Optimizing the preoperative evaluation of patients with aortic stenosis or congestive heart failure prior to noncardiac surgery

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Aortic stenosis poses a preoperative management dilemma for patients who are scheduled to undergo noncardiac surgery. Likewise, congestive heart failure (CHF) is a significant surgical risk factor, and it merits careful patient selection and perioperative management.

Unfortunately, we have few data on the preoperative evaluation of patients with either of these two conditions. The guidelines for perioperative cardiovascular evaluation for noncardiac surgery that were developed jointly by the American College of Cardiology and the American Heart Association (ACC/AHA) devote minimal discussion to aortic stenosis and CHF.[1,2] Although the guidelines raise numerous red flags, they do not provide much guidance. In the absence of hard evidence-based data, I have structured this review around my own clinical impressions and clinical experience.

AORTIC STENOSIS AS A SURGICAL RISK FACTOR

Goldman et al determined that "important valvular aortic stenosis" is a major cardiac risk factor in patients who undergo noncardiac surgery.[3] They studied 1,001 consecutive patients aged 40 years and older and found that 23 of them had severe aortic stenosis. Of these 23 patients, 3 died during or shortly after noncardiac surgery (mortality rate, 13%). Admittedly, these numbers are not very robust.

Torsher et al conducted a retrospective study of risk in 19 patients with severe aortic stenosis who underwent a total of 28 noncardiac operations.[4] They found only 2 complications (7%) and concluded that selected patients with severe aortic stenosis who are managed appropriately may proceed to noncardiac surgery with an acceptable risk. They postulated that aggressive intraoperative and postoperative monitoring and therapy yields positive results and that prompt recognition and treatment of intraoperative hypotension is necessary to avoid peripheral hypoperfusion.

According to the ACC/AHA guidelines, "Severe aortic stenosis poses the greatest risk for noncardiac surgery. If the aortic stenosis is severe and symptomatic, elective noncardiac surgery should generally be postponed or canceled. Such patients require aortic valve replacement before elective but necessary noncardiac surgery."[5]

Although the risk imposed by aortic stenosis can be managed, optimal management of aortic stenosis in a patient who is undergoing noncardiac surgery has not been fully defined, and much depends on individual physician experience, patient comorbidities, and the absolute necessity of the intended surgery. In light of the need for a somewhat individualized approach, I will walk through an actual case study.

CASE STUDY

A 55-year-old man presented to his primary care physician with symptomatic lower extremity claudication upon walking 50 feet. His activity level had been severely reduced by the leg pain as well as by dyspnea. The patient was referred to a vascular surgeon, who recommended aorto-bifemoral bypass surgery. The patient was then referred for preoperative evaluation.

History. The patient's comorbidities included ongoing smoking (40 pack-years), type 2 diabetes

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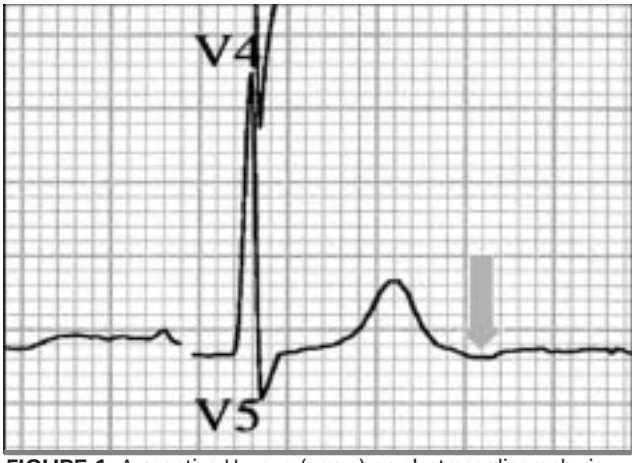

FIGURE 1. A negative U wave (arrow) on electrocardiography is usually a sign of left ventricular hypertrophy and/or obstructive coronary disease.

mellitus, hypertension, and a longstanding poorly characterized heart murmur. He was taking only three medications: baby aspirin, amlodipine, and metformin.

Physical exam. The patient was 5′ 8″ tall and 247 lb with a waist size of 46 in. His blood pressure was elevated and equal in both arms (178/104 mm Hg), and his jugular venous pressure was elevated (~8 cm H_2O at 45°). His lungs were characterized by a diffuse decrease in breath sounds without clear focality, there was a harsh systolic murmur best heard at the left upper sternal border, and S_2 was indistinct. His carotid pulses were reduced and delayed, and the results of a lower extremity and femoral exam confirmed severe lower extremity arterial vascular disease including a marked reduction of pedal pulse intensity and loud bifemoral bruits. Findings on a limited abdominal exam secondary to increased girth were normal.

