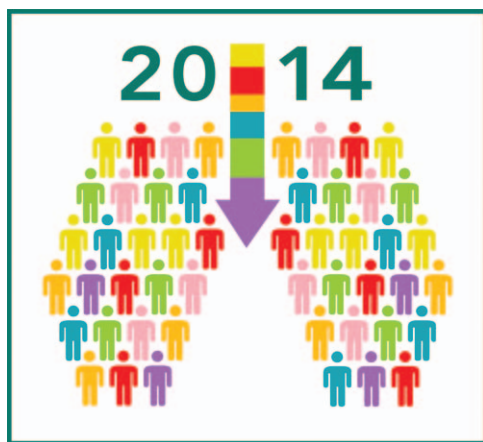


# Journal-related Activities and Other Special Activities at the 2014 American Society of Anesthesiologists Annual Meeting

Michael J. Avram, Ph.D., Jeanine P. Wiener-Kronish, M.D., Jerrold H. Levy, M.D., James P. Rathmell, M.D., James C. Eisenach, M.D.



## 23rd Annual Journal Symposium: Mechanical Ventilation

**Tuesday, October 14, 2014, 8:00 AM to 11:00 AM, Morial Convention Center, Room 275–277**

This year *ANESTHESIOLOGY* will sponsor three sessions at the Annual Meeting of the American Society of Anesthesiologists (ASA). The 2014 Journal Symposium will highlight up-and-coming and noteworthy concepts in anesthesia research and clinical practice. The title of the 2014 Journal Symposium is, “How to Mechanically Ventilate Patients in the Operating Room in 2014,” and will feature the following moderators and speakers:

### Moderators

Jeanine Wiener-Kronish, M.D., Anesthetist-in-Chief, Massachusetts General Hospital, Henry Isaiah Dorr Professor, Harvard Medical School; and Jean-Francois Pittet, M.D., Professor of Anesthesia, University of Alabama, Birmingham.

### Speakers

1. **Mechanistic basis for protective intraoperative mechanical ventilation**  
Marcos F. Vidal Melo, M.D., Ph.D., Associate Anesthetist, Massachusetts General Hospital; Associate Professor of Anesthesia, Harvard Medical School
2. **Intraoperative ventilation practices and quality improvement**  
Ana Fernandez-Bustamante, M.D., Ph.D., Assistant Professor of Anesthesiology, University of Colorado School of Medicine
3. **Protective Ventilation during general anesthesia: the PROVHILO Trial**  
Paolo Pelosi, M.D., Professor of Anesthesiology, University of Genoa, Genoa, Italy

### Description

There are increasing data documenting improved outcomes in surgical patients without preexisting lung injury, who are ventilated with protective ventilatory strategies. In a recent meta-analysis, patients without the acute respiratory distress syndrome receiving lower tidal volumes (TVs) had a significantly lower incidence of pulmonary infection, hospital length of stay, lung injury, and mortality<sup>1</sup>. Intraoperative positive end-expiratory pressure (PEEP) settings could play a substantial role in preventing those postoperative complications<sup>2</sup>. Data are still conflicting on the role of intraoperative  $\text{FiO}_2$  on surgical site infection<sup>3</sup>. Should all patients be ventilated with lower TV, higher PEEP, and lower  $\text{FiO}_2$ ? Should intraoperative TV and plateau pressure become quality measures? How should anesthesiologists individualize mechanical ventilation in an increasingly complex patient population?

Three experts will introduce these topics for the first 90 min of the symposium; with 20 min presentations and 10 min

The figure was recreated by Annemarie B. Johnson, C.M.I., Medical Illustrator, Vivo Visuals, Winston-Salem, North Carolina.

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discussions. The speakers will discuss the recent evidence for the effects of protective ventilation on postoperative outcomes in surgical patients, including the data from the PROVHILO international trial, and the issues with the implementation of protective ventilatory strategies into clinical practice.

These lectures will be followed by the oral presentations of 12 abstracts, summarized below, that were selected for their relevance to the Symposium topic. The full text for each abstract can be found at the ASA abstract Web site.

### JS01

**“Effect of Anesthesia Type on Postoperative Mortality and Morbidities”** by Nahel N. Saied, M.B., Ch.B., Liza M. Weavind, M.B., Ch.B., M.D., Mohammad A. Helwani, M.D., Xue Han, M.S., M.P.H., Matthew Shotwell, Ph.D., Pratik Pandharipande, M.D., Vanderbilt University, Nashville, TN. The authors performed a large retrospective National Surgical Quality Improvement Program-based study to examine whether the use of regional anesthesia is associated lower postoperative mortality and morbidities after adjusting for surgical procedure, clinical, and demographic confounders compared with general anesthesia. In 680,000+ elective surgical procedures, regional anesthesia cases showed a 46% lower adjusted incidence of 30-day postoperative mortality (odds ratio, 0.54) and 40% lower incidence of major postoperative complications (stroke, respiratory, and renal complications) (odds ratio, 0.60) than cases performed with general anesthesia. The incidence of intraoperative complications and perioperative deep venous thrombosis, pulmonary embolus, myocardial infarction, and peripheral nerve injury were similar for both anesthetic types.

### JS02

**“Factors that Correlate with the Decision to Delay Extubation after General Surgery”** by Zirka Anastasian, M.D., Minjae Kim, M.D., Eric J. Heyer, M.D., Ph.D., Kaitlin G Van Mallon, B.A., Mitchell F. Berman, M.D., Columbia University, New York, NY. In this single-center retrospective study of approximately 32,500 records, the authors analyzed several factors associated with a decision to delay extubation at the end of general noncardiac surgery. Delayed extubation occurred in 7.1% of patients. Factors associated with a delayed extubation were ASA class, emergency condition, procedure duration, estimated blood loss, the case end time, patient age, difficult intubation, and the number of attendings involved. Crystalloid volume, weekend surgery, and nonsupine positions were not associated with delayed extubation.

