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CASE REPORT

Minimally Invasive Beating Heart Mitral Valve Surgery

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ABSTRACT

As techniques in cardiac surgery continue to improve, the minimal invasive approach is providing benefits to the cardiac surgical patient. We report a case of a 24 year old gentleman with diagnosis of rheumatic heart disease with severe mitral stenosis that underwent mitral valve replacement via minimal invasive approach on beating heart. His post operative course was uneventful and he has been on regular follow up now. The advantages and disadvantages of the procedure are discussed here.

***Keywords**: Heart, mitral valve, thoracotomy*

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INTRODUCTION

Traditional cardiac surgery generally has been performed through a median sternotomy approach. The development of technique and technology has hastened a shift towards efficient and safe minimally invasive cardiac surgery. Mitral valve surgery is one of the common operations in cardiac surgery field. As understanbly, minimally invasive mitral valve surgery has advantages like decreased surgical trauma, postoperative pain, recovery time, and complications related to midline sternotomy are reduced. Several different approaches to the mitral valve has been used – namely partial lower sternotomy or right parasternal approach.[1] Both the approach does preserve all or part of the sternum, but it is essentially the same operation as the transsternal procedure. Yet in another approach, the surgeon can reach the heart through a right thoracotomy through the 3rd or 4th intercostal space.[2] Again unlike in conventional mitral valve surgery where heart is arrested with cardiolplegic agent at the time of surgery, a beating heart mitral valve surgery can be performed employing certain technique and understanbly with certain benefits.We describe a case in which we performed mitral valve replacement using an approach via a limited right thoracotomy on beating heart.

THE CASE

This 24 year old gentleman felt exertional breathlessness. On evaluation he was found to have severe mitral stenosis with mitral valve area 0.7 cm^2, mean mitral valve gradient of 16 mmHg with subvalvular fusion.

He was taken up for mitral valve replacement via right thoracotomy approach and on beating heart. The position of patient on table was kept supine with right thorax elevated with small pillow below the right scapula and chest. A 7-8 cm skin incision was made at mammary line

and thoracotomy was performed via right anterior 4th intercostals space. Cardiopulmonary bypass was initiated with aortic and bicaval canulation, and systemically cooled to 28 °C (**Figure 1**). An aortic root vent needle was inserted and connected to vent sucker at 100 mmHg. The patient was placed in the Trendelenburg position. Patient's perfusion pressure was kept at 70 mmHg. Heart rate was maintained between 70-80 beats per minute, and right atrium was opened.

Figure 1 Rt anterior 4th intercostal space approach & on cardiopulmonary bypass

One drop-in suckers was placed in the left atrium to maintain a bloodless operative field. Handheld retractor was used to expose the mitral valve (**Figure 2**). Anterior mitral leaflet excised, complete preservation of posterior mitral leaftlet and submitral apparatus was done to maintain left ventricular geometry. A 27 ATS Medtronic prosthetic valve was seated. Rewarming was started at the time of tying the valve sutures. Prosthetic mitral valve leaflet mobility was checked. Deairing of left side of heart performed. The right atrium was closed using a standard technique.

Figure 3 Intracardiac structures after opening of right atrium

Came out of cardiopulmonary bypass in normal sinus rhythm. Two right ventricular temporary pacing wires were put as standard protocol. Thoracotomy wound was closed in layers with intercostals drains in situ (**Figure 3**). The postoperative course was uneventful. His postoperative echo cardiogram showed normally functioning prosthetic mitral valve with normal left ventricular function. The patient discharged on 6th postoperative day.

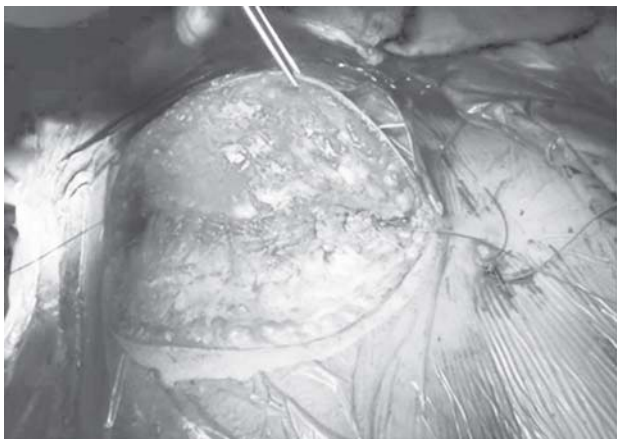

Figure 3 Closing the minithoracotomy surgical wound

DISCUSSION

The first description of minimal invasive mitral valve surgery (MIMVS) did come from Navia and Cosgrove in the mid 1990s.[1] Since then various minimally invasive approaches for mitral valve have been reported including the parasternal, hemisternotomy, minithoracotomy and totally endoscopic approaches with a common goal of all these approaches is to avoid median sternotomy related limitations or complications.[2]

Beating-heart surgery is performed without stopping the heart. The circulation of blood to the heart muscle continues during the operation. Surgery on a stopped heart is common. The heart is stopped for surgery and blood to heart is reintroduced to restart the heart again. This is called reperfusion. Reperfusion can cause impairment of heart function due to ischemia-reperfusion injury. Reperfusion injury can be avoided if the heart is kept beating during surgery.

