Short Term Results of Sternal Sparing (Minimal Invasive) Approach in Cardiac Surgery

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Abstract :

Introduction: Over the past decades minimally invasive cardiac surgery has grown in popularity. This growth has been driven by desire to translate many observed benefits like less pain, better cosmetic, less surgical trauma as compared to traditional cardiac surgery. **Material and Methods:** In this study 25 patients diagnosed having mitral or aortic valve disease requiring replacement of the valve and atrial septal defect requiring surgical closure operated between 1/08/2011 to 31/12/2013 were included. **Results:** 22 patients were operated by right thoracotomy while 3 patients were operated by mini sternotomy.16 patients were operated by central cannulation while 9 patients were operated by peripheral cannulation. Average time for mitral valve surgery was 270 min, for aortic valve surgery was 281.6 min and for ASD closure was 202.3 min. **Conclusion:** Minimally invasive cardiac surgery is the upcoming boom and it can be safely performed with the available newer cannulae, anesthesia techniques and surgical instruments.

Key words : Aortic Valve Surgery, Atrial Septal Defect Closure, Minimally Invasive Cardiac Surgery, Mitral Valve Surgery,.

Introduction :

Over the years, surgeons are always being fascinated about minimally invasive approach in surgery because of it many proven benefits including less blood loss, early recovery and less hospital stay. Initial enthusiasm for Minimally Invasive (Sternal Sparing) Cardiac Surgery was tempered by concern over reduced exposure and potential for prolonged operative time and patient safety. With innovation in perfusion, development of special surgical instruments Minimally Invasive (Sternal Sparing) Cardiac Surgery has achieved new horizons. Applying principles of practice of minimally invasive approach in cardiac surgery spectrum, we are sharing our early short term results of it to study benefits of minimally invasive methods in cardiac surgery spectrum and evaluation of hazards and complications of minimally invasive cardiac surgery if they occur.

Materials and Methods:

In this study 25 patients diagnosed having mitral or aortic valve disease requiring replacement of the valve and atrial septal defect requiring surgical closure operated between 1/08/2011 to 31/12/2013 at Cardio-thoracic surgery Dept., V.S. Hospital, Ahmedabad were included.

Inclusion criteria: Patients for valve surgery with replacement requirement of only single valve are included. Those above 45 years of age underwent coronary angiography and only those with insignificant or no coronary artery disease are included in the study. For atrial septal defect, patients with weight more than 10 kg are included in the study.

Extubation criteria: Patients with stable hemodynamic, generating good spontaneous respiration, having good tone and power and no significant drain output are extubated.

Inotropic supportive infusion: Patients are given inotropic support depending on the ventricular function and till stable haemodynamics are maintained with satisfactory periodical blood gas reports.

Post-operative analgesics: for paediatric patients, Diclofenac suppository 12.5 mg 8 hrly for 2 days followed for syrup ibugesic plus half tsf. thrice daily given. For adult patients inj. Diclofenec 75 mg iv 8 hrly followed by tab diclofenac twice daily for 3 days.

Criteria for mobilization: patients are mobilized after 6-8 hrs of removal of arterial line.

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Stay in ICU: patients are kept in ICU for 1 day after mobilization.

Exclusion criteria: Previous right thoracotomy, Renal failure, Liver dysfunction, Recent myocardial ischemia (<30 days) and Recent stroke (<30 days).

Results:

In this study, total 25 patients were operated of which 18 were for ASD, 3 for mitral valve disease and 4 for aortic valve disease. We studied different per operative procedure related and post operative patient recovery related parameters.

In our study 22 patients were operated by right thoracotomy while 3 patients were operated by mini sternotomy. 16 patients were operated by central cannulation while 9 patients were operated by peripheral cannulation. Average time for which inotropic support is given in mitral valve disease 40 hrs, for aortic valve disease 42 hrs and for atrial septal defect 24 hrs. Out of all total 32 drains, 20 were removed on day 3rd while 6 were removed on day 4th and 5th each and average time for which inotropic support is given in mitral valve disease 40 hrs, for aortic valve disease 42 hrs and for atrial septal defect 24 hrs, Out of 25 patients 1 patient developed wound infection while 1 patient developed arrhythmia/block.

Table 1: Duration of surgery for different conditions operated(in minutes) :

Procedure	Duration in minutes
Mitral valve disease	281.6
Aortic valve disease	270
Atrial septal defect	203.5

Average time for mitral valve surgery was 270 min, for aortic valve surgery was 281.6 min and for ASD closure was 202.3 min,

Table 2: Average time till extubation in different conditions for which operations done.

