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# ANESTHESIOLOGY

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## Perioperative Medicine

### CLINICAL SCIENCE

#### ◆ ◇ Dynamic Cortical Connectivity during General Anesthesia in Healthy Volunteers

 *D. Li, P. E. Vlisides, M. B. Kelz, M. S. Avidan, G. A. Mashour, for the ReCCognition Study Group* .....870

Despite a stable surgical level of anesthesia and the absence of noxious stimuli, connectivity patterns are not static but rather fluctuate dynamically and nonrandomly over time. These results suggest that single or static connectivity patterns may not be able to discriminate levels of consciousness.

#### ◆ ◇ Dynamic Cortical Connectivity during General Anesthesia in Surgical Patients

*P. E. Vlisides, D. Li, M. Zierau, A. P. Lapointe, K. I. Ip, A. M. McKinney, G. A. Mashour* .....885

During anesthesia and surgery, cortical networks display a dynamic interplay among brain states, rather than a static equilibrium. These findings suggest that a single measure of connectivity may not be a reliable correlate of surgical anesthesia depth.

#### ◇ Changes in Whole Brain Dynamics and Connectivity Patterns during Sevoflurane- and Propofol-induced Unconsciousness Identified by Functional Magnetic Resonance Imaging

*D. Golkowski, S. K. Larroque, A. Vanhaudenhuyse, A. Plenevaux, M. Boly, C. Di Perri, A. Ranft, G. Schneider, S. Laureys, D. Jordan, V. Bonhomme, R. Ilg* .....898

In a volunteer functional magnetic resonance study, general anesthesia reduced activity within and among networks. Specific between-network connectivity is necessary for consciousness.


#### ◆ ◇ Adverse Events and Factors Associated with Potentially Avoidable Use of General Anesthesia in Cesarean Deliveries

*J. Guglielminotti, R. Landau, G. Li* .....912

In New York State, 5.7% of cesarean sections without a clinical indication for general anesthesia are performed with general anesthesia. The use of potentially avoidable general anesthesia in these patients is associated with an increased risk of anesthesia-related complications, surgical site infection, and venous thromboembolism, but not death or cardiac arrest.

◇ Refers to This Month in ANESTHESIOLOGY

◆ Refers to Editorial Views

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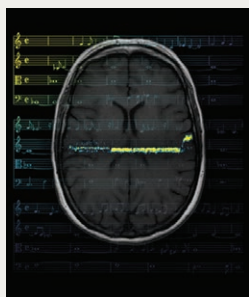
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**ON THE COVER:** Recent studies of anesthetic-induced unconsciousness have focused on functional brain connectivity patterns, but questions about the dynamic nature of these connectivity patterns remain unanswered. In this issue of ANESTHESIOLOGY, three original research articles examine dynamic cortical connectivity during general anesthesia in human volunteers and surgical patients, demonstrating that there is no single fixed state of cortical connectivity during general anesthesia. In an accompanying Editorial View, Sleight and Pullon compare the function of the conscious brain to that of an orchestra making music with an evolving balance of synchrony and syncopation, harmony and dissonance, regularity and surprise. Cover illustration: S. M. Jarret, M.F.A., C.M.I.

- Li *et al.*: Dynamic Cortical Connectivity during General Anesthesia in Healthy Volunteers, p. 870
- Vlisides *et al.*: Dynamic Cortical Connectivity during General Anesthesia in Surgical Patients, p. 885
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### Increased Reactivity of the Mesolimbic Reward System after Ketamine Injection in Patients with Treatment-resistant Major Depressive Disorder

V. Sterpenich, S. Vidal, J. Hofmeister, G. Michalopoulos, V. Bancila, D. Warrot, A. Dayer, M. Desseilles, J.-M. Aubry, M. Kosel, S. Schwartz, L. Vutsits.....923

As expected, ketamine administration led to an improvement in mood and global vigilance. The improvement in mood was accompanied by an increased recruitment of the orbitofrontal cortex, ventral striatum, medial substantial nigra and ventral tegmental area, structures that are part of the reward circuitry. Responses in the mesolimbic structures (amygdala, medial substantial nigra and ventral tegmental area, orbitofrontal cortex) to negative stimuli were decreased after ketamine administration. The data are consistent with the premise that ketamine induces sustained changes in the mesolimbic neural circuits to reset pathological reward and emotional processing.

### 👁️ ◇ Opioid Sensitivity in Children with and without Obstructive Sleep Apnea

M. C. Montana, L. Juriga, A. Sharma, E. D. Kharasch.....936

The authors hypothesized that children with obstructive sleep apnea would be more sensitive to the effects of an opioid (remifentanyl) on pupil size—a very good indicator of opioid effects. While remifentanyl did reduce pupil size in the expected dose-related fashion, there were no differences between children with obstructive sleep apnea and those without. While the authors did not observe any differences in the effect of remifentanyl on respiration, the study was not designed to examine this factor in detail.

