

# Contents

<b>Foreword: Vascular Anesthesiology: Managing the High-Risk Patient</b>	<b>xiii</b>
Lee A. Fleisher	
<b>Preface: The Changing Face of Anesthesiology Practice for Vascular Surgery Patients</b>	<b>xv</b>
Heather K. Hayanga and Megan P. Kostibas	
<b>The Vascular System: Anatomical, Physiological, Pathological, and Aging Considerations</b>	<b>557</b>
Charlie Slowey and Daniel Nyhan	
<p>The vascular system is one of the earliest recognized anatomical systems. It is composed of 3 parts; arterial, capillary, and venous, each with their own unique anatomy and physiology. Blood flow through this system is compromised in aging, atherosclerosis and peripheral vascular disease, and the practicing anesthesiologist must understand both the physiology and pathophysiology of the vascular tree.</p>	
<b>Preoperative Evaluation and Cardiac Risk Assessment in Vascular Surgery</b>	<b>575</b>
Lee A. Goeddel and Michael C. Grant	
<p>We summarize epidemiologic trends, outcomes, and preoperative guidelines for vascular surgery patients from 2010 to 2022. Vascular surgery continues to evolve in technology and engineering to treat a surgical population that suffers from a high prevalence of comorbidities. Preoperative optimization seeks to characterize the burden of disease and to achieve medical control in the timeline available before surgery. Risk assessment, evaluation, optimization, and prediction of major adverse cardiac events is an evolving science where the Vascular Surgery Quality Initiative has made an impact. Ongoing investigation may demonstrate value for preoperative echocardiography, functional capacity, frailty, and mobility assessments.</p>	
<b>Complications of Vascular Disease</b>	<b>587</b>
Jesse Kiefer and Michael Mazzeffi	
<p>Vascular diseases and their sequelae increase perioperative risk for noncardiac surgical patients. In this review, the authors discuss vascular diseases, their epidemiology and pathophysiology, risk stratification, and management strategies to reduce adverse perioperative outcomes.</p>	
<b>Patient Blood Management in Vascular Surgery</b>	<b>605</b>
Richard Gyi, Brian C. Cho, and Nadia B. Hensley	
<p>Patient blood management (PBM) is an evidence-based, multidisciplinary approach aimed at appropriately allocating blood products to patients requiring transfusion while simultaneously minimizing inappropriate transfusions. The 3 pillars of patient blood management are optimizing</p>	

erythropoiesis, minimizing blood loss, and optimizing physiological reserve of anemia. Benefits seen from PBM include limiting hospital costs and mitigating harm from numerous risks of transfusion.

**Surgical Decision-Making and Outcomes in Open Versus Endovascular Repair for Various Vascular Diseases**

627

Alana Keegan and Caitlin W. Hicks

Today's vascular surgeon must navigate their practice through a field of ever-advancing technology while maintaining knowledge of open techniques that remain equally important in the care of their patients. In this article, the authors provide insight into the perioperative decision-making that goes into choosing a surgical plan for each patient based on their disease process, anatomy, nonmodifiable risk factors, and other comorbidities.

**Monitoring During Vascular Surgery**

645

Joshua Roach and Stephanie Cha

Vascular surgical patients present unique challenges for anesthesiologists, because of their medical vulnerabilities as well as their tendency for rapid intraoperative hemodynamic changes. Intraoperative monitors have been used for decades to reduce adverse outcomes, improve mortality, and create optimal surgical conditions. Understanding the indications and appropriate management of monitoring modalities is essential for optimizing patient care, and preventing harm associated with misinterpretation. We aim to review monitoring technologies used in complex vascular procedures, as well as the current guidelines, clinical trial outcomes, and basic mechanisms of each monitoring modality.

**Abdominal Aortic Aneurysms (Etiology, Epidemiology, and Natural History)**

657

Michael P. Calgi and John S. McNeil

Abdominal aortic aneurysm is a potentially lethal condition that is decreasing in frequency as tobacco use declines. The exact etiology remains unknown, but smoking and other perturbations seem to trigger an inflammatory state in the tunica media. Male sex and advanced age are clear demographic risk factors for the development of abdominal aortic aneurysms. The natural history of this disease varies, but screening remains vital as it is rarely diagnosed on physical examination, and elective repair (most commonly done endovascularly) offers significant morbidity and mortality advantages over emergent intervention for aortic rupture.

