



Hi, this is Evan Kharasch, Editor-in-Chief of ANESTHESIOLOGY, with some highlights from the December 2021 issue, as selected by the journal editors.

In this month's podcast, we'll be exploring new information about how anesthesiologists can influence the carbon footprint of the operating room. We'll look at the hot topic of treatments for critically ill COVID-19 patients. We'll also examine whether a paravertebral block could reduce pain in breast surgery patients. And we'll close this month with two review articles. One takes on the topic of infection prevention in the ICU; the other addresses the challenges of managing perioperative neurocognitive disorders.

Let's begin this month with a prospective study of the carbon footprint associated with total knee replacements. Healthcare produces greenhouse gases both directly and indirectly. A previous study of hospitals in the United Kingdom, United States, and Canada suggested that anesthesia could have greater carbon dioxide equivalent emissions than all surgical equipment and all operating room-associated energy requirements. Understanding how carbon dioxide equivalent emissions happen in the operating room setting can help anesthesiologists monitor and reduce their workplace carbon footprints. Dr. Forbes McGain of the University of Melbourne, Australia, and colleagues collected data on 29 patients who underwent total knee replacements at a single center. Of these, 9 involved general anesthesia, 10 involved spinal anesthesia, and 10 involved combined spinal and general anesthesia. The investigators evaluated carbon dioxide equivalent emissions, also known as CO₂ emissions. The CO₂ emissions were similar across these groups. They averaged 15 kg for spinal anesthesia, 17 kg for general anesthesia, and 18 kg for combined spinal and general anesthesia. The major sources of CO₂ emissions across all groups were single-use items, including electricity for patient air warmers, and pharmaceuticals other than anesthetic gases. These single-use item categories accounted for approximately 16%, 25%, and 8% of the total CO₂ emissions in the groups having spinal anesthesia, general anesthesia, and combined spinal and general anesthesia. In the general anesthesia and combined anesthesia groups, use of a volatile anesthetic, specifically sevoflurane in this case, contributed to 32% and 17% of the total CO₂ emissions. In the spinal and combined groups, washing and sterilizing reusable items contributed to 29% and 24% of the total CO₂ emissions. The authors also found that oxygen use in spinal anesthesia was a significant contributor to CO₂ emissions, with higher flow rates than the general and combined approaches. Although the study was small and limited to a single center, the authors encouraged clinicians to be mindful of their carbon footprints and seek ways, however small, to reduce it. An editorial by Dr. Michel Struys and Matthew Eckelman accompanies this article. The editorial emphasizes that the study does not provide a definitive answer on which anesthesia method is the least environmentally friendly, but they noted some practical takeaways, such as potentially using minimal fresh gas flow to optimize sevoflurane consumption if possible. Check out the full article for free in this month's issue.

We next take a look at a clinical trial that examined anesthetic depth and the occurrence of postoperative delirium. Some previous studies have suggested that reducing the depth of anesthesia may reduce the risk of delirium, but, results of various have been inconsistent. In addition, many studies have involved general anesthesia or patients who were cognitively impaired. Dr. Charles Brown of Johns Hopkins University and his team sought to compare the incidence of postoperative delirium in patients receiving sedation, based on targeted Bispectral Index (BIS) values, compared to patients receiving general anesthesia. The authors randomized 217 patients aged 65 years and older who were undergoing lumbar spine fusion to receive either spinal anesthesia with sedation targeted to BIS greater than 60–70, or to general anesthesia where the anesthesiologists did not see the BIS readings. The primary outcome was delirium during the first three days after surgery, which was assessed using the standard Confusion Assessment Method. Based on this metric, the authors found no difference in incidence of delirium between the groups. In addition, most subgroup analyses, including age and baseline comorbidities, also showed no differences in delirium between the sedation and general anesthesia groups. The exception was patients with baseline scores less than 27 on the Mini-Mental State Examination, who showed less delirium if given spinal anesthesia compared to general anesthesia. In an accompanying editorial, Drs. Pratik Pandharipande, Elizabeth Whitlock, and Christopher Hughes noted that these reported study results supported previous work showing no impact

of depth of anesthesia on delirium outcomes. They speculated whether efforts to reduce delirium might focus on targeted interventions for patients with known modifiable risk factors. This article is available for free in this month's issue.

