

ON THE COVER:

Intraoperative hypotension predicts organ injury, including acute kidney injury, although the route from low perfusion to injury is complex and unclear. An article and editorial in this issue discuss a particular mean arterial pressure (55 mmHg) which, on average, seems to impart risk, and why an absolute definition of hypotension is elusive.

- Brady and Hogue: Intraoperative Hypotension and Patient Outcome: Does “One Size Fit All?” p. 495
- Walsh *et al.*: Relationship between Intraoperative Mean Arterial Pressure and Clinical Outcomes after Noncardiac Surgery: Toward an Empirical Definition of Hypotension, p. 507

THIS MONTH IN ANESTHESIOLOGY

3A

EDITORIAL VIEWS

Intraoperative Hypotension and Patient Outcome: Does “One Size Fit All?”

495

Kenneth Brady and Charles W. Hogue

A Race against Time: Planning Postoperative Critical Care

498

Valentín Mazo, Sergi Sabaté, and Jaume Canet

Cancer Prognosis: Can Anesthesia Play a Role?

501

Zhongcong Xie

Assessing the Utility of the Utility Function

504

Evan D. Kharasch and Carl E. Rosow

PERIOPERATIVE MEDICINE

Relationship between Intraoperative Mean Arterial Pressure and Clinical Outcomes after Noncardiac Surgery: Toward an Empirical Definition of Hypotension

507

Michael Walsh, Philip J. Devereaux, Amit X. Garg, Andrea Kurz, Alparslan Turan, Reitze N. Rodseth, Jacek Cywinski, Lehana Thabane, and Daniel I. Sessler

Intraoperative hypotension may be an important factor in the development of postoperative complications. Data from 27,381 patients undergoing 33,330 noncardiac surgeries were studied to determine the durations of various mean arterial pressures (MAP) that were associated with acute kidney injury and myocardial injury. Acute kidney injury occurred after 7.4% of surgeries while myocardial injury occurred after 2.3% of surgeries and 1.5% of patients died within 30 days of surgery. Any time spent with a MAP of less than 55 mmHg during noncardiac surgery was independently associated with an increased risk of acute kidney injury and myocardial injury. As the time with a MAP of less than 55 mmHg increased so too did the risk for acute kidney injury and myocardial injury. Thirty-day mortality was associated with more than 20 min of MAP less than 55 mmHg. Optimizing intraoperative hemodynamics may improve patient outcomes.

◇ Refers to This Month in Anesthesiology

◆ Refers to Editorial Views

🌐 See Supplemental Digital Content

📄 CME Article

◆ **Development and Validation of an Intraoperative Predictive Model for Unplanned Postoperative Intensive Care** 516

Jonathan P. Wanderer, John Anderson-Dam, Wilton Levine, and Edward A. Bittner

The authors developed an intraoperative predictive model for unplanned postoperative intensive care unit admission (area under the curve of the receiver operating characteristic curve 0.905, 95% CI, 0.900–0.909) and internally validated this model. This model may improve the process of allocating intensive care unit beds postoperatively.

◇ **Validation of a Risk Stratification Index and Risk Quantification Index for Predicting Patient Outcomes: In-hospital Mortality, 30-day Mortality, 1-year Mortality, and Length-of-stay** 525

Matthew J. G. Sigakis, Edward A. Bittner, and Jonathan P. Wanderer

Using patient data from the Massachusetts General Hospital, the Risk Stratification Indices had excellent discrimination and poor calibration but the 30-day mortality Risk Quantification Index performed well.

Changes in Blood Pressure and Cardiac Output during Cesarean Delivery: The Effects of Oxytocin and Carbetocin Compared with Placebo 541

Leiv Arne Rosseland, Tor Hugo Hauge, Guro Grindheim, Audun Stubhaug, and Eldrid Langesæter

In women at cesarean delivery, oxytocin, 5 U and carbetocin 100 µg, produced a similar 25% reduction in mean arterial pressure lasting less than 2 min. Cardiac stroke volume was not increased in women receiving placebo, despite good uterine tone, questioning the autotransfusion hypothesis.

