Preoperative Evaluation and Preparation of the Patient for Cardiac Surgery

Alec D. Weisberg, MD\textsuperscript{a,b}, Emily L. Weisberg, MD\textsuperscript{c}, James M. Wilson, MD\textsuperscript{a,b}, Charles D. Collard, MD\textsuperscript{c,d,*}

Coronary artery bypass graft (CABG) and valve surgery are among the most common operations performed worldwide. The incidence of cardiac complications after CABG is at least 10% and costs $2 billion annually.\textsuperscript{1} These figures are anticipated to increase as older patients with more comorbidities are referred for cardiac surgery. Objective risk stratification provides the physician and patient with valuable information for assessing the risk/benefit ratio before proceeding with cardiac surgery. Careful patient selection and preparation during preoperative evaluation may minimize morbidity and mortality.

MORTALITY RISK STRATIFICATION

The mortality rate associated with cardiac surgery varies widely and is influenced by multiple preoperative risk factors. Jones and colleagues\textsuperscript{2} defined 7 “core” variables that were unequivocally associated with operative mortality, and 13 “level 1” variables

KEYWORDS

- Cardiac surgery
- Preoperative evaluation
- Risk stratification
- Atrial fibrillation
- Renal dysfunction
- Stroke
- Statins
- \(\beta\)-Blockers

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\textsuperscript{a} Section of Cardiology, Department of Medicine, Baylor College of Medicine, One Baylor Plaza, Houston, TX 77030, USA
\textsuperscript{b} Texas Heart Institute, St. Luke’s Episcopal Hospital, Houston, TX, USA
\textsuperscript{c} Department of Anesthesiology, Baylor College of Medicine, 1709 Dryden Road, Suite 1700, Houston, TX 77030, USA
\textsuperscript{d} Division of Cardiovascular Anesthesiology, Texas Heart Institute, St. Luke’s Episcopal Hospital, 6720 Bertner Avenue, Room 0520, Houston, TX 77030, USA
* Corresponding author. Division of Anesthesiology, Texas Heart Institute, St. Luke’s Episcopal Hospital, 6720 Bertner Avenue, Room 0520, Houston, TX 77030. E-mail address: ccollard@bcm.tmc.edu (C.D. Collard).

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that were likely to be related to mortality (Table 1). The core variables contained 45% to 83% of the predictive information, whereas the level 1 variables had only modest predictive power. Risk scoring systems that incorporate the influence of multiple risk factors have been developed to estimate perioperative mortality. Although the American College of Cardiology (ACC) and the American Heart Association (AHA) believe that the use of statistical risk models to obtain objective estimates of CABG operative mortality is reasonable, their use must be complementary to clinical judgment, as their performance is limited by their application to different procedures and populations than their original design and validation.

**SYSTEM-BASED PREOPERATIVE EVALUATION**

If the mortality risk associated with cardiac surgery is not prohibitive, the next phase of preoperative evaluation estimates the risk of other complications and identifies conditions that will delay surgery or need to be addressed before or concomitant with operative intervention. A thorough system-based approach is the preferred strategy for preoperative evaluation.

**Cardiovascular**

Preoperative evaluation should include a careful physical examination with particular attention to the cardiac and vascular systems. Severe aortic regurgitation (AR) and peripheral vascular disease (PVD) involving the access site femoral or iliac vessels or aneurysmal disease of the aorta are contraindications to perioperative intraaortic balloon pump (IABP) placement. Furthermore, in patients with AR, the regurgitant

**Table 1**

<table>
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<th>Predictors of post-CABG mortality</th>
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<td>&quot;Core&quot; Variables</td>
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<td>Age</td>
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<td>Sex</td>
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<td>Urgency of operation</td>
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*Abbreviations: CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; Core, variables unequivocally related to operative mortality; CVD, cerebrovascular disease; DM, diabetes mellitus; Level 1, variables with a likely relation to short-term mortality; LM, left main; LVEF, left ventricular ejection fraction; MI, myocardial infarction; PCI, percutaneous coronary intervention; PVD, peripheral vascular disease.*

volume may increase during cardiopulmonary bypass (CPB) resulting in acute left ventricular (LV) distension. Varicose veins or a history of vein stripping or ligation in the lower extremities may preclude use of saphenous vein grafts as bypass conduits and prompt evaluation for alternative conduits. A carotid bruit or significant PVD may signify the presence of cerebrovascular disease (CVD) and requires further evaluation by carotid Doppler to assess the need and timing for carotid revascularization.4

