



## ON THE COVER:

Transfers of patient care and responsibility among caregivers, “handovers,” are common. Whether handovers worsen patient outcome remains unclear. An article in this issue of *ANESTHESIOLOGY* presents evidence that intraoperative anesthesia care transitions are strongly associated with worse outcomes, with a similar effect size for attendings, residents, and nurse anesthetists. (Cover photo: J.P. Rathmell; illustration: A. Johnson, Vivo Visuals.)

- Dutton: Seamless Anesthesia Care: The Handover Process, p. 673
- Saager *et al.*: Intraoperative Transitions of Anesthesia Care and Postoperative Adverse Outcomes, p. 695

## ◆ THIS MONTH IN ANESTHESIOLOGY

1A

## ■ SCIENCE, MEDICINE, AND THE ANESTHESIOLOGIST

21A

## ■ INFOGRAPHICS IN ANESTHESIOLOGY

23A

## ◆ EDITORIAL VIEWS

### Seamless Anesthesia Care: The Handover Process

*R.P. Dutton*

673

### Comorbidities and the Complexities of Chronic Pain

*A. Dahan, M. van Velzen, and M. Niesters*

675

### Letting the Gene out of the Bottle: OPRM1 Interactions

*I. Belfer, E.E. Young, and L. Diatchenko*

678

## ■ SPECIAL ANNOUNCEMENTS

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

*M.J. Avram, J.P. Wiener-Kronish, J.H. Levy, J.P. Rathmell, and J.C. Eisenach*

681

### Henrik Kehlet, M.D., Ph.D., Recipient of the 2014 Excellence in Research Award

*F. Carli*

690

### Rebecca A. Aslakson, M.D., Ph.D., Recipient of the 2014 Presidential Scholar Award

*D. Nyhan and P.J. Pronovost*

692

◆ Refers to This Month in Anesthesiology

◆ Refers to Editorial Views

BA Best Abstract article originally

presented at ANESTHESIOLOGY 2013

See Supplemental Digital Content

CME CME Article

## ■ PERIOPERATIVE MEDICINE

## CLINICAL SCIENCE

- ◆ ◆ **Intraoperative Transitions of Anesthesia Care and Postoperative Adverse Outcomes** 695  
*L. Saager, B.D. Hesler, J. You, A. Turan, E.J. Mascha, D.I. Sessler, and A. Kurz*

Each anesthetic handover increased the risk of any major in-hospital morbidity or mortality by 8%. The adverse effects of handovers were similar for attending anesthesiologists and medically directed residents and certified registered nurse anesthetists. The adverse effects of handovers were virtually identical for residents and certified registered nurse anesthetists.

- CME ◆ **A Matched Cohort Study of Postoperative Outcomes in Obstructive Sleep Apnea: Could Preoperative Diagnosis and Treatment Prevent Complications?** 707  
*T.C. Mutter, D. Chateau, M. Moffatt, C. Ramsey, L.L. Roos, and M. Kryger*

Respiratory complications were twice as likely in obstructive sleep apnea patients, whether diagnosed before or after surgery, compared to controls. Patients with a preoperative diagnosis of obstructive sleep apnea and prescription for continuous positive airway pressure were less than half as likely to experience cardiovascular complications as those diagnosed after surgery. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

- ◆ **Interatrial Septum Motion but Not Doppler Assessment Predicts Elevated Pulmonary Capillary Wedge Pressure in Patients Undergoing Cardiac Surgery** 719  
*D.L. Hajj, M.M. Ali, A. Royse, D.J. Canty, S. Clarke, and C.F. Royse*

Doppler assessment of pulmonary capillary wedge pressure (PCWP) was neither sensitive nor specific enough to be clinically useful in anesthetized and mechanically ventilated patients requiring cardiac surgery. The fixed curve pattern of the interatrial septum was the best predictor of raised PCWP only when the PCWP  $\geq 17$  mmHg. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

- ◆ **Effect of Hydroxyethyl Starch on Postoperative Kidney Function in Patients Having Noncardiac Surgery** 730  
*B.K. Kashy, A. Podolyak, N. Makarova, J.E. Dalton, D.I. Sessler, and A. Kurz*

Using a large database (44,176 adults patients undergoing noncardiac surgery), a dose-dependent renal toxicity of Hextend (high-molecular weight hydroxyethyl starch) was observed: odds ratio to develop a more serious level of acute kidney injury than crystalloids was 21% (95% CI, 6 to 38%,  $P < 0.001$ ).