Our next clinical study focuses on pulmonary function after surgery. It evaluated the effects of different ventilator approaches during emergence from anesthesia on pulmonary outcomes. It compared pressure support mechanical ventilation versus spontaneous ventilation, during emergence, on postoperative atelectasis. Pressure support ventilation had become widely used for weaning patients from mechanical ventilation in the ICU, but had not been well studied in the setting of operating room anesthesia. Dr. Heejoon Jeong of Sungkyunkwan University School of Medicine, Seoul, South Korea, and colleagues tested the hypothesis that pressure support would result in less postoperative atelectasis in adults undergoing laparoscopic surgery. The investigators randomized 100 patients who underwent either laparoscopic colectomy or robot-assisted prostatectomy. Half underwent pressure support mechanical ventilation and the other half underwent spontaneous ventilation with intermittent manual assistance, on emergence, which averaged 8–9 minutes in duration. The determination of atelectasis was based on lung ultrasonography in the postanesthesia care unit. The study found that the incidence of postoperative atelectasis was 33% in patients who had pressure support, compared to 57% in those who had spontaneous ventilation during anesthesia emergence. This difference was statistically significant. In the recovery unit, PaO₂ in pressure-support group was higher than in the spontaneous ventilation group, but the incidence of oxygen desaturation during the 48 hr postoperatively was not different between the groups. The authors noted that the study was limited to patients at low risk for atelectasis, but the results were consistent with previous studies. In an accompanying editorial, Drs. Luca Bigatello and Erland Ostberg noted that interventions to prevent atelectasis during and after emergence from anesthesia are worth pursuing. They wrote that although the current study showed no significant impact of pressure support of oxygen saturation or other clinical outcomes, it showed the importance of consistent positive pressure during anesthesia emergence. They added that more clinical evidence is needed, as is a standardized scoring system for lung ultrasound and atelectasis for improved evaluation. You can access this article for free in this month's issue.

Now, let's turn to a prospective study that explored whether paravertebral block could prevent chronic pain in breast surgery patients. Postoperative chronic pain has a significant impact on quality of life for many breast surgery patients, and clinicians continue to seek ways to manage it. Previous studies have shown reductions in chronic pain after the use of paravertebral blocks, but data remain limited. Dr. Aline Albi-Feldzer of PSL Research University, Saint Cloud, France, and colleagues conducted a multicenter, randomized, placebo-controlled trial of women undergoing partial or complete mastectomy, with or without lymph node dissection. They randomized 178 patients to ropivacaine and 174 to saline. After 3 months, chronic pain was similar between the groups: 52% in the paravertebral block group and 48% of the control group. No significant differences in pain were noted at 6 months or 12 months. The authors noted that their findings were in line with some previous studies, but not others. They added that paravertebral block may be insufficient for pain control after major breast surgery in particular, because it fails to block the supraclavicular nerves, pectoral nerves, or other brachial plexus branches. This article is available for free in this month's issue.

We move next to the hot topic of COVID-19, with a look at a one-year retrospective study of more than 2,000 COVID-19 patients. Although the overall treatment strategies for critically ill COVID-19 patients have evolved and improved, mortality remains high. Clinicians continue to work to identify treatments associated with lower mortality. Dr. Xu Zhao of Yale University led a team in examining the records of hospitalized COVID-19 patients aged 18 years and older admitted to ICUs at six hospitals in Connecticut. The study period was February 2020 to March 2021. The authors reviewed 23 treatments for COVID. Treatments given to the patients included antivirals, anticoagulants, antiplatelet agents, steroids, immunomodulators, immunosuppressants, vasopressors, and other uncategory drugs such as azithromycin. The primary outcome was in-hospital mortality, which averaged 29%. After multivariate analysis followed by multiple testing correction, they found apixaban or aspirin were associated with significantly lower mortality than patients who did not receive these treatments. The authors also conducted a propensity score-matching analysis. Patients treated with apixaban and aspirin still showed lower

mortality rates compared to patients who did not receive them. The propensity score-matching analysis showed lesser mortality for patients treated with enoxaparin, which was the anticoagulant of choice in the study population. Both prophylactic and therapeutic doses of enoxaparin were associated with lower mortality. The authors noted that the results may not be applicable to future cases because of variables such as viral mutations and changes in vulnerable populations. They added that optimization of exact dosage, timing, and duration of any of the treatments for COVID-19 would require further study. This article is available for free in this month's issue.