**Atrial fibrillation**
The incidence of atrial fibrillation (AF) after CABG, valve surgery, and combined CABG and valve surgery is approximately 30%, 40%, and 50%, respectively.5 Postoperative AF is associated with increased in-hospital and long-term mortality, renal failure (RF), stroke, congestive heart failure (CHF), hospital length of stay (HLOS), intensive care unit (ICU) readmission, and cost of hospitalization.6,7 Age is one of the most reliable preoperative predictors of postoperative AF with a reported 75% increase in the odds of developing AF for every 10-year increase in age.5 Other established predictors for the development of postoperative AF include history of AF, male gender, decreased LV ejection fraction (LVEF), left atrial enlargement, valvular heart surgery, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), chronic renal failure (RF), rheumatic heart disease, LV hypertrophy, and withdrawal from β-blocker and angiotensin 1 converting enzyme inhibitor (ACEI) therapy.6,8 Preoperative β-blocker, sotalol, and amiodarone therapy may be used to lower the incidence of postoperative AF. Although digoxin and calcium channel antagonists may be useful for ventricular rate control, they have not been demonstrated to reduce the postoperative incidence of AF.3,9

**Left ventricular dysfunction**
Surgical revascularization in patients with advanced myocardial dysfunction and coronary artery disease (CAD) is superior to medical therapy.10 LV dysfunction and CHF are associated with higher mortality during CABG.11 Topkara and colleagues11 analyzed more than 55,000 patients undergoing CABG from the New York State (NYS) database and found that patients with advanced LV dysfunction had more comorbid conditions, including previous myocardial infarction (MI), RF, and CHF. Patients with LVEF less than 20% undergoing CABG had nearly four times the in-hospital mortality rate, lower rate of discharge to home, and higher incidence of postoperative respiratory failure, RF, and sepsis than patients with an LVEF greater than 40%. Independent predictors of in-hospital mortality in the low LVEF group were hepatic failure, RF, previous MI, reoperation, emergent procedures, female gender, CHF, and age. In high-risk patients, preoperative placement of an IABP reduces the use of inotropic and vasopressor medications, CPB time, in-hospital mortality, and shortens ICU stay.12

Although LV dysfunction is often due to MI with associated necrosis and scar formation, it may also be due to hibernating or stunned myocardium, potentially reversible processes with revascularization.13 A perioperative reduction in the contractile efficiency of previously functioning myocardial segments may be seen in the immediate postoperative period. Preoperative cardiac evaluation in patients with severely reduced LV function should focus on identifying patients with dysfunctional but viable myocardium by either ⁹⁹ᵐTcMIBI, ²⁰¹Tl, ¹⁸Ffluorodeoxyglucose (FDG) positron emission tomography (PET), dobutamine echocardiography, dobutamine magnetic resonance imaging (MRI), or delayed-enhancement cardiac MRI. The sensitivity of these various imaging modalities ranges from 80% to 90% with specificity of 54% to 92%.14,15 In a patient with marginal preoperative hemodynamic function who can
expect little or no improvement in the immediate postoperative period, the likelihood of complication or death is high and possibly prohibitive for cardiac surgery.

**Recent myocardial infarction**

The timing and location of a recent MI should be included in the preoperative evaluation. Mortality associated with CABG is increased for the first 3 to 7 days following MI, and if clinically appropriate, a delay in surgery beyond this time period should be considered. Following anterior MI, the detection of a LV thrombus by preoperative transthoracic echocardiogram may alter the timing and approach of CABG. Inferior MI that significantly impairs right ventricular (RV) function is associated with hemodynamic consequences that can be exacerbated during CPB, and it is reasonable to delay CABG for 4 weeks to allow RV recovery.

**Hematologic**

Preoperative anemia is associated with increased morbidity and mortality during cardiac surgery. Kulier and colleagues found that preoperative anemia was an independent predictor of noncardiac complications. In patients with preoperative anemia and a European System for Cardiac Operative Risk Evaluation (EuroSCORE) of 4 or more, there were increased cardiac complications but these were likely attributable to other concomitant risk factors. Independent predictors of preoperative anemia are a history of anemia, RF, female gender, advanced age, DM, unstable angina, and history of CABG. As blood transfusions in patients undergoing cardiac surgery have been associated with increased morbidity and mortality, perioperative transfusion strategies that incorporate the degree of anemia and other comorbidities need to be developed for individual patients.