Procedure	Average time till extubation in minutes
Mitral valve disease	223.3
Aortic valve disease	172.5
Atrial septal defect	72.17

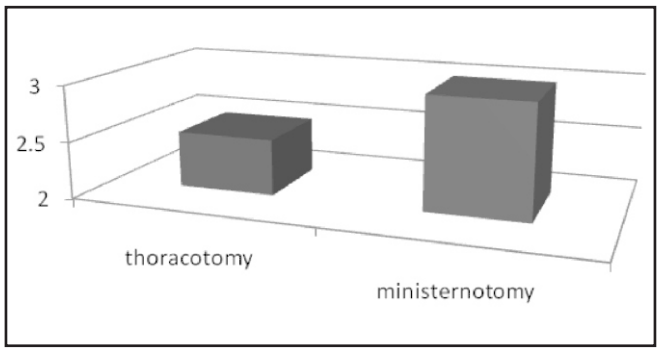
Average time for extubation of mitral valve replacement patient was 223.3 for aortic valve replacement was 172.5 and for ASD closure was 72.17 minutes.

Table 3: Average duration of stay in hospital for different conditions for which operations done(in days):

Condition	Duration(in days)
Mitral valve disease	7
Aortic valve disease	8
Atrial septal defect	5.2

Average duration of stay in hospital for mitral valve disease is 7 days, for aortic valve 8 days and for atrial septal defect is 5 days

Fig. 1: Average duration (in days) of perception of pain in thoracotomy and ministernotomy incisions



Average duration of pain perceived in thoracotomy incision is 2.5 days and for ministernotomy is 3 days.

Discussion:

Initially most of the cardiac operations were performed through midline complete sternotomy. But minimally invasive cardiac surgery encompasses a variety of operations through smaller and less traumatic incision than standard sternotomy incision. They may also include use of highly advanced instruments like thoracoscope and robotic system. By using these instruments cardiac surgeries can be performed through smaller and partial (complete sternotomy sparing) incisions. Recent cannulae have become smaller and manufactured with non kinking material to maximize operative space. Advancement in TEE aid in visualization of intraoperative findings, conforming cannulae position ensures proper de-airing. Arterial

access can be achieved with central aortic cannulation or peripheral cannulation via femoral or axillary artery. In a similar manner, cardioplegia can be administered either antegrade from aortic cannula or retrograde from coronary sinus via transjugular catheterization. Numerous incisions for minimally invasive (sternal sparing) cardiac surgery are described in form of ministernotomy, "j" sternotomy, right or left thoracotomy, inverted "t" sternotomy or "V" incisions. Improvement in visual field by using videoscope is also described for minimally invasive cardiac surgery.

Today the Minimally Invasive (Sternal Sparing) Cardiac Surgery is classified in four different categories according to access to thoracic cavity and use of advanced instruments. 1) Surgery by thoracotomy or partial sternotomy: traditional cardiac surgery involves use of long midline chest incisions with sternotomy for access of heart and various structures. In thoracotomy or partial sternotomy mediastinal structures are accessed via right or left thoracic incisions or small sternotomy incisions. In 1996, ministernotomy and parasternal incisions were used first for minimally invasive aortic valve surgeries. [1] Then good access to mitral valve with low mortality (1-3%) and morbidity for mitral valve were also comparable to conventional mitral valve surgery. Cosgrov in his study of 50 minimally invasive aortic operations showed operative time approximated conventional operations and mortality was only 2% with half of the patients being discharged by post operative day 5.[2] 2) Video assisted surgery and use of micro incisions for port access: Micro incisions are considered as 4-6 cm skin incisions and video assistance indicates that 50% or less of the operation is performed while viewing the operative field from a screen. Video assisted surgery was first used for close chest internal mammary artery harvest and congenital heart operations. [3,4]

3) Video directed and port incision surgery: in 1997 Mohr used AESOP voice activated camera robot in mitral valve repair. [5, 6] With this device voice controlled robotic arm allows hands free camera manipulation. Surgeon commands camera movements verbally providing direct eye brain action. Port incision (1-2 cm.) can be used at this level and video direction implies that most of the operation is done via secondary or assisted vision. 4) Video directed Robotic cardiac surgery: advances in perfusion techniques, intracardiac visualization, instrumentation and robotic manipulation have hastened a shift towards efficient and safe minimally invasive cardiac surgery.