- Alterations in the Functional Connectivity of Frontal Lobe Networks Preceding Emergence Delirium in Children** 740  
*J.C. Martin, D.T.J. Liley, A.S. Harvey, L. Kuhlmann, J.W. Sleight, and A.J. Davidson*

In children without emergence delirium, an electroencephalogram pattern of sleep or drowsy states was observed before peaceful awakening. In children with emergence delirium, arousal with clinical delirium occurred before observation of electroencephalogram patterns of sleep. Frontal regional functional connectivity was significantly elevated in emergence delirium compared with that of matched controls shortly after discontinuation of anesthesia.

## BASIC SCIENCE

- Fibrinogen Concentrate Does Not Suppress Endogenous Fibrinogen Synthesis in a 24-hour Porcine Trauma Model** 753  
*C. Zentai, T. Braunschweig, J. Schnabel, M. Rose, R. Rossaint, and O. Grottke*

Administration of human fibrinogen concentrates did not down-regulate endogenous porcine fibrinogen biosynthesis in this animal model.

- Thoracic Epidural Anesthesia with Ropivacaine Does Not Compromise the Tolerance of Acute Normovolemic Anemia in Pigs** 765  
*A. Pape, C.F. Weber, M. Laout, M. Steche, S. Kutschker, O. Horn, B. Zwissler, and O. Habler*

Thoracic epidural anesthesia does not decrease the tolerance to acute normovolemic anemia in healthy pigs. The hemodynamic compensation of acute anemia is fully preserved, despite sympathetic block.

- BA **Amantadine Alleviates Postoperative Cognitive Dysfunction Possibly by Increasing Glial Cell Line-derived Neurotrophic Factor in Rats** 773  
*J. Zhang, H. Tan, W. Jiang, and Z. Zuo*

Cognitive function was adversely affected by anesthesia and surgery 8 days later. This adverse effect was attenuated by the systemic administration of amantadine. Amantadine increased glial cell line-derived neurotrophic factor (GDNF) levels in glia, and intracerebroventricular administration of anti-GDNF also ameliorated behavioral abnormalities. Amantadine can reduce postoperative cognitive dysfunction by increasing GDNF production and reducing surgery-induced cerebral inflammation.

- Down-regulation of MicroRNA-21 Is Involved in the Propofol-induced Neurotoxicity Observed in Human Stem Cell-derived Neurons** 786  
*D.M. Twaroski, Y. Yan, J.M. Olson, Z.J. Bosnjak, and X. Bai*

Propofol induced apoptosis of human embryonic stem cell-derived neurons and reduced expression of miR-21. Overexpression of miR-21 reduced this toxicity. Neurons derived from human embryonic stem cell represent a useful model for the study of anesthetic neurotoxicity in humans. miR-21 plays a role in propofol-induced toxicity, and manipulation of miR-21 may serve as a therapeutic approach for prevention of toxicity.

## ■ CRITICAL CARE MEDICINE

### CLINICAL SCIENCE

- ◇ **Effects of Dexmedetomidine on Sleep Quality in Critically Ill Patients: A Pilot Study** 801  
*C. Alexopoulou, E. Kondili, E. Diamantaki, C. Psarologakis, S. Kokkini, M. Bolaki, and D. Georgopoulos*

In selected critically ill patients, dexmedetomidine infusions at night to achieve light levels of sedation increases sleep efficiency and modifies 24-h sleep patterns by shifting sleep to nights. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

- ◇ **Impact of the Anesthetic Conserving Device on Respiratory Parameters and Work of Breathing in Critically Ill Patients under Light Sedation with Sevoflurane** 808  
*R. Chabanne, S. Perbet, E. Futier, N.A.B. Said, S. Jaber, J.-E. Bazin, B. Pereira, and J.-M. Constantin*

In intensive care unit patients, Anesthetic Conserving Device (ACD) (AnaConDa®; Sedana Medical AB, Uppsala, Sweden) increases the work of breathing and worsens ventilatory parameters. Sevoflurane use *via* the ACD with a light-sedation target normalizes respiratory parameters, and may provide an alternative method for sedation, at least, for weaning patients from mechanical ventilation.

