilot study.

**Mentors:** Sudhakar Subramani, MD

**Research Type:** Clinical