# THIS MONTH IN ANESTHESIOLOGY

## 424 Vital Signs Monitoring with Wearable Sensors in High-risk Surgical Patients: A Clinical Validation Study

Several wearable wireless devices intended for vital signs monitoring have become available to identify abnormal trends in patient physiology to allow caregivers to get the right care to the right patient at the right time. An observational methods comparison study was conducted in which 25 high-risk surgical patients were monitored continuously with two wearable patch sensors, a bed-based mattress sensor, and a patient-worn monitor simultaneously during the initial days of recovery at a surgical step-down unit. Heart rates and respiratory rates measured by these monitors were considered to be acceptable for clinical purposes if they were within ± 10% of the reference standard or ± 5 beats/min or ± 3 breaths/min. More than 700 h of data were available for analysis. The wireless devices provided monitoring accuracy similar to that of the wired reference standard, although each system had specific strengths and weaknesses. Respiratory rate was the more difficult vital sign to measure for all devices; one of the patch sensors overestimated respiratory rate. *See the accompanying Editorial on* **page 407.** *(Summary: M. J. Avram. Image: A. Johnson, Vivo Visuals.)*


## 461 Preoperative Risk and the Association between Hypotension and Postoperative Acute Kidney Injury

Acute kidney injury (AKI), which occurs in 13% of patients undergoing major surgery, has been associated with intraoperative hypotension. The hypothesis that by using preoperative characteristics to risk-stratify patients undergoing noncardiac surgical procedures, hypotension ranges independently associated with AKI and varying by preoperative risk could be derived and validated was tested in a multicenter retrospective observational study of 138,021 patients, 12,431 (9.0%) of whom experienced postoperative AKI within 7 days. The strongest perioperative predictors included chronic kidney disease, American Society of Anesthesiologists physical status III or greater, elevated risk surgery, and moderate to severe anemia. These factors and others were used to stratify patients by preoperative risk of AKI. Among patients with low preoperative risk, no intraoperative hypotension ranges were associated with additional AKI risk. Among patients with medium preoperative risk, only severe intraoperative hypotension for more than 10 min was independently associated with an additional AKI risk. Among patients with high and highest preoperative risk, even milder intraoperative hypotension for more than 10 min was independently associated with additional AKI risk. *See the accompanying Editorial on* **page 416.** *(Summary: M. J. Avram. Image: J. P. Rathmell.)*

## 551 Intraoperative Oxidative Damage and Delirium after Cardiac Surgery

Postoperative delirium occurs in 25 to 52% of patients undergoing cardiac surgery. The hypothesis that increased intraoperative oxidative damage is associated with increased postoperative delirium and neuronal injury and that disruption of the blood-brain barrier modifies these associations was tested in an observational study of 400 cardiac surgery patients. Oxidative damage was assessed by measuring nonesterified free plasma concentrations of $F_2$-isoprostanes and isofurans, oxidative damage end-products of arachidonic acid peroxidation. Neuronal injury was assessed by measuring plasma concentrations of ubiquitin carboxyl terminal hydrolase isozyme L1, a neuron-specific enzyme. Disruption of or injury to the blood-brain barrier was assessed by measuring plasma concentrations of S100 calcium binding protein B, which is released from astrocytes after injury or ischemia. Delirium occurred in 109 of 400 (27.3%) patients. Increased intraoperative oxidative damage was independently associated with development of postoperative delirium and with postoperative neuronal injury. The association between increased intraoperative oxidative damage and postoperative neuronal injury was stronger in patients with increased disruption of or injury to the blood-brain barrier. *See the accompanying Editorial on* **page 418.** *(Summary: M. J. Avram. Image: ©gettyimages.)*

## 452 Pediatric Perioperative Mortality in Kenya: A Prospective Cohort Study from Twenty-four Hospitals

Surgical capacity in Sub-Saharan Africa is well below current goals, as a result of which pediatric surgical patients may experience preventable morbidity and mortality. The primary aims of this prospective cohort study included establishing a pediatric perioperative mortality rate baseline in Kenya and identifying risk factors associated with mortality in this patient population. Data were collected on 6,005 pediatric surgery cases from 24 primary, secondary, and tertiary government and nongovernment hospitals in Kenya from January 2014 until December 2016. The pediatric perioperative 7-day mortality rate was 1.7%, which is lower than previous estimates for larger groupings across Africa but 100 to 200 times higher than the pediatric perioperative mortality rate in high-resource settings. Multivariable logistic regression revealed that not using the safe surgery checklist, an American Society of Anesthesiologists physical status of III or higher, and night or weekend surgery were associated with an increased 7-day mortality rate. *See the accompanying Editorial on* **page 413.** *(Summary: M. J. Avram. Image: B. Sileshi, Vanderbilt University Medical Center.)*