The clinical rationale for this 'mini' approach is to improve outcomes in valve surgery as small incisions are being used to decrease pain and trauma, improved postoperative respiratory function, reduce blood transfusion, reduced period of hospital stay and less costly, while providing the same quality of surgery. More over the patient

satisfaction is improved, since they are able to return to work and normal activity is faster.[3] Again MIMVS has comparable long term efficacy in measures like freedom from reoperation and long-term survival compared to standard surgery.[2] The most common minimally invasive approach to the mitral valve is a right minithoracotomy.[4] The incision is made along the 4th intercostals space. The incision extends from the parasternal border from 7 to 10 cm laterally. The mitral valve is positioned in the center of the incision although the surgical field is smaller than a median sternotomy.[2]

The pericardium is entered, and antegrade aortic and right atrial canulation is performed. Patient is put on cardiopulmonary bypass and systemically cooled to 28°C to reduce metabolic demands to heart and other organs.[5] Keeping the ventricles empty and decompressed helps in endomyocardial coronary perfusion.[5] An aortic vent needle is inserted at aortic root. The left atrial approach to reach the mitral valve is common. When the left atrium is small, extension of the atriotomy over the dome of the left atrium provides an improved exposure.[1] When transseptal septal approach to mitral valve is chosen then both superior and inferior vanacava is canulated separately. The inferior vanacava canula can be inserted through a different hole in lower intercostals space to increase the area of working field. This hole latter can be used for placement of intercostal drain.

The surgical field is set once patient is on cardiopulmonary bypass, then meticulous plan for final stage of operation to be carried out. When right atrial approach is chosen, it is opened after caval tapes were put down, isolating the right atrium. A few importent steps to be kept in mind in this tricky and technically demanding operation. The most importent stage is once the atrium is opened, it might suck air and lead to immediate massive systemic embolisation. To avoid that patient is kept in Trendelenberg position so that cerebral embolisation is minimised if at all it happens, keep the surgical field flooded with carbondioxide so that CO2 embolus will get absorbed slowly, aortic root vent on optimum suction at 100 mmHg, control the patient's heart rate at around 70-80 beats/min and systemic blood pressure aroung 70 mmHg.[4, 5] The left ventricular cavity should be kept filled with blood from the level of tip of mitral valve leaflets. A vent sucker put in left atrium to keep the surgical field dry through an opening in the junction of right superior pulmonary vein and left atrium. The mitral valve is examined and anterior mitral leaflet is excised. Decalcification and release of fibrotic adhesion is done. The mitral subvalvular apparatus is preserved by reattaching it to mitral annulus. The posterior mitral leaflet is completely preserved. The preservation of mitral subvalvular apparatus is vital to maintain normal left ventricular geometry and function. A prosthetic mechanical valve is seated at mitral annulus. Rewarming is started while the surgeon ties valve sutures. Valve leaflet movement checked, left side of heart deaired and atrium is closed. Patient is repositioned, came out of cardiopulmonary bypass after putting two temporary right ventricular pacing wires for any post operative intervention if needed. The thoracic wound is closed in layers after keeping two intercostals drain, one in pericardial cavity and another in pleural cavity, temporarily.

The primary concern of minimal invasive mitral valve surgery is the incidence of neurological complications due to its possible technical limitations for adequate de-airing.[5] But in a systemic metaanalysis of 6 eligible studies by Seeburger et al. found no significant difference in neurological events.[6] A reduction in postoperative transfusion requirements is a potential advantage as significant morbidity and mortality associated with transfusions and reexploration for bleeding is minimised.[5] Again the comparative studies of conventional approach and minimal invasive mitral valve surgery on mortality, no study has showed a significant difference in mortality between the two approachs.[2] Mihaljevic et al. showed the perioperative mortality is 0.2% for the minimally invasive group and 0.3% in the sternotomy patients. Grossi et al. found 3.7% vs. 3.4% mortality between patients undergoing minimally invasive and conventional approach mitral valvesurgery.[7]

Who are candidates for this procedure? Patients with isolated aortic or mitral valve disease, and in some cases double valve disease, are the candidates for this procedure.[8] There are a few reports on isolated right coronary artery bypass grafting surgery along with this procedure.[3]

CONCLUSION

Our experience in North East Indira Gandhi regional Institute of Health and Medical Sciences (NEIGRHIMS) and other eligible literature has shown the feasible alternative to the conventional full sternotomy approach to mitral valve surgery. There is a slight learning curve, but once mastered, these techniques are no different in context of amount of time needed in the procedure.There

is less perioperative morbidity; recovery is faster and cost effective. We believe that MIBHMVS is just astep in the evolution toward more minimally invasive cardiac surgical techniques that will further enhance out comes of patients with valvular heart disease. Also this technique is excellent for atrial septal defect closure and we have been performing this operation by this technique in our institute regularly.

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