**Thoracic and Thoracoabdominal Aneurysms: Etiology, Epidemiology, and Natural History**

671

Ryan T. Downey and Rebecca A. Aron

Thoracic aortic aneurysms and thoracoabdominal aneurysms are often found incidentally. Complications include dissection or rupture. Most of the thoracic aortic aneurysms and thoracoabdominal aneurysms develop in patients with risk factors for atherosclerosis. Younger patients without significant cardiovascular risk factors may have a genetic basis and

include syndromes such as Marfan, Ehlers–Danlos, and Loeys–Dietz and bicuspid aortic valve. Most thoracic aneurysms grow slowly over time and factors that accelerate growth rate include dissection, aneurysm size, bicuspid valve disease, and Marfan syndrome. Size cutoffs where complications occur determine when surgery or intervention should be considered.

## **Aortic Dissection**

685

### **D. Keegan Stombaugh and Venkat Reddy Mangunta**

Acute aortic dissection is a highly morbid condition with high mortality that requires emergent surgical evaluation and repair. The intraoperative management of acute aortic dissection requires the anesthesiologist to do far more than administer anesthesia and begins before the patient arrives at the operative theater. High-fidelity communication with the surgeon, knowledge of the surgical plan, knowledge of the anatomy of the dissection, and a nuanced understanding of aortic dissection pathophysiology are all critical aspects of anesthetic management.

## **Anesthetic Management for Open Thoracoabdominal and Abdominal Aortic Aneurysm Repair**

705

### **Megan P. Kostibas and Laeben Chola Lester**

Open thoracoabdominal and abdominal aortic aneurysm repairs are some of the most challenging cases for anesthesiologists because of the potential for rapid blood loss combined with clamping and reperfusion, potential use of left heart bypass, the potential need for lung isolation, and potential placement and management of a spinal drain. In addition, patients often present with other significant comorbidities and a detailed understanding of the disease process, the complex physiology throughout the case, and the intricacies of organ protection are critical.

## **Anesthetic Management for Endovascular Repair of Thoracic and Abdominal Aortic Aneurysms**

719

### **Callie Ebeling and Sreekanth Cheruku**

Aortic aneurysms—both abdominal and thoracic—are a significant cause of death and disability in the United States. Endovascular aneurysm repair has since become the preferred operative treatment of most thoracic and abdominal aneurysms because of a lower rate of complications and better outcomes compared with the open approach. Patients who present for endovascular aneurysm repair often have comorbid conditions related to their aortic pathology. These conditions should be evaluated and optimized before the procedure.

## **The Unstable Carotid Plaque**

737

### **Salim Habib, Muhammad Saad Hafeez, Theodore H. Yuo, and Kathirvel Subramaniam**

Carotid revascularization is performed to prevent cerebrovascular events in patients with symptomatic (>50%) and asymptomatic high degree (>70%) carotid stenosis. As this operation carries significant risks for

perioperative stroke, careful selection of patients who will benefit from the procedure is essential. Certain plaque characteristics, including texture, are associated with increased tendency for rupture and can be used to identify high-risk patients. Medical therapy, carotid endarterectomy, and carotid stenting are the mainstays for patient management. With careful selection of patients, all anesthesia techniques (general anesthesia, monitored anesthesia care, and regional anesthesia) can be used safely for these revascularization procedures.

### **Regional Anesthesia for Vascular Surgery and Pain Management**

751

Vicente Garcia Tomas, Nicole Hollis, and Jean-Pierre P. Ouanes

Patients undergoing vascular surgery tend to have significant systemic comorbidities. Vascular surgery itself is also associated with greater cardiac morbidity and overall mortality than other types of noncardiac surgery. Regional anesthesia is amenable as the primary anesthetic technique for vascular surgery or as an adjunct to general anesthesia. When used as the primary anesthetic, regional anesthesia techniques avoid complications associated with general anesthesia in this challenging patient population. In this article, the authors describe regional anesthetic techniques for carotid endarterectomy, arteriovenous fistula creation, lower extremity bypass surgery, and amputation.

### **Critical Care of the Vascular Surgery Patient**

775

Milad Sharifpour and Edward A. Bittner

Patients that require major vascular surgery suffer from widespread atherosclerosis and have multiple comorbidities that place them at increased risk for postoperative complications and require admission to the intensive care unit (ICU). Postoperative critical care of these patients is focused on hemodynamic optimization, and early identification and management of complications to improve outcomes.

### **Chronic Pain Considerations in Patients with Cardiovascular Disease**

791

Anna L. Carpenter and Corinne M. Layne-Stuart

Cardiovascular disease affects close to half of the United States population and many of these patients will develop chronic pain syndromes as a result of their disease process. This article provides an overview of several pain syndromes that result, directly or indirectly, from cardiovascular disease including peripheral arterial disease, angina, thoracic outlet syndrome, postamputation pain, complex regional pain syndrome, and poststroke pain. Psychological and medical comorbidities that affect the medical decision-making process in the treatment of chronic pain associated with cardiovascular disease are also discussed.