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Special Article

# The Year in Vascular Anesthesia: Selected Highlights From 2017

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THIS SPECIAL ARTICLE is the first in an annual series for the *Journal of Cardiothoracic and Vascular Anesthesia* that is dedicated specifically to highlights in vascular anesthesiology. The authors would like to thank the editor-in-chief, Dr. Kaplan; the associate editor-in-chief, Dr. Augoustides; and the rest of the editorial board for the opportunity to expand the Highlights series to topics that pertain to the subspecialty of vascular anesthesia. This review begins with several updates in the perioperative optimization of vascular surgery patients. The first section highlights the increasing emphasis on identification, mitigation, and treatment of postoperative delirium in vascular surgery. The second section reviews current controversies surrounding perioperative anemia and transfusion in vascular surgery. The third section addresses updates in major adverse cardiovascular and cerebrovascular events in vascular surgery in the modern era. The final 2 sections address continued innovation in endovascular surgery; the fourth section evaluates updates in the endovascular management of complex abdominal aortic aneurysms (AAAs), and the fifth section highlights recent endovascular advances in supraaortic arch repair. The themes selected for this special article are only a small sample of the advances in the specialty that occurred during 2017. Taken together, these highlights reflect important advances for patients with cardiovascular disease requiring vascular surgery.

## Delirium in Vascular Surgery

Postoperative cognitive disturbance, including delirium and postoperative cognitive dysfunction, increasingly is recognized as an important contributor to significant perioperative morbidity and mortality.[1] The National Institute for Health and Care Excellence in the United Kingdom suggests that delirium is associated with a doubling in mortality, hospital-acquired complications, and discharge to institutional care.[2] Delirium is the most common postoperative complication in older adults and has been shown to be preventable in up to 40% of cases.[3,4] Delirium also may have long-term consequences for cognition after discharge.[1] Concerns about the implications of this commonly overlooked and often unappreciated complication, coupled with its potential preventability, has prompted significant interest in identifying evidence-based strategies to prevent and manage delirium by the American Geriatrics Society,[5] the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP),[6] and the American Society of Anesthesiologists (ASA) Perioperative Brain Health Initiative.[7]

Elderly patients are at particular risk for perioperative delirium. Approximately 40% of inpatient surgeries in the

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United States currently are performed on patients older than 65 years, a number that likely will increase as the population continues to age.[8] Previous studies evaluating delirium are not specific to the vascular surgery population.[9] Vascular surgery patients often are older and have significant comorbidities that may predispose to delirium. Not surprisingly then, risk factors and prognostic implications of postoperative delirium were subjects of interest in the literature in 2017.

Berian et al.[10] published a first-look at data derived from the ACS NSQIP Geriatric Surgery Pilot Project, which evaluated geriatric-specific risk factors for delirium and surgical outcomes. A review of the NSQIP database identified more than 20,200 elderly patients who underwent inpatient surgeries over a 2-year period from 2014 to 2015. Postoperative delirium was observed in 12.0% of patients and 11.4% of patients undergoing vascular surgery. Geriatric-specific risk factors that were significantly associated with postoperative delirium for all patients and a subset of vascular surgery patients included age, preoperative cognitive impairment, surrogate consent for surgery, preoperative use of mobility aids, and fall history within 1 year. Additional risk factors identified included surgical complexity, functional status, ASA physical status class, sex, preoperative infection (systemic inflammatory response syndrome or septic shock), race, active smoking, diabetes, preoperative open wounds, surgical wound class, preoperative creatinine, congestive heart failure, body mass index, and dyspnea. Interestingly, there was an 8.5-fold variation in postoperative delirium measured across participating hospitals. Although beyond the scope of this article, a deeper dive into this finding may highlight differences in care paradigms that may contribute to perioperative delirium or its prevention. This study suggests that postoperative delirium outcomes can be meaningfully captured in large, high-quality surgical data registries to guide quality improvement initiatives and drive best practice.

Moskowitz et al.[11] evaluated 172 patients 50 years or older undergoing elective surgeries at a Veterans Affairs medical center with a planned intensive care unit (ICU) admission. Postoperative delirium was assessed using the Confusion Assessment Method-ICU performed daily. The primary outcome variable was 5-year mortality. The overall incidence of delirium was found to be 44%, and 5-year mortality was greater in patients with delirium compared with patients without delirium (59% *v* 44%, $p < 0.001$), including after multivariate risk adjustment. Patients with postoperative delirium were 7.35 times (95% confidence interval [CI] 1.49-36.18) more likely to die within 5 years compared with those without delirium. Even though not specific to vascular surgery patients, this study is important because it is the first to specifically examine the association between postoperative delirium and long-term mortality. Although a causative link cannot be established, this study emphasizes the need for better prevention of postoperative delirium, not only for short-term but also potentially for long-term outcomes.

A final single-center, randomized controlled study by Partridge et al.[12] evaluated delirium after vascular surgery at a tertiary referral center for major vascular surgery. One hundred seventy-six patients 65 years or older undergoing elective endovascular, open aortic aneurysm repair, or lower limb bypass were randomly assigned to standard preoperative care versus a comprehensive preoperative geriatric assessment and optimization by a multidisciplinary team. Patients in the intervention group were evaluated by a geriatrician, clinical nurse specialist, social worker, and occupational therapist who documented an individualized care plan regarding prevention and management of anticipated postoperative complications. These recommendations were available to all health care professionals on the electronic medical record, but the care plan did not refer to patient involvement in the study. Mean length of stay was reduced by 40% in the intervention group ($p < 0.001$), for a mean reduction of more than 2 hospital days. There was a significantly decreased incidence of postoperative delirium and cardiac complications with a trend toward decreased infectious complications in the intervention group. Patients in the intervention group also were less likely to require a new provision of rehabilitation or care requiring a change in discharge destination, although it did not meet statistical significance ($p = 0.051$). Patients undergoing comprehensive geriatric assessment were more likely to be screened for delirium risk and were more frequently diagnosed with a new preoperative major medical morbidity requiring optimization and long-term follow-up. The number of patients who did not undergo surgery was greater in the intervention arm than in the control arm. The authors postulated that the increase in preoperative diagnosis of major medical comorbidities (eg, chronic obstructive disease, chronic kidney disease stage 3 or greater, cognitive impairment, new diagnoses of ischemic heart disease and/or heart failure) may have resulted in an increase in decisions to manage patients conservatively (ie, nonsurgically) in the intervention group. This study highlights the importance of more thorough preoperative geriatric screening, ideally with multidisciplinary engagement, to decrease major medical and cognitive morbidity.

Several systematic reviews and meta-analyses evaluated postoperative delirium in vascular surgery patients in 2017.[13–15] Galyfos et al.[13] identified 9 studies between 1990 and 2016 for a total of 2,388 patients that evaluated postoperative delirium after vascular surgery. Patients with postoperative delirium were more likely to be male; older; and to have higher rates of diabetes mellitus, hypertension, cardiac disease (coronary artery disease, previous myocardial infarction [MI], or unstable angina), and neurologic disease (cerebrovascular disease, transient ischemic attack, or stroke). Lower hemoglobin level, longer duration of surgery, open aortic surgery, higher blood loss, and longer hospital and ICU stay also were associated with postoperative delirium. General anesthesia was not associated with postoperative delirium in this study, as has been reported previously.[16] Aitken et al.[14] identified 15 articles evaluating delirium after vascular surgery that were published between 2000 and 2016. Postoperative delirium ranged from 5% and 39%. Prognostic factors predicting delirium in this study included age, preexisting cognitive impairment, hypertension, preexisting depression, and open aortic surgery. Patients who experienced delirium

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