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Perioperative Medicine

CLINICAL SCIENCE

🌐 ◆ **Saline versus Lactated Ringer's Solution: The Saline or Lactated Ringer's (SOLAR) Trial**
👁️ *K. Maheshwari, A. Turan, N. Makarova, C. Ma, W. A. S. Esa, K. Ruetzler, S. Barsoum, A. G. Kuhel, M. R. Ritchey, C. Higuera-Rueda, T. Kopyeva, L. Stocchi, H. Essber, B. Cohen, I. Suleiman, G. R. Bajracharya, D. Chelnick, E. J. Mascha, A. Kurz, D. I. Sessler* 614

In a large single-center alternating cohort trial of patients having elective colorectal or orthopedic surgery, there was no clinically meaningful difference in the risk of a composite of in-hospital mortality and major postoperative complications including renal, respiratory, infectious, and hemorrhagic complications.

🌐 ◆ **Cannabis Use Disorder and Perioperative Outcomes in Major Elective Surgeries: A Retrospective Cohort Analysis**
👁️ *A. Goel, B. McGuinness, N. K. Jivraj, D. N. Wijeyesundera, M. A. Mittleman, B. T. Bateman, H. Clarke, L. P. Kotra, K. S. Ladha* ... 625

In the United States, administrative data demonstrate that cannabis use disorder has increased in prevalence from 2010 to 2015. Active cannabis use disorder is not associated with a change in overall perioperative morbidity, mortality, length of stay, or costs. However, active cannabis use disorder is associated with a meaningful increase in the risk of postoperative myocardial infarction.

🌐 **Pharmacokinetics and Pharmacodynamics of Remimazolam (CNS 7056) after Continuous Infusion in Healthy Male Volunteers: Part I. Pharmacokinetics and Clinical Pharmacodynamics**
J. Schüttler, A. Eisenried, M. Lerch, J. Fechner, C. Jeleazcov, H. Ihmsen 636

Twenty adult male volunteers receiving remimazolam as continuous intravenous infusion at 5 mg/min for 5 min, then 3 mg/min for 15 min, and 1 mg/min for 15 min lost consciousness 5 ± 1 (mean \pm SD) min after starting the infusion and were fully alert 19 ± 7 min after stopping it. Remimazolam produced moderate hemodynamic effects and no clinically significant effect on cardiac repolarization. The disposition of remimazolam was characterized by a multicompartmental pharmacokinetic model with small distribution volumes and a high elimination clearance with small interindividual variability; its context-sensitive half time after a 4-h infusion was predicted to be 7 ± 2 min.

◆ Refers to This Month in ANESTHESIOLOGY

◆ Refers to Editorials

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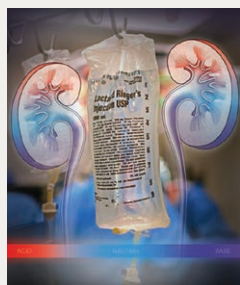
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ON THE COVER: Both saline and lactated Ringer's solution are commonly given to surgical patients. However, hyperchloremic acidosis consequent to saline administration may provoke complications. In this issue of ANESTHESIOLOGY, Maheshwari *et al.* tested the primary hypothesis that a composite of in-hospital mortality and major postoperative complications is less common in patients given lactated Ringer's solution rather than normal saline. In an accompanying editorial, Story places this new trial into perspective and warns against the generalizability to frail patients and those requiring large volumes of intravenous fluids. Cover illustration: S. Jarret, M.F.A., C.M.I. Cover photo: J. P. Rathmell.

- Maheshwari *et al.*: Saline versus Lactated Ringer's Solution: The Saline or Lactated Ringer's (SOLAR) Trial, p. 614
- Story: Intravenous Fluids: Which Recipe? p. 609

Pharmacokinetics and Pharmacodynamics of Remimazolam (CNS 7056) after Continuous Infusion in Healthy Male Volunteers: Part II. Pharmacodynamics of Electroencephalogram Effects

A. Eisenried, J. Schüttler, M. Lerch, H. Ihmsen, C. Jeleazcov.....652

Electroencephalogram changes during remimazolam infusion in 20 adult male volunteers were characterized by an initial increase in the beta frequency band and a late increase in the delta frequency band. Beta ratio had a monotonic relationship to Modified Observer's Assessment of Alertness and Sedation scores and could be modeled using a standard sigmoid E_{max} pharmacodynamic model. The standard sigmoid E_{max} model failed to describe the time course of the Narcotrend Index appropriately; it was necessary to extend the model by adding a second sigmoid term with a second effect site concentration.

