



Patient selection in robotic mitral valve surgery

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In recent years there has been increased application of robotic mitral valve surgery (1). Advantages to robotic surgery include smaller incisions, quicker recovery, less blood loss and, perhaps, a reduced risk of infection (1-4). Patients prefer the shorter recovery and cosmetic result, and surgeons benefit from enhanced visualization and dexterity. However, the key factors governing the choice of a robotic approach are patient safety and procedural success. Both mitral valve repair and replacement can be completed with the surgical robot. Of note, in patients with degenerative mitral valve disease, expectations include exceedingly low mortality (<1%) and a high rate of valve repair (>95%).

We have previously described a conservative screening algorithm based on patient history, computed tomography (CT) scanning and echocardiography that enabled us to achieve these goals; in our first 1,000 robotic mitral valve operations, we had no mortality and a repair rate of 99% (4). In our subsequent 1,600 cases, based upon increased experience and facility with the robotic platform, we have extended this approach to a wider group of patients. Herein we present our current screening algorithm—focusing on those factors that “alert” us to the possibility that we must alter our robotic approach or perform a sternal incision—and strategies to mitigate/safely work around factors in the patient history, CT scan or echocardiogram that would have previously led us to perform a sternotomy. While concomitant tricuspid valve surgery, patent foramen ovale (PFO)/atrial septal defect closure and ablation of atrial fibrillation are all feasible during robotic mitral valve surgery, we do not employ the robotic platform in patients

who require concomitant coronary artery bypass grafting, aortic valve repair/replacement or aortic surgery.

Patient history

In our practice, a previous right thoracotomy represents a contraindication to robotic mitral valve surgery. If a patient has had a previous sternotomy, robotic surgery is feasible in experienced hands. When operating on the patient who has had a previous sternotomy, it is advantageous to employ balloon occlusion of the ascending aorta, and a combination of antegrade and/or retrograde cardioplegia delivered via the ascending aortic balloon catheter and a coronary sinus catheter placed via the internal jugular vein, respectively. Though fibrillatory arrest is a possible alternative, we do not favor this approach.

Echocardiography

Aortic regurgitation

Aortic regurgitation that is greater than mild in degree often jeopardizes myocardial protection by rendering antegrade cardioplegia unpredictable and ultimately less effective. In this setting, a retrograde coronary sinus catheter placed via the internal jugular vein facilitates a safe procedure. Before removal of the aortic cross-clamp/deflation of the ascending aortic balloon, a vent should be placed across the mitral valve to prevent left ventricular distension and aid deairing in all robotic cases, and this maneuver is particularly important if there is aortic regurgitation.

Severe mitral annular calcification

Severe mitral annular calcification substantially increases the complexity and risk of mitral valve surgery. While some have reported success addressing this challenge with the surgical robot (5), we prefer a full sternotomy in this setting.

Severe left ventricular dysfunction

This is a relative contraindication to robotic mitral valve surgery, particularly early in the surgical team's experience. In patients with severe left ventricular dysfunction, optimal myocardial protection and a short myocardial ischemic time are critically important. When approaching these patients with the robotic platform, we employ both antegrade and retrograde cardioplegia and ensure a short aortic cross-clamp time.

Pulmonary hypertension

Many patients with mitral valve disease have pulmonary hypertension. While we still consider severe, fixed pulmonary hypertension (i.e., near systemic or greater pulmonary artery pressure) a contraindication to robotic surgery, lesser degrees of pulmonary hypertension are acceptable; in such cases, our standard routine of systemic cooling to 30 °C is important.

CT scan

All patients should undergo CT scanning of the chest, abdomen and pelvis, with and without contrast, before planned robotic surgery. Uncommon and unexpected findings, including type B aortic dissection, discontinuous inferior vena cava, and presence of an inferior vena cava filter have led us to pursue a sternal approach. Other CT findings require careful consideration before pursuing a robotic approach.

Aortoiliac atherosclerosis

Significant aortoiliac atherosclerosis contraindicates femoral arterial perfusion due to the increased risk of cerebrovascular events (6). The definition of "significant" is subjective; however, in the presence of soft plaque or diffuse hard/calcified plaque, we choose axillary artery cannulation for arterial inflow.

Femoral arterial diameter <7 mm

Small femoral arteries should not be cannulated directly. In the setting of an artery that is of borderline size (i.e., 6 mm), we prefer to sew an 8-mm graft to the femoral artery to enable adequate systemic flow and ensure distal limb perfusion. If the femoral vessels are less than 6 mm in diameter, we generally pursue a sternal approach. Alternatively, the surgeon may choose to cannulate both femoral arteries.

Severe pectus excavatum

In general, it is ideal to have a distance of at least 10 cm between the posterior sternal table and the anterior spine to facilitate exposure of the right pulmonary veins and left atrium. Simply put, there needs to be adequate space for left atrial retraction and mitral valve visualization. If this distance is 7–10 cm, we determine feasibility of the robotic approach by inserting a camera into the right chest and directly assessing the anatomy. If the distance is less than 7 cm, we generally pursue a sternal incision.

Comments

Most patients with isolated mitral valve pathology are suitable for a robotic approach. As with all cardiac surgical procedures, patient selection is paramount to success. When considering use of the surgical robot, the surgeon must ask himself/herself a simple question: "Can I do exactly the same operation, with the same safety and effectiveness if I employ the robot?" If the answer is "Yes", a robotic approach is appropriate.

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Footnote

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