**Heparin-induced thrombocytopenia**

Heparin-induced thrombocytopenia (HIT) is an immune-mediated complication of heparin therapy associated with arterial and venous thrombosis. There is typically a 50% or greater decrease in platelet count from baseline in association with thrombotic events. In most cases, immunoassays can detect antibodies against complexes of platelet factor 4 (PF4) and heparin. Everett and colleagues found that in patients undergoing cardiac surgery, the preoperative and postoperative incidence of antibodies to PF4/heparin was 4.3% and 22.4%, respectively, but thrombotic events occurred only in 6.3% of patients with a positive antibody. Diagnostic specificity for HIT can be increased by use of platelet activation assays such as the serotonin release assay. Post-CABG, patients with HIT have a higher incidence of saphenous vein graft occlusion than patients without HIT, but no significant difference in left internal mammary artery graft occlusion.

Management of patients undergoing cardiac surgery with antibodies to PF4/heparin and HIT is evolving. During CPB, unfractionated heparin (UFH) is the preferred agent due to familiarity with its use, reversibility with protamine, and ease of intraoperative monitoring. In this syndrome, a typical anamnestic immune response is often not formed, and rechallenge with heparin is a reasonable strategy for patients with HIT who need to undergo CPB. Warkentin and colleagues outline management guidelines for HIT patients undergoing cardiac surgery. An immunoassay for PF4/heparin antibodies should be performed and if positive, a platelet activation assay should be completed (if available). Patients who are PF4/heparin antibody negative or antibody positive by immunoassay, but antibody negative by platelet activation assay, may proceed with cardiac surgery using UFH during CPB. Preoperative and postoperative anticoagulation should be performed with a nonheparin anticoagulant.
In patients with a history of HIT whose platelet counts have recovered but are heparin/PF4 antibody positive, surgery should be delayed if possible until a platelet activation assay is negative, and then surgery can be performed using UFH during CPB. If delaying surgery is not an option, use of a nonheparin anticoagulant is recommended over UFH during CPB. In patients with HIT who remain thrombocytopenic and are heparin/PF4 antibody positive, the preferred strategy is to delay surgery until the platelets have normalized and the heparin/PF4 antibodies are negative or weakly positive. However, if delaying surgery is not feasible, alternative anticoagulation regimes during CPB should be considered.

**Hypercoagulable disorders**

Balancing the risk of thrombosis with excessive perioperative bleeding is difficult in patients with a hypercoagulable disorder. In hospitalized patients with a hypercoagulable disorder who are not on chronic anticoagulation, preoperative administration of subcutaneous UFH and low molecular weight heparin (LMWH) are important to lower the risk of developing a deep venous thrombosis while mobility is limited. For chronically anticoagulated patients, warfarin therapy should be held at least 5 days before cardiac surgery, and therapeutic anticoagulation may be bridged with UFH or LMWH. In patients with antiphospholipid antibody syndrome, perioperative anticoagulation monitoring can be difficult due to abnormal prolongation in clotting times and consultation with a hematologist and clinical pathologist is often required to design the best management strategy.

**Renal**

Preoperative renal dysfunction is common in patients undergoing cardiac surgery and is an important risk factor for increased morbidity and mortality. Cooper and colleagues found that in patients undergoing CABG, the preoperative incidence of mild, moderate, and severe renal dysfunction and dialysis dependence was 51%, 24%, 2%, and 1.5%, respectively, and operative mortality increased with declining renal function. Preoperative estimated creatinine clearance is a better predictor of postoperative adverse events than plasma creatinine level. Although renal dysfunction after cardiac surgery is an independent risk factor for mortality, improved preoperative renal function reduces this effect on mortality.