Intraabdominal Pressure Targeted Positive End-expiratory Pressure during Laparoscopic Surgery: An Open-label, Nonrandomized, Crossover, Clinical Trial

G. Mazzinari, O. Diaz-Cambronero, J. M. Alonso-Iñigo, N. Garcia-Gregorio, B. Ayas-Montero, J. L. Ibañez, A. S. Neto, L. Ball, M. Gama de Abreu, P. Pelosi, J. Maupoey, M. P. A. Navarro, M. J. Schultz667

This single-center study found that titrating intraoperative positive end-expiratory pressure in relation to observed intraabdominal pressure may counterbalance pneumoperitoneum-related rises in transpulmonary driving pressure during laparoscopic cholecystectomies.

Dexamethasone Dose and Early Postoperative Recovery after Mastectomy: A Double-blind, Randomized Trial

K. J. Steinhorsdottir, H. N. Awada, H. Abildstrøm, N. Kroman, H. Kehlet, E. K. Aasvang.....678

Dexamethasone (24 mg) did not increase the number of patients eligible to skip the postanesthetic care unit. Pain scores were low and nausea rare in both groups. Dexamethasone 24 mg was not preferable to 8 mg.

One-year Results of a Factorial Randomized Trial of Aspirin versus Placebo and Clonidine versus Placebo in Patients Having Noncardiac Surgery

D. I. Sessler, D. Conen, K. Leslie, S. Yusuf, E. Popova, M. Graham, A. Kurz, J. C. Villar, M. Mrkobrada, A. Sigamani, B. M. Biccand, C. S. Meyhoff, J. L. Parlow, G. Guyatt, D. Xavier, M. T. V. Chan, P. A. Kumar, P. Forget, G. Malaga, E. Fleischmann, M. Amir, D. Torres, C. Y. Wang, P. Paniagua, O. Berwanger, S. Srinathan, G. Landoni, Y. Le Manach, R. Whitlock, A. Lamy, K. Balasubramanian, I. Gilron, A. Turan, S. Pettit, P. J. Devereaux, on behalf of the Perioperative Ischemic Evaluation-2 Trial (POISE-2) Investigators.....692

This article reports 1-yr outcomes of the POISE-2 study. Consistent with the 30-day analysis, neither aspirin nor clonidine reduced a 1-yr composite of nonfatal myocardial infarction or death. In a subgroup analysis of patients who had prior percutaneous coronary interventions, those given aspirin had significantly fewer nonfatal myocardial infarctions and/or deaths.

Intrathecal Morphine and Pulmonary Complications after Arthroplasty in Patients with Obstructive Sleep Apnea: A Retrospective Cohort Study

J. W. Bai, M. Singh, A. Short, D. Bozak, F. Chung, V. W. S. Chan, A. Bhatia, A. Perlas.....702

Low-dose intrathecal morphine, in conjunction with multimodal analgesia, was not associated with increased risk of postoperative pulmonary complications in patients with obstructive sleep apnea.

Socioeconomic Status and Days Alive and Out of Hospital after Major Elective Noncardiac Surgery: A Population-based Cohort Study

A. Jerath, P. C. Austin, D. T. Ko, H. C. Wijeyesundera, S. Fremes, D. McCormack, D. N. Wijeyesundera.....713

The investigators evaluated more than 700,000 patients who had 13 types of surgery. Days alive and out of hospital in the initial postoperative months was about a quarter of a day shorter in the lowest than the highest socioeconomic quintile, adjusted for potential confounding factors. Confounder-adjusted serious complications were also more common in the lowest quintile (5% vs. 3.9%), as was mortality (0.6% vs. 0.4%).

Artifact Processing Methods Influence on Intraoperative Hypotension Quantification and Outcome Effect Estimates

W. Pasma, L. M. Peelen, S. van Buuren, W. A. van Klei, J. C. de Graaff.....723

The authors identified 38 papers describing blood pressure artifact-handling methods, and applied eight methods to nearly 3,000 anesthetics. The amount of observed hypotension at various thresholds varied considerably depending on the filtration method. Investigators need to carefully consider artifact handling, and fully describe their methodology.

Classification of Current Procedural Terminology Codes from Electronic Health Record Data Using Machine Learning

M. L. Burns, M. R. Mathis, J. Vandervest, X. Tan, B. Lu, D. A. Colquhoun, N. Shah, S. Kheterpal, L. Saager738

The application of machine learning and natural language processing techniques facilitate a more rapid creation of accurate real-time models for Current Procedural Terminology code classification. The potential benefits of this approach include performance optimization and cost reduction for quality improvement, research, and reimbursement tasks that rely on anesthesiology procedure codes.