### JS03

**“The Role of Tissue Oxygen Saturation (Sto<sub>2</sub>) Monitoring in Cardiac Surgery”** by Khalil Jabbour, Sr., Eliane Khalil, Fadia Haddad, Hicham Jabbour, Gemma Hayek, Samia Madi-Jebara, Anesthesiology and Critical Care, Hôtel-Dieu de France Hospital, Saint-Joseph University, Beirut, Lebanon. The authors investigated tissue oxygenation in the tenar eminence (Sto<sub>2</sub>) in 45 patients undergoing

elective coronary surgery with cardiopulmonary bypass (CPB) and its correlation with the mixed venous oxygen saturation (Svo<sub>2</sub>). Sto<sub>2</sub> measurements taken in the perioperative period were stable and did not correlate with Svo<sub>2</sub> during relevant intra- and postoperative events: anemia (hemoglobin <10 g/dl), hypotension (systolic pressure <80 mmHg), low cardiac output (CI <2l min<sup>-1</sup> m<sup>-2</sup>), atrial fibrillation or flutter, hypoxia (Sao<sub>2</sub> <95% or Pao<sub>2</sub> <80 mmHg), and temperature greater than 38.5°C. The value of Sto<sub>2</sub> as a measure of relevant tissue oxygenation in the perioperative period of coronary surgery awaits further confirmation.

### JS04

**“Intraoperative TV Trends and Practice Patterns: A Report From the Multicenter Perioperative Outcomes Group”** by S. Patrick Bender, Lyle P. Gerety, W. Gabe Tharp, William C. Paganelli, Amy Shanks, Randal S. Blank, Douglas Colquhoun, Ana Fernandez-Bustamante, Sachin Khetarpal, University of Vermont/Fletcher Allen Health Care, Burlington, VT; University of Michigan, Ann Arbor, MI; University of Virginia Health System, Charlottesville, VA; University of Colorado Hospital, Aurora, CO. In this multicenter, retrospective, observational study, the authors described current trends and practice patterns of intraoperative TVs. Data on more than 198,000 cases during general anesthesia with endotracheal intubation from nine U.S. medical centers between 2007 and 2013 demonstrate an average trend to lower initial and median intraoperative TV settings (ml/kg). TV settings in women, obese patients, and those with height less than 165 cm were larger than those in the general population, identifying a potentially at-risk group. Although the percentage of patients receiving high TV (>10 ml/kg) has decreased from 2007 (29%) to 2013 (18%,  $P < 0.001$ ), it is still substantial.

### JS05

**“Effects of One-lung Ventilation (OLV) and Positional Changes on Exhalation Enthalpy”** by Bonny M. Lee, M.D., David Rose, C.R.N.A., Ph.D., Igor Brodtkin, M.D., Neal W. Fleming, M.D., Ph.D., Anesthesiology and Pain Medicine, UC Davis Med Ctr, Sacramento, CA; Anesthesiology, University of British Columbia, Vancouver, BC, Canada. The Authors investigated changes in exhalation enthalpy, exhaled heat content, a possible indicator of cardiac function, using VQm (Rostrum Medical Innovations, Vancouver, Canada) during OLV and associated positional changes. In a prospective nonblinded nonrandomized study in 10 patients, they found that enthalpy was higher during lateral OLV compared with lateral total lung ventilation or supine total lung ventilation. These data support the hypothesis that lateral OLV improves V/Q matching.

### JS06

**“Alterations of Respiratory Mechanics in a Model of Prolonged Protective Mechanical Ventilation”** by Margit V. Szabari, M.D., Luiz Fernando R. Falcao, M.D., Ph.D.,

**Joseph J. Locascio, Ph.D., Guido Musch, M.D., Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital/Harvard Medical School, Boston, MA; Federal University of São Paulo, São Paulo, Brazil; Department of Neurology, Massachusetts General Hospital/Harvard Medical School, Boston, MA.** In this experimental study in mice, the authors investigated whether protective ventilation leads to alterations of lung mechanics when applied over long time scales. Respiratory mechanics (inspiratory capacity, hysteresis, and tissue elastance [H] with the forced oscillation technique) was measured hourly in mice allocated to two groups: protective ( $V_t = 6$  to  $8$  ml/kg, respiratory rate [RR] =  $180 \text{ min}^{-1}$ ,  $n = 10$ ) or injurious. The injurious group was further divided into two subgroups according to different TVs: inj 15 ( $V_t = 15$  ml/kg, RR =  $80 \text{ min}^{-1}$ ,  $n = 7$ ) and inj 20 ( $V_t = 20$  ml/kg, RR =  $52 \text{ min}^{-1}$ ,  $n = 5$ ). Ventilation with  $\text{FIO}_2 = 50\%$  and PEEP =  $2 \text{ cm H}_2\text{O}$  was continued for 16 h or until the mouse died. A recruitment maneuver was performed every 5 min. They found that in a long-term protective mechanical ventilation mouse model, H increased combined with higher hysteresis but normal inspiratory capacity, suggesting the development of reversible atelectasis. In the injurious group, the increase in H and decrease in inspiratory capacity suggest instead parenchymal injury.

#### JS07

**“Intraoperative Protective Mechanical Ventilation and Risk of Postoperative Pulmonary Complications” by Karim Ladha, Marcos F. Vidal Melo, Duncan J. McLean, Arina Igumenshcheva, Tobias Kurth, and Matthias Eikermann, Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA, and Team Neuroepidemiology, Inserm Research Center for Epidemiology and Biostatistics, Bordeaux, France.** The authors examined whether lung-protective ventilation that has gained widespread acceptance in the intensive care unit would also be protective during surgical procedures performed on noncardiac surgical patients who underwent general anesthesia at a tertiary care center. A total of 44,026 patients were included of which 21,219 (48.2%) received protective ventilation (defined as median PEEP of  $\geq 5 \text{ cm H}_2\text{O}$ , a median TV of  $<10$  ml/kg of predicted body weight, and a median plateau pressure of  $<30 \text{ cm H}_2\text{O}$ ) and 22,807 (51.8%) received nonprotective ventilation intraoperatively. The authors found that protective intraoperative ventilation was associated with a decreased risk of postoperative pulmonary complications. A TV of less than  $8.5$  ml/kg predicted body weight and a low plateau pressure minimized the risk of ventilator-associated major postoperative pulmonary complications.

