Journal of Cardiothoracic and Vascular Anesthesia ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Review Article

The Year in Cardiothoracic Critical Care: Selected Highlights From 2017

Jacob T. Gutsche, MD[*,1], Kamrouz Ghadimi, MD[†], John G.T. Augoustides, MD[*], Krzysztof Laudanski, MD[*], Adam Evans, MD[‡], Menachem Weiner, MD[‡], Jesse Raiten, MD[*], Emily Gordon, MD[*], Rita Milewski, MD[§], Jiri Horak, MD[*], Prakash Patel, MD[*], Harish Ramakrishna, MD[¶]

[*]*Cardiovascular and Thoracic Section, Department of Anesthesiology and Critical Care, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA*
[†]*Department of Anesthesiology and Critical Care, Duke University, Durham, NC*
[‡]*Department of Anesthesiology and Critical Care, Icahn School of Medicine, Mount Sinai Hospital, New York, NY*
[§]*Division of Cardiovascular Surgery, Department of Surgery, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA*
[¶]*Division of Cardiovascular and Thoracic Anesthesiology, Mayo Clinic, Phoenix, AZ*

Key Words: cardiac surgery; critical care; stroke; cognitive dysfunction; delirium; ARDS; PEEP; VAD; mechanical circulatory support; GI prophylaxis; contrast-induced nephropathy; fever; blood cultures; corticosteroids; angiotensin II; vasoplegic shock

THIS ARTICLE IS the second of an annual series reviewing the research highlights of the year pertaining to the specialty of cardiothoracic and vascular critical care for the *Journal of Cardiothoracic and Vascular Anesthesia*. The authors thank the editor-in-chief, Dr. Kaplan, and the editorial board for the opportunity to continue this series. In some cases, these will be research articles that are targeted at the care of patients after cardiothoracic surgery with an organ system focus, but in most cases, these articles will target the critically ill population in general. The major articles selected for 2017 are presented by organ system. The authors chose the selected articles to represent important research or scientific statements reflecting the state of the art in cardiovascular intensive care, which is a rapidly evolving specialty.

The literature highlights begin with a review of recent interventions targeting stroke and the study of acute cognitive impairment. The highlights then review recent articles describing ventilator management interventions in acute respiratory distress syndrome (ARDS), including recruitment maneuvers. In addition, the recently published phase 3 trial of angiotensin II and the American Heart Association scientific statement reviewing cardiopulmonary resuscitation in patients with mechanical circulatory support are described. Transfusion triggers are reviewed, with newer evidence questioning the use of restrictive hemoglobin triggers in older patients. In the same theme of challenging dogma based on small clinical trials, a trial questioning the empiric use of saline to prevent contrast-induced nephropathy is reviewed. Finally, updates on blood cultures after cardiac surgery and guidelines for steroid use also are reviewed.

Neurologic

Stroke remains a common and potentially devastating complication after cardiac surgery. Cardiovascular intensivists are charged with early recognition of stroke symptoms and

[1]*Address reprint requests to* Jacob T. Gutsche, MD, University of Pennsylvania, School of Medicine, Department of Anesthesiology and Critical Care, 3400 Spruce St., 680 Dulles Building, Philadelphia, PA 19104.
E-mail address: jacob.gutsche@uphs.upenn.edu (J.T. Gutsche).

https://doi.org/10.1053/j.jvca.2018.04.023

initiating early therapy. Because hypoxemia is common in the post-stroke period and is associated with worse neurologic outcomes, it seems intuitive that empiric supplemental oxygen would prevent hypoxia and improve outcomes. Roffe et al. sought to study the effects of low-dose oxygen via nasal cannula on neurologic outcomes after stroke.[1] Because attachment to supplemental oxygen may limit activity and thus negatively affect potential outcomes, the researchers randomly assigned 8,003 patients at 136 centers in the United Kingdom 1:1:1 to 3 days of continuous oxygen, nocturnal oxygen, or no routine oxygen.[1] The primary outcome was the modified Rankin Score (disability range 0 [no symptoms] to 6 [death]) assessed at 90 days.[2] The secondary outcomes were improvement on the National Institutes of Stroke Scale,[3] mortality, number of patients living at home, Barthel Index of daily living score,[4] the quality of life (EuroQol) score,[5] and the Nottingham Extended Activities of Daily Living Score.[6] It is important to note that vital signs were taken 4 times/day, and if hypoxia was detected, it was treated with supplemental oxygen, even in the control group. The authors found that supplemental oxygen significantly increased the highest and lowest oxygen saturation compared with that of control patients but did not affect the primary or secondary outcomes. As the study authors noted, these results must be taken in the context of other trials analyzing hyperoxia in stroke, such as the Normobaric Oxygen Therapy in Acute Ischemic Stroke Trial, which randomly assigned patients to room air versus high-flow oxygen for 8 hours.[7] This trial was terminated early due to higher mortality in the high-flow group. A large retrospective trial by Rincon et al. found that a mixed population of hemorrhagic and ischemic stroke patients had higher mortality when exposed to hyperoxia (partial pressure of oxygen ≥ 300 mmHg).[8]