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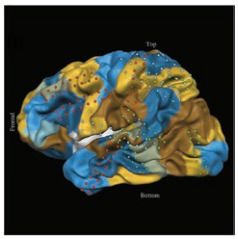
## 571 Pain Response to Open Label Placebo in Induced Acute Pain in Healthy Adult Males

Open label placebos have been shown to be effective in the treatment of chronic pain. The hypothesis that intravenous open label placebo administration would lead to a reduction of pain, area of hyperalgesia, and area of allodynia compared to a no-treatment control was tested in a randomized crossover study of induced pain in 32 adult male volunteers. Intradermal electrical stimulation was used to continually induce pain, secondary hyperalgesia, and allodynia using a current that produced a pain rating of 6 on the numeric rating scale during the first 30 min of the study. Pain, secondary hyperalgesia, and allodynia were assessed every 10 min from minute 30, the time of possible placebo administration, until minute 100. Pain was assessed using the numeric rating scale, pinprick hyperalgesia was assessed using a 256-mN von Frey filament, and allodynia was determined using a dry cotton swab. Median averaged pain scores were 21% lower and median averaged hyperalgesia and median averaged allodynia were 47% lower during open label placebo treatment than during the no-treatment intervention. *(Summary: M. J. Avram. Image: Adobe Stock.)*

## 491 Influence of St. John's Wort on Intravenous Fentanyl Pharmacokinetics, Pharmacodynamics, and Clinical Effects: A Randomized Clinical Trial

The herbal supplement St. John's wort upregulates cytochrome P450 enzymes and the active efflux transporter P-glycoprotein. Fentanyl is both a CYP3A substrate and a P-glycoprotein substrate. The hypothesis that pretreatment with St. John's wort, using a formulation and dose that induces CYP3A activity and increases intestinal P-glycoprotein function, will alter the pharmacokinetics and pharmacodynamics of intravenous fentanyl was tested in a randomized, placebo-controlled, double-blinded parallel-arm study of 16 healthy volunteers. The pharmacokinetics and the pharmacodynamics (miotic response) of a 30-min constant rate intravenous infusion of 2.5 μg/kg of fentanyl before and after placebo or St John's wort treatment were not different. A pharmacokinetically tailored 180-min target-controlled intravenous fentanyl infusion produced comparable mean steady-state plasma fentanyl concentrations (ranging from 0.8 to 1.0 ng/ml) in the placebo and St. John's wort groups. Neither the pupillary response to the fentanyl infusion nor the steady-state analgesic effect (pain tolerance to cold pressor test) of fentanyl was altered by concomitant St. John's wort treatment. *(Summary: M. J. Avram. Image: Adobe Stock.)*



## 504 Information Integration and Mesoscopic Cortical Connectivity during Propofol Anesthesia

The amounts of long-distance communication and information sharing between brain areas are important criteria for the evaluation of consciousness. Electrocorticogram data recorded from nine patients undergoing intracranial monitoring for surgical treatment of epilepsy were analyzed to assess cortical information integration at the mesoscale during propofol-induced loss of consciousness. Genuine permutation cross mutual information, which if nonzero is an index of connection strength between two nodes, was used to analyze how electrocorticogram cross-electrode coupling changed with electrode distances in different brain areas, and the changes in cortical networks during anesthesia were investigated using clustering coefficient, path length, and nodal efficiency measures. The results suggested that cortical information coupling and network connections at the mesoscopic level were correlated with electrode distances and particular to each brain area. The increased normalized average path length and clustering coefficient during unconsciousness support the hypothesis that disruption of the normal integration of global neural information may induce loss of consciousness. *(Summary: M. J. Avram. Image: From original article.)*


## 586 Controversies in Perioperative Antimicrobial Prophylaxis (Review Article)

Although clinical guidelines for antibiotic prophylaxis across a wide array of surgical procedures have been proposed, clinicians often deviate from recommendations. The most significant gap between guidelines and practices is the duration of antibiotic prophylaxis exceeding current consensus guidelines. In addition, changes in medical practice and the operating room environment have the potential to reduce infection rates and confound the impact of antibiotic prophylaxis. This review highlights certain common but controversial topics in perioperative antibiotic prophylaxis. Patient-related considerations include obesity, large volume blood loss, fluid resuscitation, allergic reactions, as well as immunosuppressed and transplant patients. Microbiome-related considerations include the effect of planned and unplanned interventions in the perioperative period on the gut microbiota and the increased risk of postoperative infection in surgical patients colonized with resistant pathogens. Controversies in selected cardiac procedures, bowel and biliary tract prophylaxis, insertion and removal of chronic indwelling urinary catheters, orthopedic procedures, and neurosurgery are also discussed. *(Summary: M. J. Avram. Image: J. P. Rathmell.)*

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