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# ANESTHESIOLOGY

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**Special Article**

◆ **Development of Rapid Response Capabilities in a Large COVID-19 Alternate Care Site Using Failure Modes and Effect Analysis with *In Situ* Simulation**  
*N. Levy, L. Zucco, R. J. Ehrlichman, R. E. Hirschberg, S. H. Johnson, M. B. Yaffe, S. K. Ramachandran, S. Bose, A. Leibowitz* .....985

Rapid response and critical care capabilities were established within a COVID-19 field hospital serving Eastern Massachusetts. Successful implementation of this service through continuous analysis, iterative change, and *in situ* simulation provides a framework for future planning.

**Perioperative Medicine**

**CLINICAL SCIENCE**

◆ ◆ **Clinical Evaluation of a High-fidelity Upper Arm Cuff to Measure Arterial Blood Pressure during Noncardiac Surgery**  
*J. Briegel, T. Böhner, A. Kreitmeyer, P. Conter, L. Fraccaroli, A. S. Meidert, M. Tholl, G. Papadakis, A. Deunert, A. Bauer, A. Hoefl, U. J. Pfeiffer* .....997

A novel noninvasive upper arm system using hydraulic coupling technology provides accurate and precise estimates of the systolic, mean, and diastolic pressure compared with direct measurements of the femoral arteries.

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◇ Refers to This Month in ANESTHESIOLOGY

◆ Refers to Editorial

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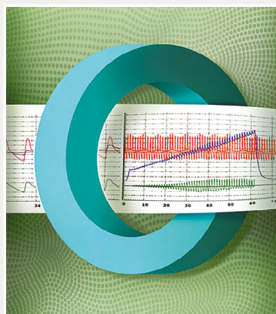
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**ON THE COVER:** In most patients having noncardiac surgery, blood pressure is measured using oscillometry *via* an upper arm cuff. Although the method is noninvasive and practical, it is known to overestimate intra-arterial pressure in hypotension and to underestimate it in hypertension. In this issue of ANESTHESIOLOGY, Briegel *et al.* tested a new high-fidelity upper arm cuff incorporating a hydraulic sensor pad. In an accompanying Editorial, Saugel *et al.* discuss the performance and practicality of using this innovative new method for noninvasive intermittent blood pressure monitoring. Cover Illustration: A. Johnson, Vivo Visuals.

- Briegel *et al.*: Clinical Evaluation of a High-fidelity Upper Arm Cuff to Measure Arterial Blood Pressure during Noncardiac Surgery, p. 997
- Saugel *et al.*: Hydraulic Coupling: A New Method for Noninvasive Intermittent Blood Pressure Monitoring, p. 964

-   **Early Childhood General Anesthesia and Neurodevelopmental Outcomes in the Avon Longitudinal Study of Parents and Children Birth Cohort**  
 *G. J. Walkden, H. Gill, N. M. Davies, A. E. Peters, I. Wright, A. E. Pickering*.....1007

**OPEN**

In a large longitudinal human birth cohort comparing children who were exposed or not to anesthesia and surgery before 4 yr, there was no evidence for a global picture of clinically and statistically significant long-term neurotoxic effects in a comprehensive array of neurodevelopmental measures between 7 and 16 yr of age. However, among the 46 neurodevelopmental outcomes assessed, there was evidence of an increased risk of poorer motor function measured by dynamic balance in multiply exposed children and lower manual dexterity in multiply and singly exposed children, and social communication scores were also lower in multiply and singly exposed children. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*




-   **Dissociative and Analgesic Properties of Ketamine Are Independent**  
 *J. Gitlin, S. Chamadia, J. J. Locascio, B. R. Ethridge, J. C. Pedemonte, E. Y. Hahm, R. Ibalá, J. Mekonnen, K. M. Colon, J. Qu, O. Akeju*.....1021

The hypothesis that the dissociative and analgesic properties of ketamine are independent was tested in healthy subjects that received 2 mg/kg ketamine, and then, 2 mg of midazolam at a later timepoint. Ketamine-induced analgesia had no strong inherent relationship with ketamine-induced dissociation beyond being independently modulated by ketamine. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*




-   **Perioperative Open-lung Approach, Regional Ventilation, and Lung Injury in Cardiac Surgery: A PROVECS Trial Substudy**  
 *D. Lagier, L. J. Velly, B. Guinard, N. Bruder, C. Guidon, M. F. Vidal Melo, M.-C. Alessi*.....1029

After induction, tidal volume was redistributed to ventral regions with a statistically significant higher dorsal fraction of ventilation in the open-lung group. However, this effect was transient with no differences noted at the end of surgery or in extubated patients at postoperative day 2. Significantly higher intraoperative levels of the soluble form of the receptor for advanced glycation end-products were noted in the open-lung group, suggestive of epithelial damage from lung overdistention.