Laboratory tests. The patient's basic metabolic profile was normal, but his fasting glucose level was not ideal (142 mg/dL), his hemoglobin A_{1c} level was elevated (7.7%), and his B-type natriuretic peptide level was 380 pg/mL. He had mild proteinuria (1+ protein) and his lipid profile was as follows: total cholesterol, 276 mg/dL; high-density lipoprotein cholesterol, 42 mg/dL; low-density lipoprotein cholesterol, 194 mg/dL; and triglycerides, 264 mg/dL.

Other investigations. Chest radiograph demonstrated an enlarged cardiac silhouette, but no abnormal lung fields. Electrocardiography (ECG) detected a prominent "negative U wave," which is a terminally negative deflection after the T wave (Figure 1). This underappreciated ECG abnormality is present in two circumstances—left ventricular hypertrophy (LVH) and/or obstructive coronary disease—making it a potentially useful marker for underlying pathology, especially in patients with multiple coronary artery disease (CAD) risk factors. Two-dimensional echocardiography identified significant LVH and severe aortic stenosis. The aortic valve peak gradient was 96 mm Hg and the mean gradient was 64 mm Hg (a mean gradient ≥ 40 mm Hg in a patient with normal LV systolic function reflects severe aortic stenosis).

Establishing a risk profile

Risk factors. Before making a decision, a review of the ACC/AHA's broad categories of cardiac risk considerations and how they apply to this patient is in order:

- *The type of operation and its risk*. An aortobifemoral bypass is a major operation with the potential to cause significant hemodynamic stress.
- *The presence and severity of CAD*. We do not know if our patient has CAD, but our suspicion is high as he has large-vessel lower extremity arterial vascular disease.
- *LV function*. Our patient's LV function is almost normal; it is at most slightly depressed.
- *Age*. Age is not a mitigating factor in this case.
- *The presence and severity of valvular heart disease*. Present and severe.
- *Serious cardiac arrhythmias*. No historical evidence of arrhythmias was found, but the substrate for arrhythmias (LVH, severe valvular heart disease) is present.
- *Comorbidities*. Several.
- *Overall functional status*. Suboptimal.

When the risk factors are added, the patient is considered to be at high cardiac risk—that is, he has a greater than 5% chance of perioperative mortality or significant morbidity because of the high potential for hemodynamic shift.

Clinical predictors. In addition to cardiac risk factors, the ACC/AHA guidelines also take into account "clinical predictors" of an adverse perioperative cardiac event (Table 1). These predictors are classified as major, intermediate, and minor. Major predictors include:

- *A recent unstable coronary syndrome, such as an acute myocardial infarction (MI) within the previous 7 days, an acute MI with residual ischemia within the previous 1 month, or unstable angina*. When any of these circumstances is present, it is best to postpone any elective or semi-elective surgery for as long as possi-

ble, optimally for at least 1 month and preferably for 3 to 6 months. Our patient does not have an unstable coronary syndrome.

• *Decompensated CHF.* Do not perform surgery on such a patient until the CHF symptoms can be stabilized and reversed. The presence of CHF is usually a greater risk to the patient than the indication for surgery.

• *Significant arrhythmias*. Again, we do not suspect arrhythmia in our patient.

• *Severe valvular disease*. We have established that our patient has severe valvular disease.

In the future, levels of B-type natriuretic peptide may be incorporated into preoperative risk assessment indices. In patients undergoing cardiac surgery, preliminary evidence suggests that preoperative B-type natriuretic peptide levels may predict length of stay, morbidity, and mortality.[6]

Functional capacity. Functional capacity can be determined by asking patients if they are independent and if they can exercise, go to the grocery store, climb a flight of stairs, etc. As established previously, our patient's functional capacity is limited.

TABLE 1
Major clinical predictors of an adverse perioperative cardiac event

Unstable coronary syndromes
• Acute myocardial infarction (< 7 days previously)
• Recent myocardial infarction with residual ischemia (< 1 month)
• Unstable angina
Decompensated congestive heart failure
Significant arrhythmias
• High-grade atrioventricular block
• Symptomatic ventricular
• Supraventricular with poor ventricular rate control
Severe valvular heart disease

Indications for coronary angiography

Is coronary angiography best performed in this patient? Let us review the class I and class II indications.

