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LESS INVASIVE SURGERY FOR CARDIAC TUMORS

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Introduction

Cardiac surgery has undergone remarkable changes in the last 2 decades. Percutaneous coronary interventions (PCI) were becoming increasingly sophisticated, and patients preferred these to the more durable but invasive option of surgery. Spurred by this, the evolution towards less invasive techniques in cardiac surgery was led by coronary bypass surgery, which of course involved operating on the surface of the heart.

The development of less invasive techniques for valve surgery began in the mid-1990s,⁵ with advances made simultaneously in the United States and Europe. It became possible to operate inside the heart using techniques that spared the sternum partially or completely. The ability to access all the chambers of the heart with these techniques made it possible to deal with cardiac tumors as well.

Less invasive advances in other surgical specialties preceded cardiac surgery and provided some of the ideas that were applied to the special problems of operating in the thorax and, in particular, on the heart. It was clear that there were 2 main groups of patients who would benefit from less invasive techniques in cardiac surgery: 1) patients who want it, including those who are the breadwinners or the main care providers in a family, and 2) patients who need it, mainly elderly, steroid dependent, debilitated, or deconditioned patients.

This article offers an overview of the development of less invasive techniques in cardiac surgery and how they have been adapted for cardiac tumors.

Evolution of Techniques

The goals of minimal-access techniques have been to minimize morbidity, enable early return to a normal lifestyle, and improve cosmesis (Figures 1 and 2). These need to be achieved without compromising the efficacy of the procedure as compared to traditional techniques. It is generally felt that preserving the bony integrity of the thorax is an important aspect of these approaches. Partial sternotomy (upper or lower) and right minithoracotomy approaches are used, with the latter being favored by most surgeons for mitral or tricuspid valve surgery. Right-sided approaches offer excellent access to the atria, often better than that achieved via sternotomy (Figure 3).



Figure 1. Minimally invasive incision for left atrial myxoma — 1 month later.



Figure 2. Mini MVR incision — 1 month later.

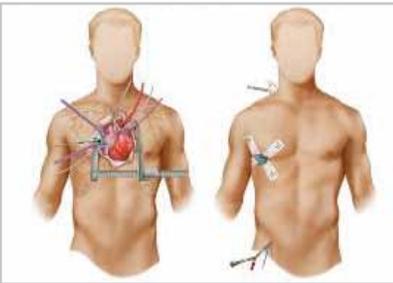


Figure 3. Comparison of sternotomy and sternal sparing incisions — schematic.



Figure 4. Left ventricular fibroelastoma seen through the aortic valve.

There has been a stepwise evolution in less invasive cardiac surgical techniques. This has required refinements in access incisions, thoracoscopic visualization, instrumentation, and perfusion technology and strategies. A critical element in the refinement of these techniques has been a better understanding of the teamwork that is needed. Roles need to be clearly defined, and good communication is key. Every member of the team is empowered to question strategy and offer suggestions.



Figure 5. Right minithoracotomy incision.

Access — A Stepwise Evolution

Direct Vision — smaller incisions via partial sternotomy or mini thoracotomy. Specially designed longer instruments were necessary. These techniques were first reported in the mid-1990s from U.S. and European centers. They were used for aortic⁵ and mitral surgery, and low rates of mortality (1%–3%) and morbidity were reported (Figures 4 and 5).

Video Assisted — techniques for video-assisted surgery were well developed in general for urologic and gynecologic surgery. These almost always involved the removal of a structure. Their adoption was delayed in cardiac surgery because most procedures involve a reconstructive element; valve repair or replacement and coronary anastomoses are examples. The removal of an intracardiac tumor requires, at the least, closure of the involved chamber of the heart. Two-dimensional scope visualization is augmented by the ability to look in through the incision and use scope illumination within the chest. Long shafted instruments continue to be refined and are essential in this method. This remains the most popular less invasive technique for cardiac surgery (Figure 6).^{6,9}

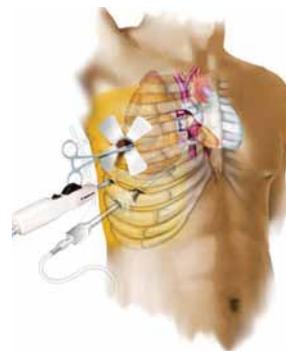


Figure 6. Mini right chest approach to atria — schematic.



Figure 7. (A and B) Da Vinci robot setup for minimal access to left atrium.