BASIC SCIENCE

Dynamics of Ketamine-induced Loss and Return of Consciousness across Primate Neocortex

J. J. Ballesteros, P. Huang, S. R. Patel, E. N. Eskandar, Y. Ishizawa....750

In a study of nonhuman primates and continuous ketamine administration, the authors demonstrate a unique and gradual evolution of high-frequency and low-frequency neural activity, which distinguish the effects of ketamine from the dynamics of propofol-induced unconsciousness.

- 🌐 **Transcription-independent Induction of ERBB1 through Hypoxia-inducible Factor 2A Provides Cardioprotection during Ischemia and Reperfusion**
J. W. Lee, M. Koepfen, S.-W. Seo, J. L. Bowser, X. Yuan, J. Li, M. Sibilia, A. V. Ambardekar, X. Zhang, T. Eckle, S.-H. Yoo, H. K. Eltzschig763

This study found that hypoxia-inducible factor 2A enhances expression of epidermal growth factor receptor 1 (ERBB1) in the myocardium in the setting of ischemia. This leads to cardioprotection through activation of the phosphatidylinositol 3-kinase/protein kinase B (Akt) signaling pathway.

- 🌐 **Individualized Positive End-expiratory Pressure and Regional Gas Exchange in Porcine Lung Injury**
T. Muders, H. Luepschen, T. Meier, A. W. Reske, J. Zinserling, S. Kreyer, R. Pikkemaat, E. Maripu, S. Leonhardt, G. Hedenstierna, C. Putensen, H. Wrigge.....808

In a porcine model of induced acute lung injury, with increased abdominal pressure caused by intraperitoneal saline infusion, using a crossover design, tracheostomized animals were ventilated using: (1) positive end-expiratory pressure (PEEP) table-based low PEEP without lung recruitment; (2) minimal tidal recruitment PEEP guided by electrical impedance tomography with recruitment; and (3) maximal oxygenation PEEP with recruitment. Using a PEEP table and no recruitment, compared with recruitment and either minimal tidal recruitment PEEP or maximal oxygenation PEEP, resulted in less delivered PEEP, and more lung collapse and regional ventilation/perfusion mismatch. The latter two methods had comparable results.

Critical Care Medicine

CLINICAL SCIENCE

- Ultrasound to Detect Central Venous Catheter Placement Associated Complications: A Multicenter Diagnostic Accuracy Study**
J. M. Smit, M. E. Haaksma, E. H. T. Lim, T. S. Steenvoorden, M. J. Blans, F. H. Bosch, M. Petjak, B. Vermin, H. R. W. Touw, A. R. J. Girbes, L. M. A. Heunks, P. R. Tuinman.....781

This prospective multicenter diagnostic accuracy study found that ultrasound can detect central line malposition with moderate sensitivity and high specificity. This study found that there is moderate agreement between chest x-ray film and ultrasound detection of central line-related pneumothorax.

BASIC SCIENCE

- 🌐 ◇ **Neutralizing Complement C5a Protects Mice with Pneumococcal Pulmonary Sepsis**
📺 *H. Müller-Redetzky, U. Kellermann, S.-M. Wienhold, B. Gutbier, J. Lienau, K. Hellwig, K. Reppe, E. Letsiou, T. Tschernig, M. Scholz, P. Ahnert, C. Maasch, K. Hoehlig, S. Klusmann, A. Vater, T. C. Firsching, J. Hoppe, N. Suttrop, M. Witzenrath*.....795

In hospitalized patients with community-acquired pneumonia, serum C5a concentrations were 1.4-fold higher compared to healthy subjects. In two mouse models of pneumonia and sepsis, NOX-D19, a C5a-neutralizing L-RNA-aptamer, caused lower pulmonary hyperpermeability and sepsis-related acute liver injury.

- 🌐 **Reconstituted High-density Lipoprotein Therapy Improves Survival in Mouse Models of Sepsis**
S. Tanaka, C. Genève, N. Zappella, J. Yong-Sang, C. Planesse, L. Louedec, W. Viranaïcken, M. Bringart, P. Montravers, E. Denamur, J. Duranteau, D. Couret, O. Meilhac825

A human injectable formulation of reconstituted high-density lipoprotein, CSL-111, composed of apolipoprotein A1 and phosphatidylcholines, was tested in three mouse models of sepsis. When administered soon after the insult causing sepsis, CSL-111 improved survival and reduced lung injury, apparent neutrophil activation, and plasma markers of inflammation, but not cytokine concentrations.