#### JS08

**“Exaggerated Acute Lung Injury in Response to Infection in the Metabolic Syndrome” by Xiaomei Feng, Judith Hellman, and Mervyn Maze, Department of Anesthesia and Perioperative Care, University of California,**

**San Francisco, San Francisco, CA.** The authors examined whether the presence of a metabolic syndrome state could exacerbate lung response to injury because of an attenuation in the inflammation-resolving response as well as deleterious effects on antimicrobial defenses in rats. The authors found that after *Staphylococcus aureus* infection, rats with a metabolic syndrome had higher level of inflammatory markers, bacterial load in blood, bronchoalveolar lavage fluid, and the lungs, as well as lung permeability as compared with the homozygous control rats. The results indicate that the metabolic syndrome state may exacerbate lung response to injury because of an attenuation in the inflammation-resolving response as well as deleterious effects on antimicrobial defenses.

#### JS09

**“Dose-dependent Association between Intermediate-acting Neuromuscular-blocking Agents and Postoperative Respiratory Complications: A Prospective Analysis of Data on File” by Duncan J. McLean, Laurent G. Glance, Arina Igumenshcheva, Karim Ladha, Daniel Diaz-Gil, Hassan Farhan, Tobias Kurth, Matthias Eikermann, Massachusetts General Hospital, University of Rochester Medical Centre, University of Bordeaux, Boston, MA.** Using a single-center data from 72,173 noncardiac surgical patients aged 18 and older who had received intermediate-acting neuromuscular-blocking agents, data were evaluated for postoperative respiratory complications, including pulmonary edema, pneumonia, or reintubation within first 3 days after surgery. A logistic regression model was created that controlled for age, sex, body mass index, procedure duration, ASA physical status classification, Charlson Comorbidity Index, Score for Prediction of Respiratory Complications, depth of anesthesia, vasopressor use, opioid use, surgical body region, surgical procedure relative value units, in-patient/ambulatory surgery, emergency surgery, blood transfusions, intraoperative resuscitation volume, intraoperative hypotension, and time between last intermediate-acting neuromuscular-blocking agents dose administration and extubation. There was a dose-dependent association between the intermediate-acting neuromuscular-blocking agent and the risk of postoperative respiratory complications and neostigmine did not ameliorate the risk.

#### JS10

**“Estimation of Minute Volume from Respiratory Inductance Plethysmography by Hilbert Huang Transform” by Jeff E. Mandel and Joshua H. Atkins, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA.** The Hilbert Huang Transform is a signal processing method that decomposes nonstationary signals into independent modes that are continuous functions of phase and magnitude. The hypothesis was that the linear regression of the magnitude of the chest and abdominal signals and their phase difference *versus* spirometer flow would yield accurate estimates of minute volumes over wide ranges of minute



ventilation. Evaluations of 52 patients during sevoflurane anesthesia for cystoscopy documented that Hilbert Huang Transform device estimates of minute ventilation correlated with spirometry and may permit reliable measurement of respiratory depression during procedures.

### JS11

**“Variation in Clinical Management of Ventilation during OLV”** by Douglas Colquhoun, Bhiken I. Naik, Marcel E. Durieux, Benjamin D. Kozower, Randal S. Blank, University of Virginia, Charlottesville, VA. Patients who were older than 19 yr of age and underwent OLV between July 2009 and July 2013 were identified; 1,296 patients were identified where full information was available. Significant numbers of patients were found to have received in excess of 8 ml/kg of predicted body weight. This is to serve as pilot data for investigations.

### JS12

**“Current National Practice Patterns for Intraoperative Ventilation”** by Jonathan P. Wanderer, Jesse M. Ehrenfeld, Richard H. Epstein, Daryl J. Kor, Ana Fernandez-Bustamante, Leslie C. Jameson, Jean-Francois Pittet, Marcos F. Vidal-Melo, Raquel R. Bartz, James M. Blum. Departments of Anesthesiology at Vanderbilt University, Thomas Jefferson Hospital, University of Colorado Denver, Mayo Clinic College of Medicine, University of Alabama Birmingham, Massachusetts General Hospital, Duke University Medical Center, University of Michigan Health System, Nashville, TN. Intraoperative data were pooled from anesthesia information management systems at the institutions listed. All 223,880 cases were at least 30 min and occurred over a 9-yr interval. The average TV was 9.75 ml/kg of ideal body weight in 2005 that decreased to 7.83 ml/kg ideal body weight in 2013. Use of PEEP has increased linearly over time.

## Best Abstracts: Basic Sciences and Clinical Sciences

ANESTHESIOLOGY will sponsor two Best Abstract sessions this year, one in basic science and one in clinical science. These abstracts were chosen by a panel of Editors, who examined the highest scoring abstracts from the ASA subcommittees, choosing those with important scientific and clinical application and novelty. Subsequently, a combination of these Editors and appointees from the ASA will choose one abstract in each category to receive the Best Abstract award for basic and for clinical science at the meeting in New Orleans.

Following are summaries of the superlative abstracts that will be presented.

### Best Abstracts: Basic Sciences

Monday, October 13, 2014, 8:00 AM to 10:00 AM, Morial Convention Center, Room 265–268

### BOS01

**“Acyclic Cucurbit[n]uril-Type Molecular Containers Bind Etomidate in Vitro and Reverse Etomidate Anesthesia**

**in Rats Dose Dependently”** by Daniel Diaz-Gil, Medical Student, Ingrid Moreno Duarte, M.D., Joseph F. Cotten, M.D., Ph.D., Jessica L. Seidel, Ph.D., Shweta Ganapati, M.Sc., Ben Zhang, M.Sc., Jeroen C. P. Simons, Cenk Ayata, M.D., Lyle Isaacs, Ph.D., Matthias Eikermann, M.D., Ph.D., Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA; Radiology, Massachusetts General Hospital, Boston, MA; Chemistry and Biochemistry, University of Maryland, Baltimore, MD. Cucurbit[n]urils are molecular containers that can reverse neuromuscular blockade and ketamine anesthesia by binding and, thereby, inactivating neuromuscular blockers and ketamine, respectively. In a randomized cross-over study in six rats, intravenous administration of 80 mg/kg of the molecular container calabaddon 2 decreased the time to righting reflex recovery from the effects of 4 mg/kg etomidate from 27 to 15 min. Escalating infusions of calabaddon 2 during steady-state etomidate infusions titrated to a burst suppression ratio between 50 and 60% in four rats produced a dose-dependent decrease of the burst suppression ratio to 41% of the baseline burst suppression ratio.