### BASIC SCIENCE

- Plasma Volume Expansion with 5% Albumin Compared to Ringer's Acetate during Normal and Increased Microvascular Permeability in the Rat** 817  
*P. Bansch, S. Statkevicius, and P. Bentzer*

One group of animals was subjected to an 11% hemorrhage and then given either 5% albumin in a volume equal to the shed blood volume or Ringer's acetate at 4.5 times that volume. Another group of animals was subjected to abdominal sepsis and at 3 h, measured plasma volume loss was replaced with either 5% albumin or with Ringer's acetate in 4.5 times the measured loss. Plasma volume expansion with albumin relative to Ringer's acetate did not differ between the two groups despite different etiologies for the decrease in plasma volume.

## ■ PAIN MEDICINE

### CLINICAL SCIENCE

- ◇ **OPRM1 A118G Gene Variant and Postoperative Opioid Requirement: A Systematic Review and Meta-analysis** 825  
*I.C. Hwang, J.-Y. Park, S.-K. Myung, H.Y. Ahn, K.-i. Fukuda, and Q. Liao*

In a meta-analysis involving 18 studies and more than 4,600 patients, carriers of the G-allele were observed to exhibit higher opioid analgesic requirements. These genetic effects were strongest in Asian patients and those receiving surgery to a viscus.

## ***Lamiophlomis rotata*, an Orally Available Tibetan Herbal Painkiller, Specifically Reduces Pain Hypersensitivity States through the Activation of Spinal Glucagon-like Peptide-1 Receptors**

835

*B. Zhu, N. Gong, H. Fan, C.-S. Peng, X.-J. Ding, Y. Jiang, and Y.-X. Wang*

Aqueous extracts of *Lamiophlomis rotata* are effective in reducing pain-related behaviors in animal models of inflammatory, neuropathic, and cancer pain. Two components of *L. rotata* extracts, shanzhiside methylester (SM) and 8-*O*-acetyl-SM, are the principal active components. *L. rotata* extracts, and SM, and 8-*O*-acetyl-SM may work through spinal GLP-1 receptors to provide the analgesic effects.

### BASIC SCIENCE

## ◆◆🌐 **Brain Neuroplastic Changes Accompany Anxiety and Memory Deficits in a Model of Complex Regional Pain Syndrome**

852

*M. Tajerian, D. Leu, Y. Zou, P. Sahbaie, W. Li, H. Khan, V. Hsu, W. Kingery, T.T. Huang, L. Becerra, and J.D. Clark*

In a model of complex regional pain syndrome (CRPS) in mice, the animals became hypersensitive to light touch, but also exhibited behaviors indicative of anxiety and diminished working memory in some tests. These changes were accompanied by structural changes in several brain regions, suggesting that CRPS can result in broad changes in the central nervous system as well as producing pain. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

## **Characterization of a Computationally Designed Water-soluble Human $\mu$ -Opioid Receptor Variant Using Available Structural Information**

866

*X. Zhao, J.M. Perez-Aguilar, F. Matsunaga, M. Lerner, J. Xi, B. Selling, A.T.C. Johnson, Jr., J.G. Saven, and R. Liu*

A water-soluble version of the human  $\mu$ -receptor was developed by mutating specific residues of the molecule. This novel receptor variant has properties similar to those of the native receptor. The development of "safe mutations" in  $\mu$ -receptor will significantly advance research into the biophysical aspects of  $\mu$ -receptor activation and the resulting downstream signaling.

### ■ EDUCATION

### IMAGES IN ANESTHESIOLOGY

## **Severe Unilateral Atelectasis during Induction of Anesthesia**

876

*P.P. Kainkaryam, P. Prasanna, and D.A. Schwartz*

## 🌐 **Chemosis Secondary to Anterograde Episcleral (Sub-Tenon) Spread of Local Anesthetic during Retrobulbar Eye Block**

877

*H.D. Palte and S. Gayer*

*SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

### ORIGINAL INVESTIGATIONS IN EDUCATION

## **The Psychological and Physiological Effects of Acute Occupational Stress in New Anesthesiology Residents: A Pilot Trial**

878

*J.H. Eisenach, J. Sprung, M.M. Clark, T.D. Shanafelt, B.D. Johnson, T.N. Kruse, D.P. Chantigian, J.R. Carter, and T.R. Long*

In a pilot study of 18 individuals recruited to assess stress at the beginning of residency, 72% consented and participated in assessments of stress, anxiety, resilience, and wellness in addition to physiological biomarkers for stress. The results provide a detailed image of stress conditions during the first months of residency as well as variability data for power analyses for hypothesis testing investigations.