In a large multicenter study of patients undergoing cardiac surgery, Mangano and colleagues found that the incidence of postoperative renal dysfunction not requiring dialysis was 7.7% and requiring dialysis, 1.4%. Mortality in patients without renal dysfunction was 0.9% but increased to 19% in patients with renal dysfunction and 63% in patients requiring dialysis. Postoperative RF is associated with increased ICU and HLOS, higher mortality, and greater likelihood for discharge to an extended care facility. Although multiple factors are associated with increased risk of postoperative renal dysfunction following cardiac surgery, advanced age, CHF, prior CABG, DM, and preexisting renal disease are factors that identify a high-risk population for renal dysfunction after CABG. Cardiac catheterization performed on the day of cardiac surgery and higher doses of contrast medium are independently associated with higher risk for postoperative RF. Preoperative serum creatinine, age, race, type of surgery, DM, shock, NYHA class, lung disease, recent MI, and prior cardiovascular surgery are associated with increased risk for postoperative dialysis and have been incorporated into a bedside risk algorithm for estimating a patient’s probability for dialysis after cardiac surgery.

Perioperative management in patients at high risk for RF and dialysis focuses on minimizing exposure to nephrotoxic drugs and contrast media and maintaining renal
perfusion. If possible, cardiac surgery immediately after cardiac catheterization should be avoided. Although N-acetylcysteine has been shown to attenuate contrast-induced declines in renal function, there is no convincing evidence that perioperative administration of N-acetylcysteine is protective in cardiac surgery. Future studies will help clarify whether off-pump CABG, which eliminates the need for CPB, is associated with lower risk for postoperative renal dysfunction.

**Endocrine**

DM is present in approximately 25% of patients presenting for CABG or percutaneous coronary intervention and is associated with worse outcomes after cardiac surgery. Patients with DM without RF or PVD who undergo CABG have similar long-term survival to patients without DM. Preoperative screening for DM is an important aspect of preparing a patient for cardiac surgery. Lauruschkat and colleagues found the incidence of undiagnosed DM in patients undergoing CABG to be 5.2%, and noted that these patients had higher perioperative mortality, required reintubation more frequently, and remained intubated longer than patients without DM and with known DM.

In patients undergoing cardiac surgery, strict perioperative glucose control using perioperative insulin infusions can significantly lower operative mortality and the incidence of mediastinitis. There is growing evidence that insulin exerts antiinflammatory effects, beyond its metabolic activities, which may partially explain its cardioprotective properties. Future studies will clarify the role of preoperative glucose control and the optimal perioperative management scheme.

**Pulmonary**

COPD is the most common cause of preoperative pulmonary dysfunction. Cohen and colleagues noted that patients with clinically significant COPD undergoing CABG had higher rates of pre- and postoperative atrial and ventricular arrhythmias, reintubation, and longer ICU stay and HLOS than matched controls. Although Fuster and colleagues showed that a preoperative FEV1 of 60% of predicted or higher is associated with increased mortality during CABG, Spivack and colleagues did not find a clear role for pulmonary function testing in preoperative evaluation for cardiac surgery. Home oxygen therapy or hypercapnia are clinical parameters that identify a population at higher risk for postoperative respiratory failure. Clinical assessment of lung function and severity of COPD is a critical component of preoperative assessment.

The incidence of respiratory failure in patients undergoing cardiac surgery varies widely depending on the definition. Filsoufi and colleagues defined respiratory failure as intubation time of 72 hours or longer and found that the incidence of respiratory failure in the NYS database was 9.1%, with the highest incidence in combined CABG and valve procedures (14.8%). Independent predictors of postoperative respiratory failure were age more than 70 years, female gender, LVEF 30% or less, combined CABG/valve surgery, CHF, DM, PVD, COPD, RF, active endocarditis, reoperation, hemodynamic instability, and IABP insertion. Postoperative respiratory failure was associated with significantly increased morbidity, mortality, and HLOS. To optimize respiratory function before surgery, existing pulmonary conditions or exacerbations should be treated, including smoking cessation, antibiotic therapy for existing pneumonia or bronchitis, diuresis for pulmonary edema, and bronchodilator and steroid treatment of COPD exacerbation. In high-risk patients undergoing CABG, inspiratory muscle training is associated with a reduction in postoperative pulmonary complications.
**Neurologic**

The incidence of neurologic complications following cardiac surgery, including global encephalopathy, focal neurologic syndromes, and decline in intellectual function and memory, ranges widely from 1% to 80%. These complications have largely been attributed to the adverse effects of CPB, which can lead to embolism, hemorrhage, hypoxia, cerebral edema, and metabolic derangements. Advanced age, prior neurologic disease, type of surgery, aortic atheroma, and duration of CPB are predictors of neurologic complications following cardiac surgery. Stroke is a devastating complication of cardiac surgery with a reported incidence ranging from 0.8% to 7%. Prediction models can be used to estimate the perioperative risk of stroke.