### BOS02

**“Cardiopulmonary Reflex Modulation of Ventricular Arrhythmogenesis”** by Kimberly J. Howard-Quijano, M.D., Kent Yamakawa, M.D., Wei Zhou, Ph.D., Kalyanam Shivkumar, M.D., Ph.D., Aman Mahajan, M.D., Ph.D. Anesthesiology, University of California at Los Angeles, Los Angeles, CA, Cardiology, University of California at Los Angeles, Los Angeles, CA, Anesthesiology, UCLA Medical Center, Los Angeles, CA. The autonomic nervous system is a major contributor to the pathophysiology of lethal ventricular tachyarrhythmias. The role of cardiac afferent neural inputs, from the heart to the spinal cord, in modulating sympathetic control of ventricular electrophysiology was determined in 11 Yorkshire pigs. Interruption of spinal afferent signals at T1 to T4 enhanced cardiac sympathoexcitability, suggesting afferent neuronal signals from the heart exert inhibitory control of myocardial excitability.

### BOS03

**“Low-density Lipoprotein-Receptor-deficient Mice on Western Diet Develop Pulmonary Hypertension and Right Ventricular Dysfunction That Are Prevented by a Novel High-density Lipoprotein Mimetic Peptide 4F”** by Soban Umar, M.D., Ph.D., Kaveh D. Navab, M.D., Rod Partow-navid, B.S., Mohamad Navab, Ph.D., Mansoureh Eghbali, Ph.D., Anesthesiology, UCLA Med Ctr, Los Angeles, CA; UCLA, Los Angeles, CA; Medicine, UCLA, Los Angeles, CA. Low-density lipoprotein receptor knockout mice fed a high fat and high cholesterol Western diet develop atherosclerosis, insulin resistance, and hyperinsulinemia. Pulmonary hypertension has been associated with insulin resistance and with low plasma high-density lipoprotein concentrations. Male low-density lipoprotein receptor knockout mice fed a Western diet for 12 weeks developed

pulmonary hypertension, right ventricular hypertrophy, and right ventricular dysfunction. These were prevented when mice were also administered high-density lipoprotein mimetic peptide 4F, which restores vascular endothelial function, has pulmonary antiinflammatory properties, and decreases airway hyperresponsiveness and oxidative stress.

#### BOS04

**“The Calcium Channel, Transient Receptor Potential Vanilloid 4 [TRPV4], Is Required for Hypoxic Pulmonary Vasoconstriction”** by Neil Goldenberg, M.D., Ph.D., Liming Wang, Ph.D., Hannes Ranke, Cand.Med., Arata Tabuchi, M.D., Wolfgang M. Kuebler, M.D., Dr. med. habil., Anesthesia, University of Toronto, Toronto, ON; University of Toronto, Toronto, ON; Physiology, Charité–Universitaetsmedizin, Berlin, Germany; Physiology, University of Toronto, Toronto, ON. Hypoxic pulmonary vasoconstriction is advantageous during regional hypoxia but may be involved in the pathogenesis of pulmonary hypertension and cor pulmonale during global hypoxic lung disease. One of the end effectors of hypoxic pulmonary vasoconstriction is calcium influx into pulmonary artery smooth muscle cells. The hypoxia-induced increase in pulmonary artery pressure in isolated perfused wild-type mouse lungs was attenuated by inhibition of the TRPV4 channel, a multimodal cation channel. It was also attenuated in lungs isolated from TRPV4-deficient mice; intravital microscopy found reduced hypoxic pulmonary vasoconstriction in precapillary pulmonary arterioles of TRPV4-deficient mice.

#### BOS05

**“Critical Changes in Cortical Neuronal Interactions in Anesthetized and Awake Rats”** by Anthony G. Hudetz, D.B.M., Ph.D., Jeannette A. Vizuet, Ph.D., Siveshgan Pillay, Ph.D., Kristina M. Ropella, Ph.D., Anesthesiology, Medical College of Wisconsin, Milwaukee, WI; Bio-medical Engineering, Marquette University, Milwaukee, WI. Reduced information integration has been implicated in anesthetic-induced unconsciousness. Changes in the information processing capacity of neuronal networks under anesthesia was studied using information theoretical indicators of neuronal interactions, integration, and complexity, derived from multichannel extracellular recordings of parallel spike trains in the visual cortex of chronically instrumented, unrestrained rats at 4 depths of desflurane anesthesia. Although integration and complexity were negatively correlated with desflurane concentrations, visual flash stimuli augmented neuronal interactions in both wakefulness and anesthesia. Critical changes in prestimulus integration and poststimulus complexity indicated the transition between consciousness and unconsciousness between 4 and 6% desflurane.

#### BOS06

**“Temporally Distinctive Neural Processes Leading to Propofol-induced Unconsciousness in a Primate Cortical**

**Network”** by Yumiko Ishizawa, M.D., M.P.H., Ph.D., Omar J. Ahmed, Ph.D., Shaun Patel, Ph.D., Emery N. Brown, M.D., Ph.D., Emad N. Eskandar, M.D., Anesthesia, Critical Care and Pain Medicine, Massachusetts General Hospital, Boston, MA; Neurology, Massachusetts General Hospital, Boston, MA; Neurosurgery, Massachusetts General Hospital, Boston, MA. Intracortical neural processes leading to propofol-induced loss of consciousness were studied in a primate cortical sensory network during a behavioral transition from full alertness to loss of consciousness. Propofol disrupted synchronous beta oscillations during the pre-loss of consciousness period, suggesting that cortico-cortical circuits are most sensitive to the effect of propofol and cortical functional disconnection is a prerequisite for neural events leading to unconsciousness. Subsequently, a transient increase in high-frequency (gamma) activity appeared to correspond to loss of consciousness. After loss of consciousness, the cortical network again became synchronized by increasingly coherent slow oscillations, which may play a role in sustaining unconsciousness.