Next, we turn to an exploratory analysis of inhaled anesthetic elimination in an animal model. Although inhaled anesthetic uptake has been well studied, elimination has not, despite its potential importance in clinical practice. Dr. James Baumgardner of the University of Pittsburgh and colleagues developed a mathematical model of anesthetic elimination to show how washout kinetics depend on the lung ventilation to perfusion ratios. The authors found that the global ventilation to perfusion ratio modifies the time constant for tissue anesthetic washout throughout the entire phase of anesthetic elimination. And that the fractional clearance of anesthetic by normal lungs becomes constant, following a short and swift initial decline in alveolar anesthetic partial pressure. The authors' model also showed that when incomplete lung clearance slows anesthetic washout, this process is more pronounced at lower ventilation to perfusion ratios. The authors stated that understanding of anesthetic elimination may be as valuable in clinical practice as uptake, in part because of the lack of options for speeding up elimination.

Our clinical focus review this month addresses the perpetual challenges of infection prevention in the intensive care unit. Healthcare associated infections affect nearly one-third of ICU patients in higher-income countries, according to lead author Dr. Michael Mazzeffi of George Washington University. The review included four evidence-based strategies for reducing ICU infections, starting with the appropriate perioperative antibiotic prophylaxis. The article highlighted data suggesting that the routine antibiotic prophylaxis should not be continued beyond 24 hours in the absence of a suspected infection. The article next emphasized the importance of hand hygiene and transmission-based precautions, as per current United States Center for Disease Control guidance. Contact transmission remains the most common source of healthcare-associated for infections in the ICU. However, such transmission of infections can be limited by strategies including hand hygiene, use of single patient rooms, proper use of personal protective equipment and disposable medical equipment, and proper disinfection of rooms between patients. Other areas where quality improvement can reduce infections include management of ventilator-associated pneumonia, central line-associated bloodstream infections, and *Clostridium difficile* infections. The article

concludes that healthcare-associated infection prevention represents an opportunity for anesthesiologists to take the lead in efforts for quality improvement, policy development, and research.

Our last article this month is a review article on the topic of sleep, pain, and cognition and their influence on perioperative neurocognitive disorders. The prevention of perioperative neurocognitive disorders is a priority, especially for older patients. Data have shown that approximately half of older patients experience postoperative delirium, according to Dr. Brian O'Gara of Harvard Medical School. Dr. O'Gara and colleagues discussed the value of multicomponent interventions in preventing postoperative delirium and other postoperative neurocognitive issues. The targets of such a multicomponent intervention are sleep, pain, and cognition. Sleep and sleep disturbances are important risk factors for the neurodegenerative diseases, but the extent, nature, and timing of their impact remains unclear. Chronic sleep patterns, environmental issues, and other sleep factors overlap with pain and cognition. The relationship between pain and perioperative neurocognitive disorders is a complicated one. The link between pain and inflammation may play a role in the development of perioperative neurocognitive disorders, if inflammation of the peripheral or central nervous system ultimately leads to neuronal injury and brain dysfunction. The article also notes the link between cholinergic neurons and pain signals, and that cholinergic deficiency has been implicated in pain hypersensitivity and delirium. And it adds that preoperative pain should be considered as well. Finally, it discusses efforts to promote the best possible functional recovery, including cognitive recovery for patients, by so-called "prehabilitation" in the form of physical, nutritional, and psychological health. These strategies may take the form of home-based exercise programs or dietary counseling. The article also cites the potential use of cognitive training to prevent perioperative neurocognitive disorders, but also admits that high-quality evidence is lacking. And it concludes with the admonition that we need to better identify high-risk patients and to choose the most effective interventions and care plans.

If you are interested in learning more about submitting to *Anesthesiology*, please visit our new Submission Advice page on the Journal website, anesthesiology.org. The page offers insight into our editors' expectations and a blueprint for creating successful manuscripts.

As 2021 draws to a close, I hope all of you continue to stay engaged and explore the latest topics in our diverse field. You can always find new studies and commentary on the journal website, www.pubs.asahq.org/anesthesiology.

As always, thank you for listening to this podcast and thank you for your support of *ANESTHESIOLOGY*. I hope you find the information presented helps to guide and improve your clinical practice. I look forward to sharing more important research with you next month.