### CLINICAL CONCEPTS AND COMMENTARY

## ◆ **Noise in the Operating Room**

894

*J.D. Katz*

Excessive noise in the operating room can have detrimental effects on the health and performance of operating room personnel. Many of the harmful effects of noise can be ameliorated by simple and inexpensive interventions.

## CONTENTS

### MIND TO MIND

- Waiting** 899  
*J.M. Berry*
- One-night Stands ...** 900  
*J.M. Berry*

### ■ CORRESPONDENCE

- Effects and Timing of Tranexamic Acid on Transfusion Requirements in Patients Undergoing Cardiac Surgery with Cardiopulmonary Bypass** 902  
*F. Sanfilippo, M. Astuto, and M.O. Maybauer*
- In Reply**  
*S. Sigaut, B. Tremey, and M. Fischler*
- 
- Lipid Emulsion Increases the Fast Na<sup>+</sup> Current and Reverses the Bupivacaine-induced Block: A New Aspect of Lipid Resuscitation?** 903  
*K. Hori, M. Kuno, and K. Nishikawa*
- In Reply**  
*M. Wagner, Y.A. Zausig, S. Ruf, E. Rudakova, M. Gruber, B.M. Graf, and T. Volk*
- 
- Healthcare Technology: Is It Cost Efficient?** 905  
*V. Saluja and G. Singh*
- Safe and Scalable Device Design: A Call for Open Standards**  
*N. Kamdar and I. Hofer*
- In Reply**  
*P.J. Pronovost, G.W. Bo-Linn, and A. Sapirstein*

### ■ ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

- Burnette's Folding Trade Card with Laughing "Gas" Surcharge** 834  
*George S. Bause*
- The Horace Wells Pew in Trinity College Chapel** 865  
*George S. Bause*
- "Charles Thomas Jackson"—Compliments of J. B. Woodworth** 893  
*George S. Bause*

### ■ REVIEWS OF EDUCATIONAL MATERIAL

908

### ■ CAREERS & EVENTS

39A

## INSTRUCTIONS FOR AUTHORS

The most recently updated version of the Instructions for Authors is available at [www.anesthesiology.org](http://www.anesthesiology.org). Please refer to the Instructions for the preparation of any material for submission to ANESTHESIOLOGY.

Manuscripts submitted for consideration for publication must be submitted in electronic format. The preferred method is via the Journal's Web site (<http://www.anesthesiology.org>). Detailed directions for submissions and the most recent version of the Instructions for Authors can be found on the Web site (<http://www.anesthesiology.org>). Books and educational materials should be sent to Michael J. Avram, Ph.D., Diplomate, ABCP, Associate Professor of Anesthesiology, Director, Mary Beth Donnelley Clinical Pharmacology Core Facility of the Robert H. Lurie Comprehensive Cancer Center, Northwestern University Feinberg School of Medicine, 300 E. Superior Street, Tarry 4-735, Chicago, Illinois 60611. Requests for permission to duplicate materials published in ANESTHESIOLOGY should be submitted in electronic format, to the Permissions Department ([journalpermissions@lww.com](mailto:journalpermissions@lww.com)). Advertising and related correspondence should be addressed to Advertising Manager, ANESTHESIOLOGY, Lippincott Williams & Wilkins, Two Commerce Square, 2001 Market Street, Philadelphia, Pennsylvania 19103 (Web site: <http://www.wkadcenter.com/>). Publication of an advertisement in ANESTHESIOLOGY does not constitute endorsement by the Society or Lippincott Williams & Wilkins, Inc. of the product or service described therein or of any representations made by the advertiser with respect to the product or service.

**ANESTHESIOLOGY** (ISSN 0003-3022) is published monthly by Lippincott Williams & Wilkins, 16522 Hunters Green Parkway, Hagerstown, MD 21740-2116. Business office: Two Commerce Square, 2001 Market Street, Philadelphia, PA 19103. Periodicals postage paid at Hagerstown, MD, and at additional mailing offices. Copyright © 2014, the American Society of Anesthesiologists, Inc.

