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Coronary artery bypass graft surgery is associated with several frequent postoperative adverse events. Outcome prediction is valued by patients and practitioners, because it provides some measure of balancing risks and benefits and provides expensive or higher-risk therapies to individuals at highest risk. Surgeons and anesthesiologists traditionally have relied on demographic, preoperative, and intraoperative risk factors to predict outcomes after cardiac surgery. Yet, such predictions often have poor positive and negative predictive value for the individual patient. Perioperative genetics attempts to determine the impact of an individual's genetic variation on the risk of developing adverse postoperative outcomes. In this article, the authors discuss emerging evidence that a patient's genetic makeup predisposes him or her to adverse outcomes following cardiac surgery and provide examples from perioperative bleeding, myocardial injury/infarction, and atrial fibrillation.

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Perioperative echocardiography is an essential skill for today's cardiac anesthesiologist and a driving force for innovation and accomplishment for the future of the subspecialty. Real-time three-dimensional transesophageal echocardiography (RT3-D TEE) will dominate the future practice of perioperative echocardiography, but transthoracic echocardiography (TTE) will grow in application,

as will contrast echocardiography. Hand-held ultrasonographs will rival current machines in capabilities and make it possible for TTE to become the stethoscope of the future for cardiac anesthesiologists.

### **Minimally Invasive Direct Coronary Artery Bypass and Off-Pump Coronary Artery Bypass Surgery: Anesthetic Considerations**

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Daniel Bainbridge and Davy C.H. Cheng

Many new surgical technologies are being developed, with the overall aim of improving outcomes. One common feature of many new technologies is that they offer a safer approach than previous techniques; one of the greatest forces for change over the last 30 years is risk reduction. Cardiac surgery risk has been effectively undercut by percutaneous-based procedures, which have offered dramatic reductions in risk—at least in the short term. Beating heart techniques, whether minimally invasive direct coronary artery bypass (MIDCAB), off-pump coronary artery bypass surgery (OPCAB), or in other forms, such as percutaneous valve replacement, are likely to dramatically increase over the next decade. What role OPCAB and MIDCAB techniques will play in this new era is anyone's guess.

### **Hybrid Coronary Artery Bypass Grafting**

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Daniel Bainbridge and Wojciech Dobkowski

Owing to the high prevalence of atherosclerotic coronary artery disease, treatment has proceeded along three separate paths: medical, surgical, and percutaneous intervention. Medical treatment is now routinely combined with both surgical treatment and percutaneous methods; however, the surgical and percutaneous routes are often viewed as in competition. Hybrid coronary revascularization, also called robotic assisted integrated coronary revascularization (RAICER), is a way of combining these two approaches. Whether any hybrid procedure will prove beneficial to patients remains unproven; however, RAICER has promise for reducing short-term complications while providing excellent and enduring treatment for coronary artery disease. Much work remains to be done on the benefits of hybrid revascularization in comparison with conventional bypass surgery or percutaneous coronary procedures.

### **Transcatheter Aortic Valve Replacement**

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Anson Cheung and Ron Ree

*Multimedia Components available within this article at [www.anesthesiology.theclinics.com](http://www.anesthesiology.theclinics.com)*

Aortic stenosis is one of the most common valve pathologies found in adults. Aortic valve replacement via a sternotomy and cardiopulmonary bypass is the treatment of choice for patients with symptomatic aortic stenosis with very acceptable risk.

However, patients with advanced age and multiple comorbidities carry significant operative risk; operative mortality as high as 25% was reported by many groups. Many of these patients are deemed nonsurgical for conventional aortic valve replacement by their cardiologists and surgeons. Novel surgical technique and valve technology offers an alternative treatment for aortic valve stenosis. Endovascular transcatheter aortic valve replacement is an emerging and promising technique, and may lower the risk in this subset of difficult patients.