Class I indications are those for which the data strongly support performing angiography. They apply to patients with known or suspected CAD. These indications include:

• *Evidence of a high potential for an adverse outcome based on noninvasive testing results*. The resting echocardiogram in our patient detected the valvular abnormalities, but no other noninvasive tests that would detect CAD were performed.

• *Unstable angina or angina pectoris that is unresponsive to medical therapy*. Our patient does not have angina.

• *Equivocal results on a noninvasive stress test in a high-risk patient undergoing high-risk surgery*. Although CAD is almost a certainty in this patient, we need to know whether or not it is functionally significant and therefore flow-limiting. In a patient with severe aortic stenosis, prominent CAD risk factors, and upcoming noncardiac surgery with significant hemodynamic risk, invasively assessing the coronary artery circulation is indicated.

Class II indications are not as fully supported by the data, and indicate a divergence of opinion about the usefulness of performing the procedure. These indications are:

• *The presence of multiple markers of intermediate clinical risk in a patient scheduled for vascular surgery*. As addressed in the prior section, these criteria certainly apply to our patient. The general recommendation is to consider a noninvasive test first, although some physicians proceed directly to cardiac catheterization. In the absence of valvular heart disease and LV systolic dysfunction, we should proceed with noninvasive imaging—typically, a dobutamine echocardiogram. If those results are satisfactory, then we can proceed with surgery. If the patient does have concomitant LV dysfunction or significant valvular disease in the absence of LV dysfunction, we would perform a cardiac catheterization first.

• *A moderate to large ischemic burden on a noninvasive stress test in a patient without high-risk features and a preserved LV ejection fraction*. Most physicians would consider this a class I indication. Almost all patients with a large ischemic burden undergo cardiac catheterization.

• *Nondiagnostic noninvasive test results in an intermediate-risk patient who is undergoing high-risk surgery*. The decision rests on individual clinical judgment, but most physicians would favor cardiac catheterization.

• *Urgent noncardiac surgery for a patient convalescing from a recent MI*. This decision rests on which circumstance takes precedence—the urgency of the planned operation or the risk of catheterization. This is a complex situation. It might be best to per-

form a simple balloon angioplasty without stenting in the setting of residual myocardial ischemia in order to avoid the need for anticoagulation. If stenting becomes necessary to treat residual CAD, it could be performed later after the patient has healed, but this practice is controversial and recommendations are in flux.

How is our patient best managed?

To review, an aorto-bifemoral bypass has been proposed for this patient. The patient has multiple cardiac risk factors, near-normal LV function, no known arrhythmias, and severe aortic stenosis. He has a reduced exercise tolerance, although ascribing the patient's reduced exercise tolerance solely to cardiac disease is problematic because he has exercise-limiting claudication and a longstanding history of tobacco use.

What is our next step?

- Optimize medical therapy, then proceed with noncardiac surgery
- Cancel the aorto-bifemoral bypass, prescribe cilostazol and a walking program, and reassess in 1 month
- Perform dobutamine echocardiography and reassess surgical candidacy
- Cancel the bypass and perform cardiac catheterization, aortic valve replacement, and possibly coronary artery bypass graft surgery.

It is fairly clear that the next step is to cancel the aorto-bifemoral bypass and perform cardiac catheterization and aortic valve replacement—that is, to treat this man like any other patient who presents to our office with severe aortic stenosis. The two circumstances that will guide our course of action are that (1) our patient has severe aortic stenosis and suspected CAD and (2) he has serious quality-of-life–limiting symptoms related to his peripheral vascular disease.

The outcome

The cardiac catheterization in our patient confirmed that his LV systolic function was normal (LV ejection fraction, ~55%). He had significant CAD, primarily in the proximal right coronary artery (80% to 90% stenosis) and to a much lesser degree in the left anterior descending artery (30%). An aortogram confirmed that both the peripheral vascular disease and the aortic stenosis were severe, and it identified a mild poststenotic dilation of the ascending aorta. The patient was referred to a cardiac surgeon so that his heart problems could be addressed prior to treatment of his lower extremities.

ADDITIONAL CONSIDERATIONS WITH AORTIC STENOSIS

Aortic stenosis and coexisting conditions

Angina and CHF. Patients with aortic stenosis who also have angina and CHF have a poor short-term prognosis, so it is best to proceed with a diagnostic work-up with the intent to perform an aortic valve replacement. Again, echocardiography is an invaluable tool that has supplanted cardiac catheterization for the hemodynamic evaluation of aortic stenosis in the vast majority of cases.