## BASIC SCIENCE

-   **Competitive Interactions between Halothane and Isoflurane at the Carotid Body and TASK Channels**  
 *J. J. Pandit, N. Huskens, P. B. O'Donoghue, P. J. Turner, K. J. Buckler*.....1046

*In vitro*, both halothane and isoflurane depressed hypoxia-evoked rise in intracellular calcium in rat carotid body cells, and activated TASK potassium channels. At equivalent concentrations, halothane exhibited stronger effects on hypoxic responses and TASK channel activation than isoflurane, but coapplications of these two drugs resulted in lesser effects than halothane alone. These observations suggest that isoflurane and halothane act as competitive agonists on TASK channels where the weaker agonist (isoflurane) antagonizes the effects of the stronger agonist (halothane). *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

-   **Lung Atelectasis Promotes Immune and Barrier Dysfunction as Revealed by Transcriptome Sequencing in Female Sheep**  
 *C. Zeng, G. C. Motta-Ribeiro, T. Hinoshita, M. A. Lessa, T. Winkler, K. Grogg, N. M. Kingston, J. N. Hutchinson, L. M. Sholl, X. Fang, X. Varelas, M. D. Layne, R. M. Baron, M. F. Vidal Melo*.....1060

Atelectasis alone dysregulated the local pulmonary transcriptome with negatively enriched immune response and alveolar–capillary barrier function. With associated systemic inflammation, the local immune response was positively enhanced while barrier function response remained negatively enriched. Interferon-simulated genes and Yes-associated protein appear to have important regulatory roles and may be novel candidate targets for therapy of atelectasis-associated injury. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

- Left Ventricular Hypertrophy Increases Susceptibility to Bupivacaine-induced Cardiotoxicity through Overexpression of Transient Receptor Potential Canonical Channels in Rats**  
*H. Hino, T. Matsuura, M. Kuno, K. Hori, S. Tsujikawa, T. Mori, K. Nishikawa*.....1077

This study compared male rats that underwent aortic constriction to induce left ventricular hypertrophy to male rats who underwent sham intervention. The rats were given intravenous bupivacaine, and the rats with left ventricular hypertrophy experienced a significantly shorter time to develop wide QRS complexes and a shorter time to develop cardiac arrest. Transient receptor potential canonical-3 channels were significantly upregulated in the myocardium of rats with left ventricular hypertrophy, and transient receptor potential canonical-3 channels exhibit the “pore phenomena,” which is a potential mechanism contributing to increased susceptibility to bupivacaine-induced cardiotoxicity.

## Critical Care Medicine

### BASIC SCIENCE

- ◆ **Positional Therapy and Regional Pulmonary Ventilation: High-resolution Alignment of Prone and Supine Computed Tomography Images in a Large Animal Model**  
*Y. Xin, M. Cereda, H. Hamedani, K. T. Martin, N. J. Tustison, M. Pourfathi, S. Kadlecsek, S. Siddiqui, F. Amzajerjian, M. Connell, N. Abate, A. Kajanaku, I. Duncan, J. C. Gee, R. R. Rizi*.....1093

The authors utilized their previously reported computed tomography data from five mechanically ventilated sedated pigs before and after lung injury by tracheal administration of hydrochloric acid to assess positional inflation characteristics in response to supine and prone positioning and two levels of positive end-expiratory pressure (5 and 10 cm H<sub>2</sub>O) applied in random order. Regional cluster distributions of units of paired, digitally aligned prone and supine lung tissue according to density and deformation dimensions (deflation, stable density/volume, and reinflation) were analyzed. Patterns followed both gravitational and nongravitational distributions. Reinflation was concentrated in the caudal lung region near the dorsal portion of the diaphragm. Recruitment of nonaerated tissue contributed to reinflation in this region after injury. The demonstrated clinical benefits of prone positioning may be related to localized changes (recruitment or reinflation) in the dorso-caudal lung region, a hypothesis that awaits further testing. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

- ◆ **Low Spontaneous Breathing Effort during Extracorporeal Membrane Oxygenation in a Porcine Model of Severe Acute Respiratory Distress Syndrome**  
*S. Dubo, V. Oviedo, A. Garcia, L. Alegría, P. García, E. D. Valenzuela, L. F. Damiani, J. Araos, T. Medina, M. C. Bachmann, R. Basoalto, S. Bravo, D. Soto, P. Cruces, P. Guzmán, J. Retamal, R. Cornejo, G. Bugeño, P. Brebí, A. Bruhn*.....1106

The authors compared spontaneous ventilation with low breathing efforts in pressure support mode (10 cm H<sub>2</sub>O) with positive end-expiratory pressure (10 cm H<sub>2</sub>O) versus near-apneic ventilation (driving pressure, 10 cm H<sub>2</sub>O; respiratory rate, 5/min; positive end-expiratory pressure, 10 cm H<sub>2</sub>O) in pigs subjected to experimental lung injury and connected to extracorporeal membrane oxygenation evaluating hemodynamic and respiratory parameters along with postmortem lung histology after 21 h of allocated ventilation. Spontaneously ventilating pigs exhibited markedly higher respiratory rates but similar tidal volumes with higher dorsal ventilation. No differences in lung histology were noted between groups, suggesting that this protocol may be of potential clinical use. *SUPPLEMENTAL DIGITAL CONTENT IS AVAILABLE IN THE TEXT*

## Education

### IMAGES IN ANESTHESIOLOGY

- Adaptation Allowing for Bronchial Blocker Proximal Port Filtration during Lung Isolation for Patients with Airborne Precautions**  
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*K. T. Shelton, J. P. Wiener-Kronish*.....1120

The role of cardiothoracic anesthesiology intensivists has expanded over the past few decades. Cardiothoracic anesthesiology intensivists are taking on larger roles in cardiac critical care specializing in cardiogenic shock and extracorporeal membrane oxygenation.

### REVIEW ARTICLE

- ◆ **Cryoneurolysis and Percutaneous Peripheral Nerve Stimulation to Treat Acute Pain: A Narrative Review**  
*B. M. Ilfeld, J. J. Finneran IV*.....1127

Two alternative regional analgesics are presented. Cryoneurolysis reversibly ablates peripheral nerves lasting weeks to months. Percutaneous peripheral nerve stimulation results in no sensory or motor deficits and may be used for up to 60 days.

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