Pain Medicine

CLINICAL SCIENCE

- 📺 ◇ **Subomohyoid Anterior Suprascapular Block versus Interscalene Block for Arthroscopic Shoulder Surgery: A Multicenter Randomized Trial**
👁️ *F. W. Abdallah, D. N. Wijeyesundera, A. Laupacis, R. Brull, A. Mocon, N. Hussain, K. E. Thorpe, V. W. S. Chan*839

Subomohyoid anterior suprascapular block is noninferior to interscalene block in providing analgesia for the first 24 h after shoulder surgery. Subomohyoid anterior suprascapular block does not appear to differ significantly from interscalene block in terms of superior trunk blockade or overall quality of recovery.

🌐 Suture-method *versus* Through-the-needle Catheters for Continuous Popliteal-sciatic Nerve Blocks: A Randomized Clinical Trial

J. J. Finneran IV, M. W. Swisher, R. A. Gabriel, E. T. Said, M. U. Abanobi, W. B. Abramson, D. J. Dalstrom, A. K. Schwartz, W. T. Kent, D. Yang, E. J. Mascha, B. M. Ilfeld854

A novel catheter attached to the back of a suture-shaped needle can be inserted under ultrasound guidance to provide popliteal-sciatic nerve blockade. In the first two days after foot and ankle surgery, analgesia provided using the suture-type catheters was found to be noninferior to that provided by conventional through-the-needle catheters.

BASIC SCIENCE

🌐 Aldosterone Synthase in Peripheral Sensory Neurons Contributes to Mechanical Hypersensitivity during Local Inflammation in Rats

D. M. Mohamed, M. Shaqura, X. Li, M. Shakibaei, A. Beyer, S. Treskatsch, M. Schäfer, S. A. Mousa867

Extra-adrenal production of aldosterone by aldosterone synthase within peripheral sensory neurons contributes to ongoing mechanical hypersensitivity *via* intrinsic activation of neuronal mineralocorticoid receptors. Intrathecally-applied aldosterone synthase inhibitor reduced aldosterone content in peripheral sensory neurons and subsequently attenuated enhanced mechanical hypersensitivity resulting from local inflammation.

Supraspinal Opioid Circuits Differentially Modulate Spinal Neuronal Responses in Neuropathic Rats

A. H. Dickenson, E. Navratilova, R. Patel, F. Porreca, K. Bannister881

In vivo electrophysiologic recordings from the dorsal horn of the spinal cord in male rats reveal differential effects of morphine at the anterior cingulate cortex, right amygdala, and ventromedial medulla on evoked pain responses. These data differentiate supraspinal opioid circuit regulation of spinal nociceptive processing and suggest that the regulation of sensory and affective components of pain are likely separate.

Education

IMAGES IN ANESTHESIOLOGY

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ORIGINAL INVESTIGATION IN EDUCATION

🌐 Lung Ultrasound in Emergency and Critically Ill Patients: Number of Supervised Exams to Reach Basic Competence

C. Arbelot, F. L. D. Neto, Y. Gao, H. Brisson, W. Chunyao, J. Lv, C. S. V. Barbas, S. Perbet, F. P. Caltabellotta, F. Gay, R. Deransy, E. J. S. Lima, A. Cebey, A. Monsel, J. Neves, M. Zhang, D. Bin, Y. An, L. Malbouisson, J. Salluh, J.-M. Constantin, J.-J. Rouby, for the APECHO Study Group899

A multicenter, international study was conducted in 10 intensive care units among residents and staff in anesthesiology, critical care, emergency medicine, and internal medicine who underwent supervised training to determine the number of exams required to achieve basic competence. After 25 supervised examinations, 80% of lung regions were adequately classified by trainees. Ultrasound exam average duration was 8 to 10 min in experts and decreased from 19 (after 5 exams) to 12 min (after 25 exams) in trainees.

CLINICAL FOCUS REVIEW

◇ Perioperative Point-of-Care Ultrasound: From Concept to Application
D. Ramsingh, Y. S. Bronshteyn, S. Haskins, J. Zimmerman908

This Clinical Focus Review targets all anesthesiologists and seeks to highlight the following aspects of perioperative point-of-care ultrasound: clinical utility, technology advancements, training/certification, education, reporting/billing, and limitations.

◇ Anesthetic Implications of Button Battery Ingestion in Children
J. B. Eck, W. A. Ames917

Button battery ingestion in children has been associated with significant morbidity and mortality. The mechanisms of injury, potential complications, mitigation strategies, and the underlying urgent need for battery removal are reviewed.

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