**Annual Subscription Rates:** *United States*—\$758 Individual, \$1431 Institution, \$304 In-training. *Rest of World*—\$800 Individual, \$1589 Institution, \$304 In-training. Single copy rate \$132. Subscriptions outside of North America must add \$52 for airfreight delivery. Add state sales tax, where applicable. The GST tax of 7% must be added to all orders shipped to Canada (Lippincott Williams & Wilkins' GST Identification #895524239, Publications Mail Agreement #1119672). Indicate in-training status and name of institution. Institution rates apply to libraries, hospitals, corporations, and partnerships of three or more individuals. Subscription prices outside the United States must be prepaid. Prices subject to change without notice. Subscriptions will begin with currently available issue unless otherwise requested. Visit us online at [www.lww.com](http://www.lww.com).

Individual and in-training subscription rates include print and access to the online version. Online-only subscriptions for individuals (\$257) and persons in training (\$257) are available to nonmembers and may be ordered by downloading a copy of the Online Subscription FAXback Form from the Web site, completing the information requested, and faxing the completed form to 301-223-2400/44 (0) 20 7981 0535. Institutional rates are for print only; online subscriptions are available via Ovid. Institutions can choose to purchase a print and online subscription together for a discounted rate. Institutions that wish to purchase a print subscription, please contact Lippincott Williams & Wilkins, 16522 Hunters Green Parkway, Hagerstown, MD 21740-2116; phone: 1-800-638-3030 (outside the United States 301-223-2300/44 (0) 20 7981 0525); fax: 301-223-2400/44 (0) 20 7981 0535. Institutions that wish to purchase an online subscription or online with print, please contact the Ovid Regional Sales Office near you or visit [www.ovid.com/site/index.jsp](http://www.ovid.com/site/index.jsp) and select Contact and Locations.

**Address for non-member subscription information, orders, or change of address:** Lippincott Williams & Wilkins, 16522 Hunters Green Parkway, Hagerstown, MD 21740-2116; phone: 1-800-638-3030 (outside the United States 301-223-2300/44 (0) 20 7981 0525); fax: 301-223-2400/44 (0) 20 7981 0535; email: [customerservice@lww.com](mailto:customerservice@lww.com). In Japan, contact LWW Japan Ltd., 3-23-14 Hongo, Bunkyo-ku, Tokyo 113, Japan; phone: 81-3-5689-5400; fax: 81-3-5689-5402; email: [bcclaim@lww.co.jp](mailto:bcclaim@lww.co.jp). In Bangladesh, India, Nepal, Pakistan, and Sri Lanka, contact Globe Publications Pvt. Ltd., B-13 3rd Floor, A Block, Shopping Complex, Naraina, Vihar, Ring Road, New Delhi 110028, India; phone: 91-11-25770411; fax: 91-11-25778876; email: [info@globepub.com](mailto:info@globepub.com).

**Address for member subscription information, orders, or change of address:** Members of the American Society of Anesthesiologists receive the print and online journal with their membership. To become a member or provide a change of address, please contact the American Society of Anesthesiologists, 520 N. Northwest Highway, Park Ridge, IL 60068-2573; phone: 847-825-5586; fax: 847-825-1692; email: [membership@ASAhq.org](mailto:membership@ASAhq.org). For all other membership inquiries, contact Lippincott Williams & Wilkins Customer Service Department, P.O. Box 1580, Hagerstown, MD 21741-1580; phone: 1-800-638-3030 (outside the United States 301-223-2300/44 (0) 20 7981 0525); fax: 301-223-2400/44 (0) 20 7981 0535; email: [memberservice@lww.com](mailto:memberservice@lww.com).

**Postmaster:** Send address changes to ANESTHESIOLOGY, P.O. BOX 1550, Hagerstown, MD 21740.

**Advertising:** Please contact Michelle Smith, Senior Account Manager, Advertising, Lippincott Williams & Wilkins, 333 Seventh Avenue, 19th Floor, New York, NY 10001; tel: (646) 674-6537, fax: (646) 607-5479, e-mail: [Michelle.Smith@wolterskluwer.com](mailto:Michelle.Smith@wolterskluwer.com). For classified advertising: Keida Spurlock, Recruitment Advertising Representative, Lippincott Williams & Wilkins, Two Commerce Square, 2001 Market Street, Philadelphia, PA 19103; tel: (215) 521-8501, fax: (215) 689-2453, e-mail: [Keida.Spurlock@wolterskluwer.com](mailto:Keida.Spurlock@wolterskluwer.com).