In patients undergoing CABG, the incidence of coexisting carotid artery disease more than 50% is 17% to 22% and more than 80% disease, 6% to 12%. Approximately 30% of postoperative strokes are due to significant carotid artery stenosis. Stroke risk increases with the severity of stenosis, and the stroke risk in patients with carotid stenoses of less than 50%, 50% to 80%, and more than 80% is approximately 2%, 10%, and 11% to 18.8%, respectively. Even in the asymptomatic patient, carotid stenosis of 75% is an independent predictor of stroke risk after CABG. ACC/AHA guidelines state that selective carotid screening should be considered in the following high-risk patient groups: older than 65 years, left main coronary artery stenosis, carotid bruit on examination, PVD, history of smoking, and history of transient ischemic attack or stroke.

The goal of carotid revascularization before CABG is the prevention of cerebrovascular events. Carotid endarterectomy (CEA) and CABG can be performed as either a staged or combined procedure, and the combined incidence of stroke, MI, and death for either procedure is 10% to 12%. In 1 review of 97 studies, there was a trend toward higher mortality, stroke, and MI in patients undergoing combined CEA-CABG relative to staged CEA-CABG. According to the ACC/AHA guidelines, CEA should be considered before CABG or concomitant with CABG in patients with a symptomatic carotid stenosis or in asymptomatic patients with unilateral or bilateral internal carotid stenosis of 80% or more. Carotid artery stenting (CAS) is a less invasive alternative than CEA for carotid revascularization. In a recent review by Guzman and colleagues of 6 studies including 277 patients undergoing staged CAS and CABG, only 2.2% of patients suffered a stroke following CABG. However, the overall 30-day event rate after CABG (including events during CAS) for minor stroke, major stroke, death, and death or any stroke was 2.9%, 3.6%, 7.6%, and 12.3%, respectively. Although it is accepted that cerebral revascularization should take place before coronary revascularization unless it is a true emergency, future studies are necessary to clarify which carotid revascularization strategy is superior.

**Nutrition**

Preoperative assessment of nutritional status and body mass index (BMI) can identify patients at higher risk for cardiac surgery. Low BMI (<20 kg/m²) and hypoalbuminemia (<2.5 g/dL) are predictors of increased mortality, postoperative RF, HLOS, and prolonged ventilatory support following CABG. In malnourished patients undergoing elective cardiac surgery, nutritional status should be optimized before operation, if possible.

Obese patients undergoing cardiac surgery have increased incidence of infection of the sternal wound and saphenous vein graft harvest site, RF, prolonged ventilation, and HLOS. Obesity and obstructive sleep apnea are independent risk factors for developing AF. Obesity and the metabolic syndrome are associated with a higher
risk of developing AF after CABG in patients older than 50 years and 50 years and under, respectively. If clinically appropriate, cardiac surgery may be delayed while efforts at weight loss are attempted.

MEDICATIONS

After risk stratification is completed, the final phase of preoperative evaluation focuses on patient preparation to minimize complications. Perioperative medical therapy improves outcomes in patients undergoing noncardiac and cardiac surgery. However, despite the potential benefit, these medications are likely underutilized in clinical practice. In patients undergoing CABG, Filion and colleagues noted preoperative aspirin, β-blocker, ACEI, and statin use was 41.4%, 52.4%, 33.4%, and 30%, respectively. On the day of surgery, aspirin use remained stable at 43%, but β-blocker, ACEI, and statin use declined to 42.9%, 8.9%, and 8.9%, respectively. Cardiac surgical patients are also frequently exposed to a variety of antiplatelet agents and anticoagulants, which can potentiate surgical bleeding. Current medical therapy should be reviewed for all patients, keeping in mind which medications should be initiated, continued, and stopped before surgery.