#### BOS07

**“Effects of Isoflurane on Presynaptic Voltage-gated Calcium Channel Subtypes in Rat Hippocampal Neurons”** by Daniel Cook, B.S., Zhenyu Zhou, M.D., Ph.D., Masato Hara, M.D., Ph.D., Joel Baumgart, Ph.D., Hugh C. Hemmings, Jr., M.D., Ph.D., Anesthesiology, Weill Cornell Medical College, New York, NY. The effects of isoflurane on the predominant presynaptic neuronal voltage-gated calcium channel subtypes, N-type and P/Q-type channels, were studied in cultured rat hippocampal neurons by measuring synaptic vesicle exocytosis with live cell fluorescence microscopy and selective pharmacologic inhibition to isolate subtype-specific effects. Although isoflurane further inhibited exocytosis when N-type channels were blocked, it inhibited exocytosis further only in a subset of cells in which P/Q-type channels were blocked. Thus, Isoflurane inhibited synaptic vesicle exocytosis coupled to either N-type or P/Q-type voltage-gated calcium channels, with terminal specific differences in the contribution of each subtype.

#### BOS08

**“The Role of Glutamatergic and Dopaminergic Neurons in the Periaqueductal Gray on the Descending Inhibition of Pain”** by Norman E. Taylor, M.D., Ph.D., Shu Zheng, B.S., Christa J. Van Dort, Ph.D., Emery N. Brown, M.D., Ph.D., Ken Solt, M.D., Massachusetts General Hospital, Boston, MA; Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA; Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital, Boston, MA. Electrical brain stimulation targeting the periaqueductal gray can produce profound antinociception but may also produce unwanted side effects because specific neuron types are not targeted. To better define neural circuitry in the periaqueductal gray responsible for the analgesic effect of electrical stimulation, dopamine,

glutamate, and  $\gamma$ -aminobutyric acid neurons in the periaquiductal gray of mice expressing cre recombinase were targeted using Designer Receptors Exclusively Activated by Designer Drugs. Designer Receptors Exclusively Activated by Designer Drugs are G-protein-coupled receptors engineered to be selectively activated by a specific ligand. Activation of dopamine and glutamate neurons in the ventral lateral periaquiductal gray produced profound analgesia without signs of anxiety, whereas inhibition of  $\gamma$ -aminobutyric acid interneurons had no antinociceptive effect.

### BOS09

**“Neuron-targeted Caveolin-1 Attenuates Traumatic Brain Injury-mediated Motor and Cognitive Deficits”** by Junji Egawa, M.D., Weihua Cui, M.D., Edmund Posadas, Jan M. Shilling, M.D., Piyush M. Patel, M.D., Ph.D., Brian P. Head, Ph.D., Anesthesia, VASDHS/UCSD, San Diego, CA; Anesthesia, Beijing Tiantan Hospital/Capital Medical University, Beijing, China. Traumatic brain injury causes neurological, cognitive, and behavioral deficits. Neuron-targeted caveolin-1 (Cav-1), a cholesterol binding and scaffolding protein found within membrane/lipid rafts, enhances membrane/lipid raft formation, increases pro-growth signaling, and promotes neuritic growth in primary neurons. Wild-type and neuron-targeted Cav-1 overexpressing transgenic mice (SynCav1 TG) were subjected to either traumatic brain injury by a stereotaxic impactor or a sham procedure and were followed by motor and cognitive testing. SynCav1 TG mice were less vulnerable to traumatic brain injury-mediated contextual fear memory deficits 49 days after injury.

### BOS10

**“Peroxiredoxin-1 and Toll-like Receptor (TLR) 2 Pathway Contributes to Neurotoxic Microglial Activation after Cardiac Arrest”** by Mizuko Ikeda, M.D., Ph.D., Tetsuhiro Fujiyoshi, M.D., Ph.D., Sarah Mader, B.S., Ines P. Koerner, M.D., Ph.D., Oregon Health and Science University, Portland, OR. Microglia may be activated to a neurotoxic phenotype after cardiac arrest (CA) and cardiopulmonary resuscitation, contributing to cognitive decline related to delayed neuronal death in the hippocampus. TLR 2, expressed on microglia in the central nervous system, recognizes danger-associated molecular patterns and activates the immune system. Wild-type and TLR2-knockout mice were subjected to CA/cardiopulmonary resuscitation and neuronal death and microglial activation were evaluated 3 days later. Microglia activation to a neurotoxic phenotype after CA/cardiopulmonary resuscitation was facilitated by danger signal peroxiredoxin-1 (Prx1). Although microglial activation was attenuated in TLR2-knockout mice, neuronal death was not different, suggesting that both Prx1 and TLR2 pathway contribute to neurotoxic microglial activation after CA.

### BOS11

**“A CCR2 Antagonist Suppresses Infiltration of Bone Marrow-derived Microglia (BMDM) Into the Central**

**Nervous System and Reverses Anxiety-like Behavior as well as Hypersensitivity Induced by Chronic Neuropathic Pain”** by Atsushi Sawada, M.D., Ph.D., Yukitoshi Niiyama, M.D., Ph.D., Michiaki Yamakage, M.D., Ph.D., Anesthesiology, Sapporo Medical University School of Medicine, Sapporo, Japan. Psychological stress is reported to promote infiltration of bone marrow-derived microglia (BMDM) into the brain and induce anxiety-like behavior. Monocyte chemoattractant protein-1 (MCP-1) and its receptor, C-C chemokine receptor type 2 (CCR2), have been shown to participate in BMDM infiltration. Mice were subjected to partial sciatic nerve ligation to induce neuropathic pain, which produced anxiety-like behavior and promoted BMDM infiltration into the central nucleus of the amygdala *via* the MCP-1/CCR2 axis in mice 28 days after partial sciatic nerve ligation. A CCR2 antagonist, RS102895, suppressed BMDM infiltration into the brain and reversed both anxiety-like behavior and hypersensitivity induced by chronic neuropathic pain.

