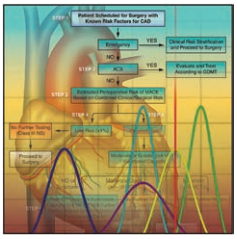
THIS MONTH IN

ANESTHESIOLOGY



889 Impact of the Choice of Risk Model for Identifying Low-risk Patients Using the 2014 American College of Cardiology/American Heart Association Perioperative Guidelines

Three risk models are recommended by the American College of Cardiology and the American Heart Association guidelines for predicting the risk of major adverse cardiac event (MACE) in patients scheduled to undergo noncardiac surgery: the Revised Cardiac Risk Index; the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) Surgical Risk Calculator; and the ACS NSQIP Myocardial Infarction or Cardiac Arrest Calculator. Each of the prediction models was used to calculate the predicted risk of MACE for individual patients using data from the ACS NSQIP database and the agreement of the models on the classification of patients as low-risk (less than 1%) *versus* elevated risk (greater than or equal to 1%) was assessed. The Revised Cardiac Risk Index, which is the most widely used risk stratification tool, had only fair-to-poor agreement with two newer tools created using data from the ACS. These risk models disagreed about 30% of the time on which patients were at low risk *versus* elevated risk of MACE. *See the accompanying Editorial View on* **page 867.** *(Summary: M. J. Avram. Illustration: S. Jarret/J. Rathmell.)*

1015 Brain Dynamics and Temporal Summation of Pain Predicts Neuropathic Pain Relief from Ketamine Infusion

Although intravenous ketamine infusion can produce significant refractory neuropathic pain relief, approximately half of patients will not respond to this therapy. The current study tested the hypotheses that patients with high temporal summation of pain and enhanced fluctuations between networks and pathways that underlie the ability to disengage attention from pain will achieve sustained pain relief from treatment with ketamine in 30 patients with refractory moderate-to-severe neuropathic pain and 30 age- and sex-matched healthy controls. Participants underwent behavioral testing and a magnetic resonance imaging session, were treated with intravenous ketamine infusion for 6 h/day for 5 consecutive days, and had pain assessed 1 month later. Treatment response was defined as at least 30% reduction in numerical rating scale pain scores. Patients with refractory neuropathic pain who had enhanced levels of temporal summation of pain and greater default mode network-descending antinociceptive pathway dynamic functional connectivity were more likely to respond to treatment with ketamine. *(Summary: M. J. Avram. Image: J. P. Rathmell.)*

880 Comparison of the TOFscan and the TOF-Watch SX during Recovery of Neuromuscular Function

Quantitative neuromuscular monitoring is required to ensure neuromuscular function has recovered completely at the time of tracheal extubation. The TOF-Watch SX is an acceleromyography device that is used in most studies that require assessment of neuromuscular function because it is currently considered to be the standard for objective neuromuscular monitoring, but it is no longer commercially available. The TOFscan is a new acceleromyography monitor that uses a three-dimensional transducer to measure contraction of the adductor pollicis muscle in all three planes and does not require initial calibration. This observational study assessed the agreement between train-of-four ratios obtained with the TOFscan and those obtained with the TOF-Watch SX during spontaneous recovery of neuromuscular function in 25 surgical patients administered rocuronium. When train-of-four measures with the TOF-Watch SX were normalized, bias and 95% limits of agreement between the TOF-Watch SX and the TOFscan at train-of-four ratios between 0.2 and 1.0 were 0.015 and –0.097 to 0.126, respectively. *See the accompanying Editorial View on* **page 864.** *(Summary: M. J. Avram. Image: J. P. Rathmell.)*

872 Recommendations for the Nomenclature of Cognitive Change Associated with Anaesthesia and Surgery—2018

Research into cognitive change after anesthesia and surgery has consistently documented decline in cognitive function in elderly patients after anesthesia and surgery, yet there exists no nomenclature, diagnostic framework, or referral recommendations for such cognitive change within the specialties of anesthesiology and surgery. A multispecialty working group followed a modified Delphi procedure to develop nomenclature and diagnostic criteria for cognitive change associated with anesthesia and surgery that are consistent with the terminology used in the wider clinical community when assessing and reporting cognitive impairment, but that retains the temporal association with anesthesia and surgery. They also aligned perioperative cognitive disorders with terms used in the community, including Diagnostic and Statistical Manual for Mental Disorders, 5th edition (DSM-5) definitions. This clinical nomenclature offers a framework for understanding the effect of anesthesia and surgery on outcomes, care, and management for the elderly and thereby enhance consistency of communication and reporting. *See the accompanying Editorial View on* **page 861.** *(Summary: M. J. Avram. Image: @ThinkStock.)*