Antiplatelet Therapy

Aspirin, plavix, and glycoprotein (GP) IIB/IIIa inhibitors are beneficial in the management of acute coronary syndrome and during percutaneous coronary intervention (PCI). Early (<6 hours) postoperative administration of aspirin is associated with a reduced risk of saphenous vein graft thrombosis, mortality, MI, stroke, RF, and bowel infarction. Preoperative use of aspirin is associated with an increased risk for postoperative bleeding and need for transfusion. Concomitant use of other antiplatelet agents and anticoagulants and certain disease states (eg, aspirin hyper-responders, thrombocytopenia, and renal disease) may potentiate the bleeding risk of aspirin. The preoperative use of clopidogrel in the presence or absence of aspirin in patients undergoing CABG is associated with increased postoperative bleeding, transfusions, and reoperations. In urgent or emergent CABG, aspirin administration should be continued or initiated in the preoperative period as the benefits outweigh the risk of bleeding. In elective CABG, the Society of Thoracic Surgeons (STS) and ACC/AHA recommend that it is reasonable to consider withholding aspirin before surgery for 3 to 5 days or 7 to 10 days, respectively. Aspirin should be resumed within 6 hours of a surgical revascularization procedure if there are no contraindications. Clopidogrel should be stopped 5 to 7 days before CABG. Eptifibatide and tirofiban are short-acting GP IIB/IIIa inhibitors, and should be discontinued 4 to 6 hours before cardiac surgery. Abciximab is a longer-acting agent, and should be discontinued 12 to 24 hours before surgery. After administration, there is little free abciximab circulating in the plasma but large quantities of eptifibatide and tirofiban. Platelet transfusion is an effective strategy to increase the circulating platelet population with available GP IIB/IIIa inhibitors for abciximab but not for eptifibatide and tirofiban.

Anticoagulant Therapy

UFH, LMWH, fondaparinux, and direct thrombin inhibitors are beneficial in the management of acute coronary syndromes and during PCI, and are used for prophylactic and therapeutic anticoagulation. UFH has not been shown to increase postoperative blood loss after cardiac surgery when discontinued shortly before operation. Preoperative LMWH and fondaparinux administration are associated with increased
bleeding, and based on expert opinion, LMWH and fondaparinux should be discontinued 24 hours before surgery and replaced with UFH (if anticoagulation is indicated).\textsuperscript{75,78} There are limited data regarding the safety of preoperative administration of direct thrombin inhibitors before CABG. Bivalirudin, a short-acting direct thrombin inhibitor, should be discontinued 3 hours before surgery. Hirudin and argatroban, longer-acting agents, should be stopped earlier than bivalirudin and replaced with UFH before cardiac surgery.\textsuperscript{75,78} Warfarin should be stopped at least 5 days before cardiac surgery to allow normalization of the INR.\textsuperscript{23} If continued therapeutic anticoagulation is necessary, UFH or LMWH may be initiated preoperatively.

\textbf{\beta\textsuperscript{-}Blocker Therapy}

\beta\textsuperscript{-}Blocker therapy improves acute and long-term outcomes for patients with ischemic heart disease.\textsuperscript{75,79} In addition, in high-risk patients undergoing major noncardiac and vascular surgery, \beta\textsuperscript{-}blocker therapy reduces the rate of cardiovascular events.\textsuperscript{60,62} There has been cautious extension of their application to cardiac surgical patients due to concerns regarding their negative inotropic effects and possible exacerbation of underlying reactive airway disease. Nearly 40\% of patients undergoing CABG do not receive preoperative \beta\textsuperscript{-}blocker therapy, and patients with higher-risk features (eg, DM, CHF, underlying lung disease, and older age) are less likely to be treated with \beta\textsuperscript{-}blocker therapy. Preoperative \beta\textsuperscript{-}blocker therapy is associated with a statistically significant lower rate of 30-day mortality. Although a similar effect is seen in women, the elderly, and patients with chronic lung disease, DM, or moderately depressed LV function during subgroup analysis, a trend toward higher mortality is present in patients with a LVEF less than 30\%.\textsuperscript{65}

\beta\textsuperscript{-}Blocker therapy has also been shown to reduce the incidence of postoperative AF when administered pre-\textsuperscript{66} and postoperatively.\textsuperscript{9} Perioperative interruption of long-term \beta\textsuperscript{-}blocker therapy increases susceptibility to postoperative arrhythmias.\textsuperscript{6} In addition to lowering the incidence of AF, \beta\textsuperscript{-}blocker therapy is associated with reduced risk of postoperative neurologic complications.\textsuperscript{67} The ACC/AHA recommends the use of preoperative or early postoperative \beta\textsuperscript{-}blocker therapy in patients undergoing cardiac surgery without contraindications to its use.\textsuperscript{3}