### BOS12

**“Common MicroRNAs (miRs) Regulate Liver Protection of Anesthetic and Ischemic Preconditioning”** by Tomonori Morita, M.D., Masashi Ishikawa, M.D., Atsuhiko Sakamoto, M.D., Ph.D., Anesthesiology and Pain Medicine, Nippon Medical School, Tokyo, Japan; Nippon Medical School, Tokyo, Japan. Anesthetic preconditioning (APC) and ischemic preconditioning (IPC) ameliorate liver ischemia-reperfusion injury. miRs and their target genes play an important role in regulating hepatic ischemia-reperfusion injury. The effects of APC and IPC on the activation of a common pathway were assessed by conducting comprehensive miR screening tests and pathway analysis in male rats randomly divided into control, APC, and IPC groups. TaqMan Low Density Array identified 112 expressed miRs that were common to APC and IPC. Ingenuity Pathway Analysis identified five miRs related to the Akt-GSK-cyclin D1 pathway, expressions of which were reduced by both APC and IPC.

### Best Abstracts: Clinical Sciences

**Tuesday, October 14, 2014, 1:00 PM to 3:00 PM, Morial Convention Center, Room 275–277**

### BOC01

**“Comprehensive, Patient-centered Total Care of Patients with Total Knee Arthroplasty: The Practice and Outcomes of the Perioperative Surgical Home”** by Chunyuan Qiu, M.D., M.S., Vu T. Nguyen, M.D., Atef Morkos, M.D., Maria A. Morkos, Andrew T.-Y. Ko, Jessica Y. Qiu, Chandra D. Heyman, M.B.A., Jamie M. Cabrera, P.A., Narendra S. Trivedi, M.D., Diana LaPlace, M.D., Anesthesiology, Kaiser Permanente, Baldwin Park, CA; Anesthesiology, Kaiser Permanente Baldwin Park Medical Center, Baldwin Park, CA; Anesthesiology, Kaiser Permanente Baldwin Park Medical Center, Yorba Linda, CA;



Medical School, George Washington University, Washington, DC; Anesthesiology, Kaiser Permanente Baldwin Park Medical Center, Huntington Beach, CA; Anesthesiology, Kaiser Permanente Riverside Medical Center, Anaheim Hills, CA; Anesthesiology, Kaiser Permanente Baldwin Park Medical Center, Orange, CA. An anesthesiologist-led team was created to establish the Perioperative Surgical Home for total knee arthroplasty patients. The anesthesiologist was primarily responsible for both preparation for anesthesia and medical optimization. High-risk patients were evaluated by both an anesthesiologist and an internist in one appointment. Data from 405 total knee arthroplasty patients under 8 months of the Perioperative Surgical Home protocol were compared with data from 546 total knee arthroplasty patients cared for in the previous year. The anesthesiologist-led Perioperative Surgical Home program maintained excellent clinical outcomes, with reduced length of hospital stay and increased skilled nursing facility bypass, without any additional resources and staff.

#### BOC02

**“Chronic Pain Management: A Closed Claims Update”** by Kelly A. Pollak, M.D., Linda S. Stephens, Ph.D., Karen L. Posner, Ph.D., Dermot R. Fitzgibbon, M.D., James P. Rathmell, M.D., Edward Michna, M.D., Karen B. Domino, M.D., M.P.H., Anesthesiology and Pain Medicine, University of Washington and Seattle Cancer Care Alliance, Seattle, WA; Anesthesiology and Pain Medicine, University of Washington, Seattle, WA; Anesthesiology and Pain Medicine, University of Washington, Seattle, WA; Anesthesia and Critical Care, Massachusetts General Hospital/Harvard Medical School, Boston, MA; Pain Management Center, Brigham and Women’s Hospital/Harvard Medical School, Boston, MA. The Closed Claims Project data base was reviewed to identify temporal trends in the 981 chronic pain management malpractice claims occurring between 1980 and 2011. Chronic pain management claims increased from 3% of anesthesia malpractice claims in the 1980s to 18% of the claims after 2000. Although death and severe nerve injury each occurred in 6% of chronic pain claims in the 1980s, they occurred in 20 and 28% of chronic pain claims, respectively, after 2000.

#### BOC03

**“Development and Assessment of a Novel Perioperative Ultrasound Curriculum for Anesthesiology Residents: A FAER [Foundation for Anesthesia Education and Research] Sponsored Study”** by Catherine Hua, B.S. (In Progress), Adriana Capatina, B.S., Brenton S. Alexander, B.S., Khanhvan Le, B.A., Patrick Wu, M.D., Cecilia Canales, B.S., M.P.H., Maxime Cannesson, M.D., Ph.D., Davinder S. Ramsingh, M.D., Department of Anesthesiology, University of California, Irvine, CA; University of California Irvine, Irvine, CA; University of California Irvine Medical Center, Orange, CA. Point-of-care

ultrasonography can improve clinical decision making. A 1-yr comprehensive whole-body ultrasound examination curriculum using model and simulation instruction was developed for anesthesia residents and efficacy of learning this curriculum was assessed. Material covered included evaluation of volume status, cardiac ultrasonography, pulmonary ultrasonography, vascular access, tracheal identification, and optic nerve diameter measurement for intracranial pressure estimation. Higher test scores were observed on postlecture multiple choice tests for the 29 CA1 to CA3 residents taking the course.

#### BOC04

**“The Predictive Validity of 12- to 36-month Neurodevelopmental Testing after Complex Neonatal Cardiac Surgery”** by Marcie R. Meador, M.S., R.N., Ashraf M. Resheidat, M.D., Ronald B. Easley, M.D., Ken M. Brady, M.D., Rachel Dugan, B.S.N., R.N., Robert Voigt, M.D., Marie Turcich, L.P.C., L.M.F.T., L.S.S.P., Dean B. Andropoulos, M.D., Pediatric Anesthesiology, Baylor College of Medicine/Texas Children’s Hospital, Houston, TX; Baylor College of Medicine, Houston, TX; Baylor College of Medicine/Texas Children’s Hospital, Houston, TX; Developmental Pediatrics, Texas Children’s Hospital, Houston, TX; Pediatric Anesthesiology, Baylor College of Medicine, Houston, TX. Although it is recommended that standard neurodevelopmental tests not be performed before 24-month corrected gestational age, testing at 12 months of age is reported in children with congenital heart disease. Neurodevelopmental outcomes for cognitive, language, and motor domains were measured at 12 months of age and at 36 months of age in 38 subjects who had undergone neonatal congenital heart disease surgery using the Bayley Scales of Infant and Toddler Development-III scores. The cognitive domain and language domain scores at 12 months were predictive of scores at 36 months after adjusting for relevant covariates.

