

THIS MONTH IN ANESTHESIOLOGY



976 Carbon Footprint of General, Regional, and Combined Anesthesia for Total Knee Replacements

Health care produces greenhouse gases both directly (electricity and gas) and indirectly from emissions associated with consumption of goods and services. For anesthesiologists to reduce their workplace carbon footprint, they must understand the sources and amounts of the greenhouse gases produced as they care for patients in the operating room. The carbon footprints in carbon dioxide equivalent emissions associated with general anesthesia (n = 9), spinal anesthesia (n = 10), and combined (general and spinal) anesthesia (n = 10) for total knee replacement surgery in Melbourne, Australia, were similar. Single-use equipment, electricity for the patient air warmer, and pharmaceuticals were major sources of carbon dioxide equivalent emissions across all

anesthetics. Sevoflurane was a significant source of the carbon dioxide equivalent emissions of both general anesthesia and combined anesthesia. Washing and sterilizing reusable items contributed substantially to the carbon dioxide equivalent emissions of both spinal and combined anesthesia. Oxygen use was an important contributor to the carbon footprint of spinal anesthesia. *See the accompanying Editorial on page 937. (Summary: M. J. Avram. Image: "This is the waste of one operation... my operation" by Dutch spacial artist Maria Kojick, created with waste generated during her own surgery; cover photograph by Eva Glasbeek, published with permission from the artist.)*



992 Spinal Anesthesia with Targeted Sedation based on Bispectral Index Values Compared with General Anesthesia with Masked Bispectral Index Values to Reduce Delirium: The SHARP Randomized Controlled Trial

The estimated incidence of postoperative delirium after lumbar spine fusion surgery, which is common in older adults, is 10 to 30%. The hypothesis that spinal anesthesia with targeted light sedation based on bispectral index (BIS) values (BIS more than 60 to 70) would reduce the incidence of postoperative delirium compared to general anesthesia with masked BIS values was tested in a randomized controlled superiority trial of 217 older patients undergoing lumbar spine fusion surgery. The median (interquartile range) average BIS value in the spinal anesthesia group was 62 (53 to 70), whereas that in the general anesthesia group was 45

(41 to 50). The overall incidence of delirium, defined as any positive assessment during hospitalization, was 22% (48 of 217). The incidence of delirium in the spinal anesthesia group, 25% (28 of 111), was not different from that of the general anesthesia group, 19% (20 of 106), in the intention-to-treat analysis; the absolute difference (95% CI) was 6.4% (−4.6 to 17.4%) and the relative risk (95% CI) was 1.22 (0.85 to 1.76). *See the accompanying Editorial on page 940. (Summary: M. J. Avram. Image: J. P. Rathmell.)*



1004 Pressure Support versus Spontaneous Ventilation during Anesthetic Emergence—Effect on Postoperative Atelectasis: A Randomized Controlled Trial

Postoperative atelectasis is a common pulmonary complication that increases the risk of hypoxemia and provides the pathophysiologic basis for other postoperative pulmonary complications. Laparoscopic colectomy and robot-assisted laparoscopic prostatectomy are associated with a higher risk of postoperative atelectasis due to the high intra-abdominal pressure and the Trendelenburg position. The hypothesis that pressure support ventilation reduces the incidence of postoperative atelectasis compared to spontaneous respiration with intermittent manual assistance was tested in a randomized, controlled, patient- and evaluator-blinded trial

of 97 patients undergoing laparoscopic colectomy or robot-assisted laparoscopic prostatectomy. All patients were evaluated using lung ultrasonography 30 min after their postanesthesia care unit arrival. Anesthesia-induced atelectasis was considered to be clinically significant if more than three of the twelve lung sections evaluated showed any sign of atelectasis. The incidence of postoperative atelectasis diagnosed by lung ultrasonography was 33% (16 of 48) in the pressure support group and 57% (28 of 49) in the control group; the risk ratio (95% CI) was 0.58 (0.35 to 0.91). *See the accompanying Editorial on page 943. (Summary: M. J. Avram. Image: J. P. Rathmell.)*



1091 Preoperative Paravertebral Block and Chronic Pain after Breast Cancer Surgery: A Double-blind Randomized Trial

Chronic pain after breast cancer surgery is frequent and affects quality of life. The existing evidence on the role of paravertebral block in preventing chronic pain after breast cancer surgery is weak and conflicting. The hypothesis tested in a double-blind, randomized, placebo-controlled study of 352 patients undergoing partial or complete mastectomy with or without lymph node dissection for cancer was that preoperative ultrasound-guided paravertebral block with ropivacaine reduces the incidence of pain greater than or equal to 3 on a 0 to 10 visual analog scale 3 months after surgery. In the intention-to-treat population, 93 of 178

(52%) patients in the paravertebral block group and 83 of 174 (48%) patients in the control group had pain greater than or equal to 3 on the visual analog scale 3 months after surgery. The associated odds ratio (95% CI) was 1.20 (0.79 to 1.82). Similar results were obtained for the secondary outcomes of pain greater than or equal to 3 at 6 and 12 months after surgery. *(Summary: M. J. Avram. Image: Adobe Stock.)*