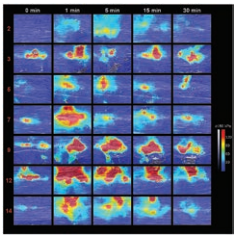
<zdoi;10.1097/ALN.0000000000002474>

912 Caffeine Accelerates Emergence from Isoflurane Anesthesia in Humans: A Randomized, Double-blind, Crossover Study

Caffeine was the most effective of a series of drugs that elevate intracellular cyclic adenosine monophosphate and dramatically accelerate emergence from anesthesia when administered intravenously to rats. The hypothesis that caffeine is able to accelerate emergence from anesthesia was tested in a randomized, double-blind, two-way crossover study of 8 males spontaneously breathing isoflurane (1.2% end-tidal concentration) for 60 min. Ten minutes before terminating isoflurane, volunteers received an infusion over 10 min of either saline (control) or caffeine citrate, 15 mg/kg (equivalent to 7.5 mg/kg of caffeine base). The mean (± SD) time for the test subjects to emerge from anesthesia, defined as return of the gag reflex after discontinuation of anesthesia, was 16.5 (± 3.9) min when receiving saline and 9.6 (± 5.1) min when receiving caffeine. The mean difference (99% CI) in time to emerge from anesthesia was 6.9 min (1.8 to 12 min). Subjects awoke at a significantly higher expired isoflurane concentration when receiving caffeine. *(Summary: M. J. Avram. Image: M. K. Tanious, Brigham and Women's Hospital, Boston.)*

942 Resting-state Dynamics as a Cortical Signature of Anesthesia in Monkeys

Anesthetics are pharmacological agents with a variety of neuronal and molecular targets that induce loss of conscious. Sevoflurane, propofol, and ketamine produce functional disconnection within frontoparietal networks, suggesting a blockade of feedback connections. The hypothesis tested was that these anesthetic agents may affect long-distance cortical networks, particularly the frontoparietal network, which is thought to belong to a Global Neuronal Workspace, a theoretical model of conscious access that stipulates that information becomes conscious when it is available to a widely distributed prefrontoparietal and cingulate cortical network. The dynamic resting-state activity of nonhuman primates was measured using functional magnetic resonance imaging during wakefulness and under sevoflurane, propofol, and ketamine anesthesia and the matrix of functional correlations compared to the underlying anatomical (*i.e.*, structural) connectivity matrix. Sevoflurane, propofol, and ketamine profoundly affected the dynamics of cortical brain activity patterns, with the functional correlation maps becoming very similar to the anatomical connectivity map, whatever the initial molecular mechanism. *See the accompanying Editorial View on* **page 869.** *(Summary: M. J. Avram. Image: A. Johnson/J. P. Rathmell.)*



989 Ultrasound Elastography for Rapid, Real-time Detection of Localized Muscular Reaction in Malignant Hyperthermia–susceptible Pigs

Awareness of a patient's malignant hyperthermia predisposition based on diagnostic testing is essential to preventing serious malignant hyperthermia events. The *in vitro* contracture test after surgical muscle biopsy is a well-established and comprehensive diagnostic test. Genetic testing can be used to confirm malignant hyperthermia susceptibility but not to exclude it. The hypothesis that intramuscular injection of halothane and caffeine causes not only localized metabolic muscular reactions but also regional changes in muscle stiffness that can be detected by *in vivo* ultrasound (shear wave) elastography was tested in pigs with and without predisposition to malignant hyperthermia that had microdialysis probes placed into their gracilis muscle. *In vivo* shear wave elastography detected a temporary increase in local tissue stiffness soon after intramuscular injection of halothane and caffeine in malignant hyperthermia susceptible pigs. Quantitative shear wave elastography allowed earlier detection of reactions to halothane and caffeine than measurement of local lactate concentrations in microdialysis fluids, although the responses were analogous. *(Summary: M. J. Avram. Image: Adapted from original article.)*

1029 Role of Network Science in the Study of Anesthetic State Transitions (Review Article)

The heterogeneity of molecular mechanisms, target neural circuits, and neurophysiological effects of general anesthetics makes it difficult to develop a reliable and drug-invariant index of general anesthesia. Application of network science to general anesthesia could lead to discovery of a fundamental mechanism of anesthetic-induced unconsciousness. A network is a catalog of the components of a system, called nodes or vertices, and the direct interactions between them, called links or edges, which can be directed or undirected. The properties and organizational principles of networks are reviewed as are recent studies of information processing or transfer in large-scale brain networks and the pivotal role of hubs in information integration or disintegration. The network effects of general anesthetics are then reviewed to suggest how anesthesia reduces the capacity of the network to generate information and integrate spatiotemporally distributed information, leading to unconsciousness. The review concludes with consideration of recent studies that could reveal a network-level mechanism for diverse emergence patterns from general anesthesia. *(Summary: M. J. Avram. Image: Adapted from original article.)*