#### BOC05

**“The Association of Postoperative Delirium and Cognitive Decline 4 to 6 Weeks after Cardiac Surgery”** by Charles H. Brown, M.D., M.H.S., Andrew LaFlam, B.S., Laura Max, B.A., Karin Neufeld, M.D., M.P.H., Charles W. Hogue, M.D., Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, MD; Psychiatry, Johns Hopkins University School of Medicine, Baltimore, MD. Delirium may occur in more than half of patients after cardiac surgery and is associated with adverse consequences, including cognitive decline. The association of delirium with cognitive decline was assessed in 35 patients after cardiac surgery involving CPB using rigorous delirium assessments and an extensive psychometric battery. Postoperative delirium occurred in 48% of the patients and was associated with a significant decrease in composite cognitive Z-score 4 to 6 weeks after surgery after adjusting for age, history of stroke, and CPB time.

**BOC06**

**“Psychological Sequelae of Surgery in a Cohort of Patients from Three Intraoperative Awareness Prevention Trials”** by Elizabeth L. Whitlock, M.D., M.Sc., Thomas L. Rodebaugh, Ph.D., Afton L. Hassett, Psy.D., Eric Jacobsohn, M.B., Ch.B., George A. Mashour, M.D., Ph.D., Michael S. Avidan, M.B., B.Ch., Anesthesia and Perioperative Care, University of California, San Francisco, San Francisco, CA; Psychology, Washington University in Saint Louis, Saint Louis, MO; University of Michigan Medical School, Ann Arbor, MI; Anesthesia and Perioperative Medicine, University of Manitoba, Winnipeg, MB, Canada; Anesthesiology, University of Michigan, Ann Arbor, MI; Anesthesiology, Washington University School of Medicine, Saint Louis, MO. Although intraoperative awareness is a known risk factor for posttraumatic stress disorder (PTSD), other risk factors are poorly understood. Patients with intraoperative awareness and matched controls without it were screened for symptoms of PTSD. Fifteen of the 35 patients (43%) with intraoperative awareness and 29 of the 184 patients (16%) without it exceeded the civilian screening cutoff score for PTSD symptoms resulting from their surgery a median of 2 yr postoperatively. Among the six predictors for severity of PTSD-complex symptoms were not only intraoperative awareness but also perioperative dissociation. Age, sex, and cardiac surgery were not predictors of PTSD.

**BOC07**

**“Prospective, Cohort Study on Unresolved Dilemmas in Noncardiac Surgery after Previous PCI [Percutaneous Coronary Intervention]”** by Marcin Wasowicz, M.D., Ph.D., Summer Syed, M.D., Lukasz Starzyk, M.D., Ph.D., Duminda N. Wijeyesundera, M.D., Ph.D., F.R.C.P.C., Scott W. Beattie, M.D., Ph.D., F.R.C.P., Anesthesia, Toronto General Hospital/University of Toronto, Toronto, ON; Anesthesia and Perioperative Medicine, Hamilton Health Science Hospital/McMaster University, Hamilton, ON; Anesthesia and Pain Management, Bern University Hospital, Bern, Switzerland; Anesthesia and Pain Management, Toronto General Hospital/University of Toronto, Toronto, ON, Canada; Anesthesia, Toronto General Hospital/University of Toronto, Toronto, ON, Canada. There is a high incidence of perioperative myocardial infarction in patients previously treated with percutaneous coronary interventions and stent implantations presenting for elective noncardiac surgery within a year. The incidence of myocardial infarction in 160 patients having elective noncardiac surgery within a year of percutaneous coronary interventions was 19%, despite adherence to American College of Cardiology/American Heart Association guidelines and proper inhibition of platelet function by aspirin. The risk of myocardial infarction in these patients was associated with chronic renal failure, diabetes, and anemia but not with use of aspirin or its withdrawal.

**BOC08**

**“Oxidative Stress Leads to Altered Gene Expression in Cardiac Myocytes Following CPB in Patients with Poorly Controlled Type II Diabetes vs. Nondiabetics”** by Jeffrey Hubbard, M.D., M.S., Thomas Huang, B.A., Khuram Owais, M.D., Vwaire Orhurhu, B.A., M.P.H., Anam Pal, M.D., Mario Montealegre, M.D., Kamal Khabbaz, M.D., Feroze Mahmood, M.D., Robina Matyal, M.D., Anesthesia, Critical Care, and Pain Medicine, Beth Israel Deaconess, Boston, MA; Anesthesia, Critical Care, and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA; Epidemiology and Bioinformatics, Harvard School of Public Health, Boston, MA; Surgery, Beth Israel Deaconess Medical Center, Boston, MA. Functional and molecular changes caused by type II diabetes mellitus can lead to severe cardiomyopathy, neuropathy, and other adverse outcomes after CPB. Right atrial appendage tissue was collected from 20 nondiabetic patients and 20 diabetic patients before and after CPB. Gene expression, measured using microarray analysis, revealed altered expression of several interrelated factors associated with oxidative stress. Cardiac myocytes of patients with poorly controlled type II diabetes had more altered expression of mitogen-associated protein kinase (MAPK) pathway genes than did those of nondiabetic patients.

**BOC09**

**“Patient-controlled Analgesia by Target Controlled Infusion of Hydromorphone during Postoperative Pain after Cardiac Surgery”** by Doris Rohde, Ph.D., Jan Mell, Ph.D., Katharina Fröhlich, Ph.D., Harald Ihmsen, Ph.D., Jürgen Schüttler, Ph.D., Christian Jeleazcov, Ph.D., Department of Anesthesiology, University Hospital Erlangen, Erlangen, Germany. Patient-controlled analgesia (PCA) using bolus doses of opioids for acute postoperative pain relief can lead to large fluctuations in plasma opioid concentrations. After undergoing cardiac surgery, 43 adults received hydromorphone as a combined PCA-target controlled infusion, with a target plasma concentration between 0.8 and 10 ng/ml, for 6 to 8 h after extubation, followed by PCA as bolus doses of 0.2 mg until 8 AM on the first postoperative day. Hydromorphone PCA-target controlled infusion had a narrower plasma hydromorphone concentration range, 0.8 to 13.4 ng/ml, than did PCA alone, 0.0 to 34.6 ng/ml, with high analgesic efficacy.