Oxytocin Pretreatment Attenuates Oxytocin-induced Contractions in Human Myometrium *In Vitro* 552

Mrinalini Balki, Magda Erik-Soussi, John Kingdom, and Jose C. A. Carvalho

In myometrial strips obtained at elective cesarean delivery from women not receiving oxytocin, *in vitro* pretreatment to oxytocin at concentrations more than 10^{-10} M reduced the subsequent contractile response to oxytocin. These data suggest that oxytocin-induced desensitization might explain the greater oxytocin dose required and greater bleeding in women at cesarean delivery who have undergone oxytocin-augmented labor.

Phasic Genioglossus and Palatoglossus Muscle Activity during Recovery from Sevoflurane Anesthesia: A Prospective Observational Study in Children 562

Ilavajady Srinivasan, Samuel Strantzas, and Mark W. Crawford

Phasic, but not tonic, inspiratory activity of the genioglossus and palatoglossus muscles increases progressively with decreasing depth of sevoflurane anesthesia in spontaneously breathing children.

Cognitive Changes after Saline or Plasmalyte Infusion in Healthy Volunteers: A Multiple Blinded, Randomized, Cross-over Trial 569

David A. Story, Lucy Lees, Laurence Weinberg, Soon-Yee Teh, Katherine J. Lee, Sarah Velissaris, Rinaldo Bellomo, and Sarah J. Wilson

In a randomized, cross-over, multiple blinded study of healthy adult volunteers using 30 ml/kg over 1 h of either 0.9% saline or Plasmalyte, the authors found that measures of cognition did not differ, despite expected differences in plasma chemistry.

A Human Volunteer Study to Identify Variability in Performance in the Cognitive Domain of the Postoperative Quality of Recovery Scale 576

Colin F. Royse, Stanton Newman, Zelda Williams, and David J. Wilkinson

The investigators propose a new scoring system that includes performance tolerance such that more than 80% of subjects are considered recovered in the cognitive domain at 3 days. There were no important differences between methods of delivery; telephone administration of the Postoperative Quality of Recovery Scale is thus, valid.

Different Propofol–Remifentanil or Sevoflurane–Remifentanil Bispectral Index Levels for Electrocorticographic Spike Identification during Epilepsy Surgery 582

Ashraf A. Dahaba, Jian Yin, Zhaoyang Xiao, Jing Su, Helmar Bornemann, Hailong Dong, and Lize Xiong

Both sevoflurane and propofol based anesthesia increased electrocorticographic spike frequency and amplitude in a dose-dependent manner at comparable bispectral index ranges. Rather than interfering with detection, deeper levels of general anesthesia might actually facilitate intraoperative electrocorticographic detection of epileptiform foci.

- ◆ ◆ **Isoflurane, a Commonly Used Volatile Anesthetic, Enhances Renal Cancer Growth and Malignant Potential *via* the Hypoxia-inducible Factor Cellular Signaling Pathway *In Vitro*** 593

Laura L. Benzonana, Nicholas J. S. Perry, Helena R. Watts, Bob Yang, Iain A. Perry, Charles Coombes, Masao Takata, and Daqing Ma

Exposure of human renal cancer cells to isoflurane (0.5–2%, 2 h) resulted in up-regulation of levels of hypoxia-inducible factor-1 α and -2 α along with enhanced cell migration and cytoskeleton rearrangements. Isoflurane promotes cancer cell growth and migration *in vitro* and hence enhances malignant potential.

- 🌐 **Sevoflurane Protects Ventricular Myocytes against Oxidative Stress-induced Cellular Ca²⁺ Overload and Hypercontracture** 606

Akiko Kojima, Hirotohi Kitagawa, Mariko Omatsu-Kanbe, Hiroshi Matsuura, and Shuichi Nosaka

Sevoflurane protected ventricular myocytes against H₂O₂-induced cellular Ca²⁺ overload and hypercontracture by correcting electrophysiological abnormalities associated with cellular Ca²⁺ handling.

