Anesthesia for non-cardiac surgery in the patient with cardiac disease

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THIS talk will describe an approach to the patient with heart disease who is undergoing non-cardiac surgery. Emphasis will be placed on the pathophysiology of the lesion, the preoperative evaluation, anesthetic goals and pertinent therapeutic options. Because of the time limitations of the presentation, not all cardiac conditions will be addressed. Instead, this talk will focus on five important lesions that have been chosen because of their severity and prevalence: coronary artery disease, aortic stenosis, hypertrophic obstructive cardiomyopathy, rheumatic mitral stenosis, and mitral valve prolapse. In managing patients with valvular heart disease there are two important philosophies to remember. First, "the enemy of good is better." Most valvular lesions cannot be completely treated by medical management. In other words, don't over-treat these patients; aim for stability, not "normal" hemodynamics. Second, for the reasons that will become clearer in the discussion of aortic stenosis, in patients with multiple valvular lesions which may suggest contradictory anesthetic goals, always give the highest priority to the aortic stenosis.

Coronary artery disease

Coronary artery disease affects over seven million Americans and thus it is not uncommon to have to care for these patients in non-cardiac surgery. Proper preoperative evaluation of these patients is critical to identify patients with either acute myocardial infarction or unstable angina. This topic is covered in another refresher course, and this talk will focus on the intraoperative management. The main anesthetic goals are avoiding extremes of blood pressure and tachycardia. However, because ischemia can occur in the absence of significant hemodynamic changes, careful monitoring is essential. Patients with active ischemia prior to the operation require more aggressive monitoring and treatment, than those with chronic stable ischemic heart disease. In addition to a

multilead electrocardiogram, this aggressive monitoring may include an arterial line, a pulmonary artery catheter, and transesophageal echocardiography. Therapeutically, in addition to nitroglycerine, beta-blockers, and calcium channel blockers, anticoagulation may be a useful pharmacologic modality. Placement of an intra-aortic balloon pump may also be useful. In non-emergent situations in patients with unstable angina, revascularization prior to non-cardiac surgery must be considered. It should be noted that non-cardiac surgery within two weeks of coronary stenting has been associated with "catastrophic outcomes." It appears that coronary arteries need time to heal after interventional procedures.

Aortic stenosis

Aortic stenosis derives its position as the most important valvular lesion because of its potential for sudden death (15-20%), and because of the inability to obtain adequate systemic perfusion by external cardiac massage during a cardiac arrest. The three main etiologies of aortic stenosis are congenital, senile calcification and rheumatic disease. The normal aortic valve is 2 to 3 cm². As the valve orifice narrows, resistance to flow develops and a pressure gradient across the valve also occurs. This pressure gradient leads to a pressure overload of the left ventricle.

There is compensatory concentric hypertrophy to normalize the wall stress, but other abnormalities persist: increased oxygen demand, reduced oxygen delivery, and reduced diastolic relaxation and compliance. Symptoms i.e., angina, congestive heart failure, syncope, and sudden death, usually begin to occur when the valve area falls below 1 cm². Preoperative evaluation of a systolic ejection murmur will generally begin with an echocardiogram, and if the symptoms or echocardiogram indicate, cardiac catheterization will be performed. The important measurements obtained during catheterization are the aortic valve gradient, the aortic valve area, left ventricular (LV) end-diastolic

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FIGURE 1 Pressure volume loop of a normal left ventricle (dashed line) and a left ventricle in a patient with aortic stenosis (solid line).

pressure, and LV ejection fraction. The main anesthetic goals are to maintain normal sinus rhythm, adequate intravascular volume, and systemic vascular resistance. In addition to the usual pharmacologic agents, there are two additional interventions to consider. One is the preoperative placement of an intra-aortic balloon pump to improve coronary perfusion, and the other option in patients who are not candidates for aortic valve replacement, is to perform balloon valvuloplasty to reduce the stenosis prior to non-cardiac surgery.

Hypertrophic obstructive cardiomyopathy (HOCM)

One rationale for including this lesion is that like aortic stenosis, HOCM can precipitate sudden death. It is also included because of its unique dynamic physiology and unusual treatments. HOCM results in obstruction to LV ejection in the LV outflow tract (LVOT). Like aortic stenosis it also causes a pressure overload of the LV. In addition to the pressure overload, systolic anterior motion of the mitral valve induced by a venturi effect, often precipitates mitral regurgitation.

Factors such as hypovolemia, tachycardia, systemic vasodilation, and increased contractility all exacerbate the obstruction. The clinical presentation includes angina, congestive heart failure, syncope and sudden death. Preoperative evaluation includes baseline and provocative (Valsalva, or nitrates) echocardiography. The important measurements are the LVOT diameter, the gradient across the LVOT, and the severity of the mitral regurgitation. The main anesthetic goals are to maintain normal sinus rhythm, intravascular volume, systemic vascular resistance, and to avoid hypercon-

FIGURE 2 A four-chamber transesophageal echocardiography view with arrow pointing to systolic anterior motion of the mitral valve (SAM) in the left ventricular outflow tract (LVOT).

tractile states. In the acute perioperative period therapy is limited to pharmacologic agents, but in the chronic care of HOCM, the synchronous contractile pattern induced by pacing may be therapeutic.

Rheumatic mitral stenosis

Mitral stenosis is a narrowing of the mitral valve orifice that results in left atrial hypertension, limited filling of the LV, pulmonary congestion, and in moderate to severe cases, pulmonary arterial hypertension and right ventricular pressure overload. Dyspnea is the most common presenting symptom, and many of the patients are in atrial fibrillation. Echocardiography can demonstrate left atrial enlargement, mitral valve fibrosis and calcification, and a gradient across the mitral valve. Cardiac catheterization will also determine the gradient across the valve, the mitral valve area, LV function, and the right sided pressures. The anesthetic goals for patients with mitral stenosis are to control the heart rate and if possible restore and preserve sinus rhythm, insure adequate intravascular volume, and to prevent systemic arterial vasodilation. Additionally in patients with pulmonary hypertension, hypercarbia and hypothermia, which may exacerbate the increased pulmonary vascular resistance should be avoided. Several special therapeutic options for these patients exist. Balloon valvuloplasty may be performed, and cardioversion for atrial fibrillation may be useful. There are also some new pharmacologic agents for treatment of refractory severe pulmonary hypertension: inhaled prostacyclin and nitric oxide.

Mitral valve prolapse syndrome (MVP)

MVP is the most common valvular abnormality occurring in 3 to 8% of the population. Anatomically it is characterized by billowing of one of the mitral valve leaflets into the left atrium. There may be minimal or significant mitral regurgitation associated with this condition. In addition to the valvular abnormalities, there may be an increased risk of autonomic dysfunction. Patients experience palpitations, chest pain, dyspnea, fatigue, and orthostatic hypotension. Though there is some debate over the exact criteria to diagnose MVP, echocardiography is still the diagnostic method of choice. Because of the leaflet abnormalities some of these patients receive antiplatelet or other anticoagulant therapy. Other than infective endocarditis prophylaxis for those patients with abnormal leaflets, there are few defined anesthetic goals for these patients.

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