**BOC10**

**“Long-acting Local Anesthesia with Neosaxitoxin in Combination with 0.2% Bupivacaine and Epinephrine Versus Bupivacaine Alone: A Randomized, Controlled, Double-blind FDA Phase 1 Trial”** by Carolina Donado, M.D., Laura Cornelissen, Ph.D., Kimberly Lobo, M.S., M.P.H., Joseph Kim, M.A., Joseph Cravero, M.D., Charles B. Berde, M.D., Ph.D., Department of Anesthesiology, Perioperative, and Pain Medicine, Boston



**Children's Hospital/Harvard Medical School, Boston, MA.** Neosaxitoxin, a site 1 sodium channel blocker, produces prolonged local neuronal blockade when combined with bupivacaine or epinephrine. In a randomized, controlled, double-blind trial in 18 volunteers, subcutaneous bupivacaine injection in one calf was compared with injection of bupivacaine, epinephrine, and 10 or 30  $\mu$ g of neosaxitoxin or of saline in the other. Median complete block duration for mechanical pain threshold increased from 5.3 h for bupivacaine to 22 h by adding epinephrine and either dose of neosaxitoxin. Median complete block duration for mechanical touch detection increased from 7 h for bupivacaine to 34 and 35 h by adding epinephrine and 10 or 30  $\mu$ g neosaxitoxin, respectively.

### BOC11

**"Pharmacokinetic-Pharmacodynamic Modeling Study of the Reversal of Opioid-induced Respiratory Depression by the BK-channel Blocker GAL021"** by Margot Roozkrans, M.D., Erik Olofsen, M.Sc., Rutger van der Schrier, M.D., James McLeod, M.D., Albert Dahan, M.D., Ph.D., Anesthesiology, Leiden University Medical Center, Leiden, The Netherlands; Galleon Pharmaceuticals, Horsham, PA. GAL021, a BK-channel blocker and respiratory stimulant, is a novel agent for treatment of opioid-induced respiratory depression that does not affect sedation, analgesia, or hemodynamics. In a randomized, placebo-controlled crossover study, 12 volunteers were administered intravenous low- and high-dose GAL021 or placebo on top of low- and high-dose alfentanil-induced respiratory depression under isohypocapnic conditions. The maximum dose of GAL021 reversed opioid-induced respiratory depression by 53%, with a blood-effect site equilibration half time that was not different from zero, suggesting it stimulates respiration at the peripheral chemoreceptors of the carotid bodies.

### BOC12

**"Oxygen Reserve Index—a New, Noninvasive Method of Oxygen Reserve Measurement"** by Peter Szmuk, M.D., Jeffrey W. Steiner, D.O., Patrick N. Olomu, M.D., Joanna Dela Cruz, B.S., Daniel Sessler, M.D., University of Texas Southwestern and Children's Medical Center, Dallas, TX; University of Texas Southwestern and Children's Medical Center, Dallas, TX; Cleveland Clinic, Cleveland, OH. When the saturation level of oxygen in hemoglobin ( $\text{SpO}_2$ ) is 100%, the partial pressure of oxygen in arterial blood ( $\text{PaO}_2$ ) must be measured from arterial blood. When oxygen reserves decrease rapidly, a decrease in  $\text{PaO}_2$  may not be apparent until  $\text{SpO}_2$  starts to decrease. The oxygen reserve index is a noninvasive early warning estimation of decreasing oxygen reserves. After tracheal intubation of 17 pediatric

patients, oxygen administration was discontinued and  $\text{SpO}_2$  was allowed to drift to 92%. The mean time from the start of the oxygen reserve index alarm to  $\text{SpO}_2$  98% was 40 s and for a further decrease to 92% was 52 s. The oxygen reserve index alarm provides an increased warning time for avoiding potential hypoxia.

## 12th Annual Celebration of Research Luncheon Session

**Monday, October 13, 2014, 11:45 AM to 1:15 PM, Morial Convention Center, Great Hall B. Lunch will be provided!**

This year's Celebration of Research will take place on Monday during the Annual Meeting. James C. Eisenach, M.D., Editor-in-Chief of ANESTHESIOLOGY, will serve as moderator. Featured speakers will be the 2014 recipient of the ASA Excellence in Research Award, Henrik Kehlet, M.D., Ph.D., Professor, Section for Surgical Pathophysiology, The Juliane Marie Centre, Copenhagen, Denmark; and the recipient of the 2014 Presidential Scholar Award, Rebecca A. Aslakson, M.D., Ph.D., Assistant Professor, Department of Anesthesiology and Critical Care Medicine, and Palliative Care Program, The Johns Hopkins University, Baltimore, Maryland.

The recipients of the 2014 Resident Research Awards will also be introduced during the Celebration event. Additional information regarding Journal-related activities and FAER-related activities will be included in the ASA Pocket Guide distributed at the 2014 Annual Meeting.

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## Competing Interests

The authors declare no competing interests.

## References

1. Serpa Neto A, Simonis FD, Barbas CS, Biehl M, Determann RM, Elmer J, Friedman G, Gajic O, Goldstein JN, Horn J, Juffermans NP, Linko R, de Oliveira RP, Sundar S, Talmor D, Wolthuis EK, de Abreu MG, Pelosi P, Schultz MJ: Association between tidal volume size, duration of ventilation, and sedation needs in patients without acute respiratory distress syndrome: An individual patient data meta-analysis. *Intensive Care Med* 2014; 40:950–7
2. The PROVE Network Investigators; for the Clinical Trial Network of the European Society of Anaesthesiology: High versus low positive end-expiratory pressure during general anaesthesia for open abdominal surgery (PROVHILO trial): a multicentre randomised controlled trial. *Lancet* 2014 [Epub ahead of print]
3. Munoz-Price LS, Sands L, Lubarsky DA. Effect of high preoperative oxygen supplementation on surgical site infections. *Clin Infect Dis* 2013; 57:1465–72