- miR-21 Contributes to Xenon-conferred Amelioration of Renal Ischemia–Reperfusion Injury in Mice** 621

Ping Jia, Jie Teng, Jianzhou Zou, Yi Fang, Xiaoyan Zhang, Zeljko J. Bosnjak, Mingyu Liang, and Xiaoqiang Ding

In mice, miR-21 contributes to the renoprotective effect (attenuation of tubular damage, apoptosis, and lipid peroxidation) of Xenon *in vivo* by inhibiting apoptosis and the Akt signaling pathway.

■ CRITICAL CARE MEDICINE

- Prospective Randomized Crossover Study of a New Closed-loop Control System *versus* Pressure Support during Weaning from Mechanical Ventilation** 631

Noémie Clavieras, Marc Wysocki, Yannael Coisel, Fabrice Galia, Matthieu Conseil, Gerald Chanques, Boris Jung, Jean-Michel Arnal, Stefan Matecki, Nicolas Molinari, and Samir Jaber

Full closed-loop controlled ventilation, in comparison with pressure support ventilation, improved oxygenation, ventilatory variability and time spent in an adequate ventilation zone in critically ill patients.

- 🌐 **Unilateral Acid Aspiration Augments the Effects of Ventilator Lung Injury in the Contralateral Lung** 642

Maria Amigoni, Giacomo Bellani, Vanessa Zambelli, Margherita Scanziani, Francesca Farina, Lorella Fagnani, Roberto Latini, Roberto Fumagalli, and Antonio Pesenti

A unilateral loss of aeration can lead to ventilator-induced lung injury in the contralateral uninjured lung.


- Negative Pressure Ventilation and Positive Pressure Ventilation Promote Comparable Levels of Ventilator-induced Diaphragmatic Dysfunction in Rats** 652

Christian S. Bruells, Ashley J. Smuder, Lucy K. Reiss, Matthew B. Hudson, William Bradley Nelson, Michael P. Wiggs, Kurt J. Sollanek, Rolf Rossaint, Stefan Uhlig, and Scott K. Powers

Twelve hours of mechanical ventilation, both negative pressure and positive pressure, resulted in similar levels of ventilator-induced diaphragmatic dysfunction, and the levels of lung injury did not affect the magnitude of diaphragmatic dysfunction.

CONTENTS

■ PAIN MEDICINE

- ◆  **Fentanyl Utility Function: A Risk–Benefit Composite of Pain Relief and Breathing Responses** 663
Merel Boom, Erik Olofsen, Meike Neukirchen, René Fussen, Justin Hay, Geert Jan Groeneveld, Leon Aarts, Elise Sarton, and Albert Dahan
- During the first half hour after bolus injection of 3.5 µg/kg fentanyl, the probability of respiratory depression exceeds that of analgesia. The shape of the utility function depends on the response thresholds chosen and the rate of drug administration.
- 🌐 **Intrathecal Gabapentin to Treat Chronic Intractable Noncancer Pain** 675
Richard Rauck, Robert J. Coffey, David M. Schultz, Mark S. Wallace, Lynn R. Webster, Sally E. McCarville, Eric J. Grigsby, and Linda M. Page
- In a prospective, blinded, placebo-controlled trial conducted on a heterogeneous group of chronic pain patients, no analgesic effects were identified during 22 days of intrathecal gabapentin infusion.
- Glycemia-dependent Nuclear Factor κB Activation Contributes to Mechanical Allodynia in Rats with Chronic Postischemia Pain** 687
Marie-Christine Ross-Huot, André Laferrière, Mina Khorashadi, and Terence J. Coderre
- Nuclear factor κB, a nuclear transcription factor that is increased under hyperglycemic conditions, contributes to pain-related hypersensitivity in ischemic pain.

■ EDUCATION

IMAGES IN ANESTHESIOLOGY

- Shear Wave Elastography: Novel Technology for Ultrasound-guided Regional Anesthesia** 698
Shilpa Munirama, Joyce Joy, Roos Eisma, George Corner, Sandy Cochran, and Graeme McLeod
- Tension Pneumothorax and Widespread Pneumatosis after Endoscopic Retrograde Cholangiopancreatography** 699
Emily H. Garmon, Ed Contreras, and Joseph Conley

ANESTHESIA LITERATURE REVIEW 700

REVIEW ARTICLE

-   **Neuraxial Anesthesia in Parturients with Intracranial Pathology: A Comprehensive Review and Reassessment of Risk** 703
Lisa R. Leffert and Lee H. Schwamm

Understanding the factors that contribute to clinically significant brain tissue shifts or herniation (*e.g.*, increased intracranial pressure, brain edema, or hydrocephalus) enables anesthesiologists to determine which parturients with intracranial lesions can safely undergo neuraxial analgesia/anesthesia.