Video Directed — these are done entirely with video-scopic visualization. The surgery is performed through a small access incision with the surgeon looking at a monitor. The benefits of tactile feedback are preserved. Three-dimensional scope visualization has improved the ease of using this technique.^{7,10}

Robotic (Telemanipulation) — the Da Vinci surgical robot (Intuitive Surgical) allows true port access surgery with shafted instruments that have “wrists” with many degrees of freedom. The robot is used most frequently for mitral valve surgery and could potentially be used for the removal of cardiac tumors (Figure 7).⁸

Perfusion and Myocardial Protection Strategies

Intracardiac surgery requires placing the patient on cardiopulmonary bypass and usually achieving cardioplegic arrest. In less invasive surgery, this usually



Figure 8. Femoral cannulation for cardiopulmonary bypass.

requires peripheral cannulation techniques. Femoral arterial and venous cannulation are used most frequently (Figure 8). Femoral arterial cannulation has the potential for catastrophic complications such as retrograde dissection, embolic complications and limb ischemia. Patients who are being considered for this must be screened for the presence of significant aortoiliac disease. There is a growing tendency for axillary arterial cannulation to be used because of the antegrade perfusion achieved and the very low risk of arterial complications. All techniques of peripheral cannulation have been made safer and easier by the development of cannulae that are thin-walled and strong. These allow smaller diameters to be used while still achieving good flow rates on cardiopulmonary bypass.

Cross clamping of the aorta is done using modified clamps that can be introduced through separate incisions. Chitwood, Cosgrove and Cygnet clamps are examples of these (Figure 9). Endoclamping of the aorta was made feasible by Heartport technology in the late 1990s and may lead to a lower embolic risk. Most surgeons employ external aortic clamping because of its simplicity.

Cardioplegic arrest may be obtained with antegrade and retrograde cardioplegia using cannulae designed for less invasive techniques.

Transesophageal echocardiography is indispensable for cannula placement. In addition, it provides precise delineation of the extent of the tumor and confirms complete removal.



Figure 9. Right minithoracotomy — LA myxoma showing Cygnets aortic cross clamp.

Cardiac Tumors

The most commonly encountered tumors are benign. Half of these are myxoma and the rest are mainly lipoma, fibroelastoma, rhabdomyoma and fibroma. About 75% of myxomas occur in the left atrium, 10%–20% in the right atrium, and the remainder in the ventricles (Figures 10 and 11).^{1,2}

Malignant cardiac tumors are rare and are probably not suitable for less invasive techniques because of the extensive resection and reconstruction that may be required.⁴

Less invasive techniques provide excellent access to the atria and, through the mitral and tricuspid valves, to the ventricles. Resection of atrial tumors frequently involves a partial resection of the septum (Figure 12). Primary or patch reconstruction is easily performed via a right chest mini access incision — typically submammary and through the fourth intercostal space. Benign tumors in the ventricle may be removed by going through the atrioventricular valves. They are usually attached to the free wall in the right ventricle and the posterior papillary muscle in the left ventricle (Figure 13). Recurrence following resection is rare.³

Conclusion

A myriad of small improvements in a few years have brought less invasive cardiac surgical techniques into the mainstream, and it can now be offered to most patients with benign cardiac tumors. Early recovery, return to work, and superior cosmetic results are the rule following these techniques.



Figure 10. Left atrial myxoma.



Figure 11. Left atrial myxoma — sessile septal attachment.

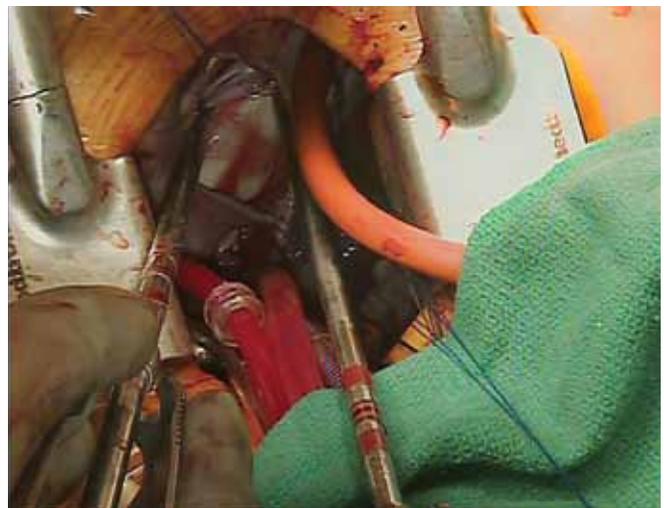


Figure 12. Reconstruction of interatrial septum with bovine pericardial patch.



Figure 13. Right mini thoracotomy incision — large myxoma left atrium.

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