### **Endovascular Stenting of Thoracic Aortic Aneurysm**

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Jacob T. Gutsche, Wilson Szeto, and Albert T. Cheung

In 2005, the findings of the multicenter Gore Tag study led to United States Food and Drug Administration approval for endovascular repair of thoracic aortic aneurysms (TEVAR). TEVAR provides a therapeutic option for patients who have thoracic aortic aneurysm and for the treatment of type B aortic dissection with malperfusion. Spinal cord ischemia and stroke are recognized neurologic complications of TEVAR. Identification of high-risk patients combined with targeted anesthetic and perioperative management may decrease the risk of neurologic complications after TEVAR.

### **Transmyocardial Laser Revascularization: From Randomized Trials to Clinical Practice. A Review of Techniques, Evidence-Based Outcomes, and Future Directions**

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Keith B. Allen, James Kelly, A. Michael Borkon, R. Scott Stuart, Emmanuel Daon, Alexander F. Pak, George L. Zorn, and Michelle Haines

Cardiac surgeons are increasingly faced with a more complex patient who has developed a pattern of diffuse coronary artery disease that cannot be completely revascularized by CAGB alone. Considering the increased operative and long-term cardiac risks predicted by incomplete revascularization, and the documented operative and long-term benefits associated with sole therapy and adjunctive TMR in randomized patients with diffuse coronary artery disease, increased use of sole therapy and adjunctive TMR therapy is warranted.

### **Brain Protection in Cardiac Surgery**

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Kelly Grogan, Joshua Stearns, and Charles W. Hogue

Brain injury is a major source of patient morbidity after cardiac surgery, and is associated with prolonged hospitalization, excessive operative mortality, high hospital costs, and altered quality of life. Frequency and the clinical manifestations depend on multiple factors, including the completeness and timing of neurologic testing. Ischemic brain infarctions may or may not be associated with stroke or postoperative neurocognitive dysfunction, but the long-term implications of these lesions on neurologic function have not yet been extensively evaluated. This article reviews the current views on the

pathophysiologic basis of cerebral injury after cardiac surgery and provides a summary of measures aimed at reducing its occurrence.

### **Assisting the Failing Heart**

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Annette Vegas

Anesthesiologists increasingly encounter patients who have a spectrum of heart failure ranging from stable chronic heart failure to acute heart failure to cardiogenic shock. Improved medical therapy has increased the survival of patients who have chronic heart failure but not of patients who have acute heart failure. New surgical techniques and mechanical devices may offer alternatives to certain patients who have refractory heart failure. This article provides an overview of established and newer pharmacologic and nonpharmacologic therapies and surgical interventions to manage patients who have heart failure, including the perioperative management of heart transplantation and ventricular assist devices.

### **Hepatic and Renal Protection During Cardiac Surgery**

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Geraldine C. Diaz, Vivek Moitra, and Robert N. Sladen

Hepatic injury in cardiac surgery is a rare complication but is associated with significant morbidity and mortality. A high index of suspicion postoperatively will lead to earlier treatment directed at eliminating or minimizing ongoing hepatic injury while preventing additional metabolic stress from ischemia, hemorrhage, or sepsis. The evidence-basis for perioperative renal risk factors remains hampered by the inconsistent definitions for renal injury. Although acute kidney injury (as defined by the Risk, Injury, Failure, Loss, End-stage criteria) has become accepted, it does not address pathogenesis and bears little relevance to cardiac surgery. Although acute renal failure requiring renal replacement therapy after cardiac surgery is rare, it has a devastating impact on morbidity and mortality, and further studies on protective strategies are essential.

### **Analgesia Best Practice After Cardiac Surgery**

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Alex Konstantatos, Andrew J. Silvers, and Paul S. Myles

Sources of pain after cardiac surgery include sternotomy, rib retraction, conduit harvest, and drain tubes sites. An analgesic regimen should consider individual patient characteristics, including age, preoperative history of pain and response to analgesics, comorbidities, and psychologic state. Intraoperative and postoperatively administered opioids remain the mainstay of therapy, but adjunctive analgesics such as paracetamol, nonsteroidal anti-inflammatory drugs and tramadol, and regional techniques, can reduce opioid consumption and opioid-induced respiratory depression. This may facilitate earlier tracheal extubation, mobilization, and recovery.

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