MIND TO MIND

- Some Day** 719
Richard L. Saupé
- The Terracotta Warriors** 721
Merlin D. Larson

■ CORRESPONDENCE

Should We Offer the Surgeon a Break? 724*Soren Sondergaard***Cardiac Output Monitoring Is Already Standard***Sloan C. Youngblood, Sandeep Markan, and Raja Palvadi***In Reply***Jean-Louis Vincent and David Fagnoul***In Reply***Yannick Le Manach, Chris Hofer, Benoit Vallet, Benoit Tavernier, and Maxime Cannesson***Laterality of Motor Control and Consciousness Shares the Same Hemisphere** 727*Iraj Derakhshan***In Reply***Xiaolin Liu and Anthony G. Hudetz***Postanesthesia Evaluation of Neuromuscular Function** 729*Aaron F. Kopman***In Reply***Jeffrey H. Silverstein, Jeffrey L. Apfelbaum, Richard T. Connis, David G. Nickinovich; on behalf of the American Society of Anesthesiologists Task Force on Postanesthetic Care***A Plea for the Cautious Use of Droperidol** 730*Mitchel B. Sosis***In Reply***Gregory A. Nuttall***An Updated Report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway: Where Is the Aspiration Risk Assessment?** 731*Adam I. Levine and Samuel DeMaria, Jr.***Updated Difficult Airway Algorithm: Confusing and Contradictory***Sylvia H. Wilson and Latha Hebbbar***In Reply***Robert A. Caplan, Jeffrey L. Apfelbaum, Richard T. Connis, David G. Nickinovich; on behalf of the American Society of Anesthesiologists Task Force on Management of the Difficult Airway***Hydroxyethyl Starch 130/0.4 and Postoperative Acute Kidney Injury** 733*A. B. Johan Groeneveld, Roberta J. Navickis, and Mahlon M. Wilkes***Hydroxyethyl Starch 130/0.4: Safe for the Kidney in Surgical Patients?***Christian J. Wiedermann***In Reply***Claude Martin, Matthias Jacob, Eric Vicaut, Bertrand Guidet, Hugo Van Aken, and Andrea Kurz*

Epidural and Continuous Wound Infusion in Enhanced Recovery Protocols 737*Daniel Harper***In Reply***Emmanuel Futier, Antoine Petit, and Jean-Etienne Bazin***Transparent Guideline Methodology Needed** 739*Ingeborg Lidal, Camilla Norén, and Marjukka Mäkelä***In Reply***Jeffrey L. Apfelbaum, Stephen M. Rupp, Richard T. Connis, David G. Nickinovich;
on behalf of the American Society of Anesthesiologists Task Force on Central Venous Access*■ **REVIEWS OF EDUCATIONAL MATERIAL** 742■ **CAREERS & EVENTS** 25A**INSTRUCTIONS FOR AUTHORS**

The most recently updated version of the Instructions for Authors is available at 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., Department of Anesthesiology, Northwestern University Feinberg School of Medicine, Ward Memorial Building, Room 13-199, 303 East Chicago Avenue, Chicago, IL 60611-3008. Requests for permission to duplicate materials published in ANESTHESIOLOGY should be submitted in electronic format, to the Permissions Department (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.lww.com/advertisingratecards/>). 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 © 2013, the American Society of Anesthesiologists, Inc.

Annual Subscription Rates: *United States*—\$719 Individual, \$1309 Institution, \$289 In-training. *Rest of World*—\$759 Individual, \$1454 Institution, \$289 In-training. Single copy rate \$126. 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.

Individual and in-training subscription rates include print and access to the online version. Online-only subscriptions for individuals (\$245) and persons in training (\$245) 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 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. 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: bclaim@lwwis.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.

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. 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.

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. 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.