In the theme of stroke, Nogueira et al. published the results of the Dawn trial, which randomly assigned patients with occlusion of the internal carotid artery or proximal middle cerebral artery who were last known to be well 6 to 24 hours earlier to endovascular thrombectomy or standard care.[9] Patients were selected for this trial because their symptoms indicated poor perfusion, but the area of infarct demonstrated on computed tomography scan was smaller than predicted on examination, indicating brain tissue that could be salvaged. It should be noted that this trial was sponsored by Stryker Neurovascular, which provided the thrombectomy device, a retrievable self-expanding stent, known as the Trevo device.[10] This is particularly important for cardiac surgery patients who frequently have not had a reliable neurologic examination due to time under anesthesia in the operating room and sedation in the intensive care unit (ICU). In addition, some patients emerge from anesthesia with stroke deficits, making it difficult to pinpoint the timing of stroke, but often excluding them from thrombectomy because of the narrow therapeutic window of 6 hours. The primary endpoints were the mean score on the utility-weighted modified Rankin scale at 90 days and the rate of functional independence (modified Rankin scale 0-2) at 90 days. The trial enrolled 206 patients (107 patients underwent thrombectomy and there were 99 control patients) with a median interval in time from last known to be well of 12.2 hours in the thrombectomy group and 13.3 hours in the control group. The investigators found that the mean score for disability on the utility-weighted modified Rankin scale at 90 days was 5.5 in the thrombectomy group and 3.4 in the control group (adjusted difference [Bayesian analysis] 2.0 points; 95% credible interval 1.1-3.0; posterior probability of superiority > 0.999). In addition, the functional independence at 90 days was 49% in the thrombectomy group compared with 13% in the control group (adjusted 33 percentage points; 95% credible interval 24-44; posterior probability of superiority > 0.999). Surprisingly, the rate of intracranial hemorrhage or death did not differ significantly.

Another common complication of cardiac surgery that receives less attention than stroke but causes significant distress to health care workers, patients, and patient's families is acute brain dysfunction, which manifests as delirium or coma. Both delirium and coma have been associated with higher rates of mortality in the ICU and long-term cognitive impairment. It is known that acute kidney injury increases the risk for morbidity and mortality in the ICU, but it is unclear how this affects brain function. Siew et al. sought to understand whether acute kidney injury was associated with delirium and coma in the ICU.[11] The investigators examined 466 critically ill patients with respiratory failure and/or shock and assessed them for delirium with the Confusion Assessment Method for the ICU (CAM-ICU)[12] and coma with the Richmond Agitation-Sedation Scale.[13] Patients were assessed for acute kidney injury using the creatinine arm of the Kidney Disease Improving Global Outcomes (KDIGO) system.[14] In this study, 65% of the patients experienced acute kidney injury, with 1 in 10 patients requiring renal replacement therapy (RRT). Seventy-five percent of patients experienced at least 1 episode of delirium, and 60% of patients experienced at least 1 episode of coma. The authors found that KDIGO stage 2 and 3, but not stage 1, acute kidney injury increased the odds of associated delirium 2.5-fold and the odds of associated coma 3-fold. Interestingly, in patients receiving RRT, the incidence of coma and delirium was attenuated on days that the patients received RRT. The investigators found that patients who did not receive sedation had preserved associations of delirium and coma with acute kidney injury, emphasizing the point that impaired clearance of these drugs is not the only mechanism of acute brain dysfunction. A prospective trial is needed to analyze the potential benefit of earlier dialysis in patients with KDIGO stage 2 and 3 kidney injury to prevent acute brain dysfunction. For the clinician, it is imperative to quickly reduce doses of sedatives in patients with acute kidney injury and to alter doses of potentially neurotoxic drugs when patients acquire acute kidney injury.

Pulmonary

A significant number of patients in the ICU are mechanically ventilated and require assessment for extubation. This typically is performed with a spontaneous breathing trial (SBT) using pressure support ventilation with or without

Please cite this article as: Gutsche JT, et al. (2018), https://doi.org/10.1053/j.jvca.2018.04.023