Severe LV dysfunction. Patients with suspected advanced aortic stenosis and severe LV dysfunction may actually have "pseudoaortic stenosis," which is a low-gradient aortic stenosis in the presence of severe LV dysfunction. We must determine if severe valvular aortic stenosis is present vs severely reduced cardiac output and forward perfusion pressure preventing adequate aortic valve excursion. We can differentiate the two by performing dobutamine echocardiography; if leaflet excursion is increased or if the calculated aortic valve area increases, the patient likely has pseudostenosis. In contrast, if the calculated valve area remains constant and the leaflets do not demonstrate increased excursion, we can confidently proceed to aortic valve replacement as this represents a true case of valvular stenosis.

Correcting stenosis prior to noncardiac surgery

When noncardiac surgery is absolutely necessary in a patient whose aortic valve surgical risk would otherwise be deemed prohibitive, one option is to perform a valvuloplasty. However, it is fraught with risks, particularly embolism. Also, rates of recurrent aortic stenosis are extremely high, so valvuloplasty might turn out to be only a temporary palliative procedure.

CHF AS A SURGICAL RISK FACTOR

Growing number of surgical candidates with CHF

In addition to the paucity of published data on the preoperative evaluation of patients with CHF, our assessment is complicated by the changing epidemiology of patients who are undergoing noncardiac surgery. First, increasing life spans mean that a greater number of older patients are undergoing noncardiac surgery. Second, surgeons are developing less invasive surgical options. Both of these factors have broadened the base of older patients who are eligible for surgery, and these patients often possess more comorbidities and more complex medical problems. CHF is one of the most serious of these comorbidities, and it is becoming more common.

Systolic vs diastolic: Better differentiation needed

An important aspect of CHF is that systolic and diastolic heart failure have not yet been preoperatively differentiated. Of the two, more attention has been given to systolic heart failure, but older patients with noncompliant hypertrophied ventricles can experience significant intraoperative and postoperative difficulties as well—particularly with fluid shifts, excessive fluid administration, and perhaps some concomitant myocardial ischemia. There may be important differences between systolic and diastolic heart failure with respect to risk stratification and management, but we just do not know at present.

A more important risk than CAD?

It seems as if the focus on preoperative risk has generally been CAD, but some studies have shown that CHF is actually more serious. For example, Hernandez et al retrospectively reviewed the records of 1,532 patients with CHF who had undergone major cardiac surgery.[7] These patients were among thousands in a national Medicare database, and they represented a broad spectrum of older patients who underwent major noncardiac surgery. The researchers found that among patients aged 65 years or older, those with CHF experienced significantly greater morbidity and mortality than did patients without CHF, including those with CAD. In fact, the complication rate in CHF patients (11.7%) was nearly double the rate in patients with CAD (6.6%) and in controls who had neither CHF nor CAD (6.2%). Overall, the mere presence of CAD was not necessarily significant. The trend was observed throughout for various endpoints, including operative mortality, 30-day mortality, postdischarge mortality, length of hospitalization, the need for intensive care, and readmission rates. The trend was maintained regardless of the type of procedure or the urgency of the operation.

Certainly, this study had some inherent weaknesses. For example, it would be interesting to see how outcomes would have differed if the patients with CHF had been compared to patients with *functionally significant* CAD instead of being compared to all patients with CAD regardless of severity. Another concern is that many of the patients with CHF may not have been on beta-blockers—or if they were, the dosages may not have been titrated to the level of maximum therapeutic benefit. The myth persists that beta-blockers can be deleterious in patients with CHF, yet the risk of beta-blockade is typically small in patients who are either compensated or nearly compensated, while the benefit in these patients is clearly elucidated. Despite the study's limitations, it did bring to the fore the importance of CHF as a significant perioperative risk factor. Therefore, careful preoperative patient selection and perioperative management is mandatory.

DIFFICULT DECISIONS

Suppose we determine that cardiac surgery is necessary just to prepare a high-risk patient for subsequent noncardiac surgery. We must ask ourselves if two operations are worth the expected outcome. What will all this surgery do to the patient's quality of life? Is it better to do nothing?

These are hard questions, and we will not always find the answers in published guidelines or in a textbook. This is when we are truly "doctors." This is when we call on our judgment, experience, and instincts as well as our commitment that whatever we do will be dictated by what is best for the patient.

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