1076 Treatments Associated with Lower Mortality among Critically Ill COVID-19 Patients: A Retrospective Cohort Study

The mortality rate of critically ill COVID-19 patients admitted to intensive care units declined over time from approximately 50% in the early stage of the pandemic, possibly due to effective treatments. This retrospective cohort study used multivariable analysis to test the hypothesis that certain treatments would be associated with lower mortality in 2,070 patients treated for COVID-19–related complications in the intensive care units of six hospitals affiliated with an academic North American health system from February 2020 to March 2021. Only treatments that were used in at least 5% of patients were included in the analysis. The all-cause in-hospital mortality was 29% (593 of 2,070). The results of the 23 hypotheses tested, corresponding to all treatments

included in the multivariable analyses, were corrected for multiple hypothesis testing using the Bonferroni method. Of 23 treatments analyzed, apixaban (used in 20% [408 of 2,072] of patients; hazard ratio [95% CI], 0.42 [0.34 to 0.52]) and aspirin (used in 66% [1,335 of 2,072] of patients; hazard ratio [95% CI], 0.72 [0.54 to 0.96]) were associated with lower mortality. (Summary: M. J. Avram. Image: J. P. Rathmell.)



1042 Effect of Global Ventilation to Perfusion Ratio, for Normal Lungs, on Desflurane and Sevoflurane Elimination Kinetics

Understanding the elimination kinetics of inhaled anesthetics is of more practical importance than understanding their uptake kinetics. Normal lungs are assumed to play a major role in the elimination of inhaled anesthetics in the early rapid stages and a negligible role subsequently. The fraction of cardiac output that is completely cleared of anesthetic in one pass is the fractional clearance. A mathematical model of inhaled anesthetic elimination was developed in a *post hoc* analysis of anesthetic partial pressures measured in mixed venous and arterial blood samples after simultaneous administration of desflurane and sevoflurane to seven piglets under normal, low, and high alveolar ventilation to cardiac output ratio (\dot{V}_A/\dot{Q}) conditions. After a brief and rapid

decline in alveolar anesthetic partial pressure, the fractional clearance of anesthetic became constant, and incomplete clearance from the lungs slowed tissue washout. Slowing of tissue elimination by incomplete lung clearance became more pronounced at low \dot{V}_A/\dot{Q} ratios and was predicted to become more pronounced as blood/gas solubility increases. See the accompanying Editorial on [page 948](#). (Summary: M. J. Avram. Image: J. P. Rathmell.)



1122 Prevention of Healthcare-associated Infections in Intensive Care Unit Patients (Clinical Focus Review)

Healthcare-associated infections in higher-income countries affect up to 30% of intensive care unit (ICU) patients who are vulnerable because of not only underlying comorbidities and immunosuppression but also the presence of invasive catheters and devices. They increase morbidity, mortality, and costs. Surgical site infection, central line–associated bloodstream infection, and ventilator-associated events are strongly associated with mortality, whereas catheter-associated urinary tract infection is not consistently associated with it. Contact transmission is the most common route by which healthcare-associated infections are spread in the ICU. This Clinical Focus Review discusses evidence-based strategies for reducing healthcare-associated infections

in ICU patients, ranging from hand hygiene and transmission-based precautions to hospital infection prevention departments with dedicated personnel to perform healthcare-associated infection surveillance and implement control measures. Specific strategies discussed include appropriate perioperative antibiotic prophylaxis to prevent surgical site infection, the use of chlorhexidine as an adjunct for central line–associated blood stream infection prevention, and antimicrobial stewardship to prevent *Clostridioides difficile* infection. (Summary: M. J. Avram. Image: J. P. Rathmell.)



1132 Sleep, Pain, and Cognition: Intervenable Targets for Optimal Perioperative Brain Health (Review Article)

Perioperative neurocognitive disorders include postoperative delirium, delayed neurocognitive recovery, and postoperative neurocognitive disorder. Postoperative delirium is an acute, fluctuating disturbance in attention and awareness that is associated with higher risk of long-term cognitive impairment and poor functional outcomes. Delayed neurocognitive recovery and postoperative neurocognitive disorder are characterized by deficits in memory and executive function that are barriers to optimal functional recovery. Three intervenable targets to consider in a multicomponent intervention designed to optimize perioperative brain health are sleep, pain, and cognition. Sleep and circadian disturbances are risk factors for development of neurodegenerative diseases,

which are predisposing factors for postoperative delirium. Severe or uncontrolled preoperative or postoperative pain and increased levels of pain from the preoperative to the postoperative period are associated with postoperative delirium. Poor baseline cognition is strongly associated with perioperative neurocognitive disorders. Multicomponent interventions optimizing sleep, pain relief, and cognition can be effective in preventing postoperative delirium, but further work is needed to determine if they can prevent delayed neurocognitive recovery and postoperative neurocognitive disorder. (Summary: M. J. Avram. Image: From original article.)