Sotalol has \beta\textsuperscript{-}blocker and class III antiarrhythmic drug effects. Sotalol has been found to be more effective in reducing the incidence of postoperative AF than \beta\textsuperscript{-}blocker therapy,\textsuperscript{69} but its use is associated with more postoperative bradycardias and hypotension.\textsuperscript{80} The ACC/AHA recommends that low-dose sotalol can be considered in patients who are not candidates for traditional \beta\textsuperscript{-}blocker therapy to lower the incidence of postoperative AF.\textsuperscript{3}

\textbf{ACEI or Angiotensin-II Receptor Blocker Therapy}

ACEI or angiotensin-II receptor blocker (ARB) therapy reduces the risk of developing AF, particularly in patients with systolic dysfunction or LV hypertrophy.\textsuperscript{81} In patients undergoing CABG, postoperative withdrawal of ACEI therapy is associated with an increased incidence of new onset and recurrent AF, and perioperative treatment with ACEI is associated with a reduced risk of AF.\textsuperscript{6} In an underpowered study of cardiac surgical patients, preoperative ACEI or ARB therapy was associated with a nearly 30\% lower risk of developing AF, but this reduction was not statistically significant.\textsuperscript{63} In addition, treatment with quinapril for 4 weeks preoperatively and 1 year postoperatively in patients undergoing CABG reduced clinical ischemic events.\textsuperscript{70} The antiinflammatory properties of ACEI or ARB therapy likely contribute to these cardioprotective effects.\textsuperscript{82} However, preoperative administration of ACEI or ARB therapy
may increase the perioperative requirement for vasopressor drug administration. Although there are no specific guidelines, it is probably reasonable to continue preoperative ACEI or ARB therapy in patients with underlying hypertension given their potential benefits but consider withholding therapy in patients with marginal blood pressure.

**Statins**

Preoperative administration of 3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitor (statin) therapy in vascular and cardiac surgery is associated with 59% and 38% reductions in mortality, respectively. Liakopoulos and colleagues found that preoperative statin therapy in patients undergoing cardiac surgery was associated with a reduction in early all-cause mortality, AF, and stroke. Statin therapy may be protective through lipid-independent or pleiotropic effects including antiinflammatory, antithrombotic, and vasodilatory effects. All patients undergoing cardiac surgery should receive statin therapy unless specifically contraindicated.

**Amiodarone**

Preoperative administration of amiodarone is an effective, well-tolerated therapy for prevention of postoperative AF. In the PAPABEAR trial, a 13-day perioperative course of oral amiodarone in patients undergoing cardiac surgery significantly reduced the overall incidence of atrial tachyarrhythmias regardless of concomitant preoperative \( \beta \)-blocker therapy and postoperative sustained ventricular tachyarrhythmias. A single-day, preoperative loading dose of oral amiodarone did not reduce the incidence of postoperative AF in patients undergoing cardiac surgery. Given that effective amiodarone prophylaxis requires a preoperative treatment period, loading protocols seem limited to elective cardiac surgery. Intravenous amiodarone given immediately after cardiac surgery is also effective in reducing the incidence of AF. ACC/AHA guidelines recommend that preoperative administration of amiodarone should be considered for patients at high risk for developing AF with contraindications to \( \beta \)-blocker therapy.

**SUMMARY**

Morbidity and mortality associated with cardiac surgery is significant to the patient and costly to the health care system. During preoperative evaluation, statistical risk models should be used to obtain objective estimates of operative mortality and morbidity. In patients with severe LV dysfunction, a cardiac imaging modality should be considered to help identify dysfunctional but viable myocardium. A recent MI, particularly if associated with LV thrombus formation or severe RV dysfunction, may prompt a delay in cardiac surgery. Patients at high risk for renal dysfunction need management strategies aimed at minimizing renal insults. Existing pulmonary conditions should be treated as best possible before initiation of mechanical ventilation. Carotid Doppler should be performed in patients at increased risk for coexistent carotid artery disease, and if significant carotid artery disease is present, CEA should be considered either before or concomitant with cardiac surgery. With regard to medical therapy, \( \beta \)-blocker, ACEI, and statin therapy should be used in the absence of contraindications, and amiodarone therapy instituted in patients at high risk for AF. Clopidogrel should be withheld 5 to 7 days before surgery, and the risk/benefit ratio of preoperative aspirin therapy assessed.
REFERENCES