### 👁️ ◇ Nasopharyngeal Tube Effects on Breathing during Sedation for Dental Procedures: A Randomized Controlled Trial

Y. Kohzuka, S. Isono, S. Ohara, K. Kawabata, A. Kitamura, T. Suzuki, F. R. Almeida, Y. Sato, T. Iijima.....946

Apnea and hypopnea occur frequently during dental procedures under sedation. The majority of the events are not detectable with pulse oximetry. Insertion of a nasal tube with small diameter does not reduce the incidence of apnea/hypopnea.

### 🌐 ◇ Intravenous Lidocaine Does Not Improve Neurologic Outcomes after Cardiac Surgery: A Randomized Controlled Trial



R. Y. Klinger, M. Cooter, T. Bisanar, N. Terrando, M. Berger, M. V. Podgoreanu, M. Stafford-Smith, M. F. Newman, J. P. Mathew, for the Neurologic Outcomes Research Group of the Duke Heart Center.....958

This multicenter trial of intravenous lidocaine administered during and after cardiac surgery did not show an effect on cognition at 6 weeks postoperatively.

### 🌐 ◇ Pediatric Risk Stratification Is Improved by Integrating Both Patient Comorbidities and Intrinsic Surgical Risk

V. G. Nasr, S. J. Staffa, D. Zurakowski, J. A. DiNardo, D. Faraoni.....971

Surgical procedures identified by specialty are not independent risk factors for perioperative mortality in pediatric patients. However, in multivariable predictive algorithms, the interaction of patient comorbidities with the intrinsic risk of the surgical procedure strongly predicts 30-day mortality.

## BASIC SCIENCE

### 🌐 Disruption of Rapid Eye Movement Sleep Homeostasis in Adolescent Rats after Neonatal Anesthesia

N. Lunardi, R. Sica, N. Atluri, K. A. Salvati, C. Keller, M. P. Beenhakker, H. P. Goodkin, Z. Zuo.....981

Anesthesia with isoflurane, nitrous oxide, and midazolam on postnatal day 7 is associated with alterations in sleep architecture three weeks later in adolescent rats.

### 🌐 Breathing under Anesthesia: A Key Role for the Retrotrapezoid Nucleus Revealed by Conditional *Phox2b* Mutant Mice

T. Bourgeois, M. Ringot, N. Ramanantsoa, B. Matrot, S. Dauger, C. Delclaux, J. Gallego.....995

Ketamine, propofol, and fentanyl caused lethal respiratory failure in most mice with selective genetic loss of retrotrapezoid nucleus neurons, at doses that were safe in their wild type littermates.

## Pain Medicine

## BASIC SCIENCE

### Extrafascicular and Intraperineural, but No Endoneural, Spread after Deliberate Intraneural Injections in a Cadaveric Study

M. A. Reina, X. Sala-Blanch, E. Monzó, O. C. Nin, P. E. Bigeleisen, A. P. Boezaart.....1007

Using the ultrasound-guided injection of heparinized blood into the nerves of cadavers, the extrafascicular spread of injectate was observed. Intra-fascicular spread of injectate was rarely observed, making this an unlikely route of nerve damage after accidental intraneural injection.


### ◇ Activating $\alpha\beta 2$ Nicotinic Acetylcholine Receptors Alleviates Fentanyl-induced Respiratory Depression in Rats

J. Ren, X. Ding, J. J. Greer.....1017



The nonselective nicotinic acetylcholine receptor agonist nicotine and the  $\alpha 4\beta 2$  nicotinic acetylcholine receptor agonist A85380, but not the  $\alpha 7$  nicotinic acetylcholine receptor agonist PNU282987, reversed respiratory depression induced by activation of  $\mu$ -opioid receptors in rats both *in vitro* and *in vivo*. Coadministration of A85380 with fentanyl not only markedly reduced respiratory depression and apneas but also enhanced the fentanyl-induced analgesia.

## Education




### IMAGES IN ANESTHESIOLOGY

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### ORIGINAL INVESTIGATION IN EDUCATION

-   **Failure to Debrief after Critical Events in Anesthesia Is Associated with Failures in Communication during the Event**  
*A. F. Arriaga, R. E. Sweeney, J. T. Clapp, M. Muralidharan, R. C. Burson II, E. K. B. Gordon, S. A. Falk, D. Y. Baranov, L. A. Fleisher* .....1039
- Failure to debrief after critical events is common among anesthesia trainees and likely anesthesia teams. Communication breakdowns are associated with a high rate of the failure to debrief.

### REVIEW ARTICLES

-   **Understanding the Effects of General Anesthetics on Cortical Network Activity Using *Ex Vivo* Preparations**  
*L. J. Voss, P. S. García, H. Hentschke, M. I. Banks* .....1049
- The greatest gap in understanding loss and recovery of consciousness lies at the network level. Here the authors describe brain slice electrophysiology as a tool for a mechanistic understanding of consciousness as a thalamo-cortical phenomenon.
-  **Respiratory Physiology for the Anesthesiologist**  
*L. Bigatello, A. Pesenti*.....1064
- Knowledge of the normal paths of oxygen and carbon dioxide provides the grounds to understand hypoxemia and hypercarbia. Knowledge of the interaction of pressure, flow, compliance, and resistance provides the grounds to understand mechanical ventilation.

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