Surgeon operates from a consol, immersed in three dimensional view of the operative field through a computer interface his or her motions are reproduced in scaled proportions through microwrist instruments that are mounted in robotic arm inserted through chest wall. Various robotic system like Zeus robotic system (computer motion inc. santa Barbara, CA) and da Vinci system (intuitive surgical inc. Mountain view, CA) are currently in use for minimally invasive (sternal sparing) cardiac surgery. Inmay 1998, Carpentier et al in Paris performed the first mitral valve repair using an early prototype of the da Vinci articulated intracardiac "wrist" robotic device. [7] Lange and associates in Munich were the first to perform a totally endoscopic mitral valve surgery using only 1 cm ports with da Vinci.[8]

Various procedures performed by minimally invasive (sternal sparing) cardiac surgery are Mitral and Aortic valve repair or replacement, Tricuspid valve procedures, DVR (AVR+MVR) and MVR+TVR, Atrial septal defect closure (primum and secundum), Concomitant maze procedures (MVR and maze procedure), CABG (lt. internal mammary to left anterior descending artery graft and AVR + CABG (especially in case of grafting involves right coronary artery). In our study, we evaluated the results concerned with procedure and patient recovery and found that the minimally invasive surgery is not only safe but also beneficial to patients in terms of morbidity like decreased pain and less hospital stay.

Advantages of minimally invasive (sternal sparing) cardiac surgery over traditional cardiac surgery is as follows: Smaller incisions as these surgeries are done through thoracotomy or partial sternotomy or via multiple smaller incisions through which thoracoscopic instruments or robotic instruments enter the thoracic cavity, Smaller scars which is more acceptable cosmetically especially in young female patients and children, Reduced pain as these surgeries involve sparing of sternum and less dissection of tissues as compared to traditional surgeries.[9] Conventional knot tying add significant time to each procedure. Technological advancement and use of nitinol "u" clips decrease operative time significantly, Shorter recovery

time as compared to traditional surgery, Patients are mobilized early and recovers fast. [10] Less blood loss and fewer requirements of transfusions. So avoidance from transfusion related hazards.[11] Fewer physical restrictions as compared to traditional operations in post operative period. Patient undergoing standard incision cardiac surgery are restricted from driving an automobile or lifting objects of weighing more than 5 pound in early post operative period while patients undergoing minimally invasive cardiac surgery do not subjected to these restrictions, Cost effective analysis also showed favorable results.[12]

Disadvantages of minimally invasive (sternal sparing) cardiac surgery are: Rigidity of chest wall limits access to deeper organs in hand assisted surgeries and as a significant source of post operative pain no matter how small the incision is, many of the steps in minimally invasive (sternal sparing) cardiac surgery are performed without full exposure of the underlying structures and chance of damage to these structures are there in minimally invasive (sternal sparing) cardiac surgery. Limited exposure of cardiac chambers may hamper overall assessment of ventricular function and operative sites, Use of long rigid instruments to grasp tissues lack the tactile feeling which is an important part of surgical skill in any operative procedures. Cherup and associates described maldevelopement of the breast and pectoral muscles in children who had undergone thoracotomy in early childhood.[13] Scoliosis is also known to occur after extensive thoracotomies.[14] Complex congenital heart disease or pre operatively unidentified pathology if comes during surgery conversion to sternotomy has to be done as they may not be tackled by smaller incisions. Many minimally invasive (sternal sparing) cardiac surgery procedures performed in adults may single lung ventilation during off CPB period and this may add its own risk to overall procedure. Minimally invasive surgery and robotic technology did not significantly increases total hospital cost. However when taking into account the initial capital investment for the robotic surgical system through amortization of the institutional costs, the cost was significantly higher for robotic operations. [15]

Anaesthesia management for minimally invasive cardiac surgery

While the fundamentals of anaesthesia management are the same for minimally invasive (sternal sparing) cardiac surgery, several areas have required adaptation from the standard cardiac anaesthetic. One important change is that minimally invasive thoracotomy procedures often require single-lung ventilation during different parts of the operation. This may be achieved with the use of a double lumen tube or bronchial blocker and requires an anesthesiologist experienced with the technical and physiologic consideration of one lung anaesthesia.

In some situations, anesthesiologists place endocoronary sinus retrograde cardioplegia catheters through ultrasonography. [16]

Nearly coincident with the evolution of minimally invasive (sternal sparing) cardiac surgery, interest in benefits of "fast-tract" anaesthesia arose. The term fast tract anaesthesia has been used to designate a paradigm shift away from the high dose narcotic techniques previously used for cardiac surgery toward more balanced techniques utilizing moderate doses of narcotics, shorter-acting muscle relaxants, and an increased use of potent volatile anesthetics, and sometimes regional techniques for postoperative pain control.[17] Both minimally invasive (sternal sparing) cardiac surgery and fast-tract anaesthesia have been advocated in leading to decreased intubation periods, decreased intensive care unit stay durations, and decreased costs.

Conclusion:

Minimally invasive cardiac surgery is the upcoming boom and it can be safely performed with the available newer cannulae, anesthesia techniques and surgical instruments. It gives better results not only in terms of cosmesis but it is helpful for early mobilization of the patient and reduced pain in post operative period. More and more patients nowadays are being operated by minimally invasive technique.

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