

# Comparison of Standard Midline Sternotomy and Minimally Invasive Thoracotomy for Mitral valve Replacement

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## ABSTRACT

**Introduction:** Minimally invasive cardiac valve surgery is gaining acceptance. Right anterolateral thoracotomy has been recommended as an alternative approach to standard Median Sternotomy for patients undergoing mitral valve replacement. Objective of the study was to compare right anterolateral thoracotomy (minimal invasive thoracotomy) with standard Median Sternotomy for mitral valve replacement in terms of postoperative infection, blood loss and pain score.

**Material and method:** Sixty consecutive adult patients with severe mitral valve disease scheduled for elective mitral valve operation were prospectively randomized over a period of 1 year to undergo either minimally invasive surgery (Group I, n:30) or operation through median sternotomy (Group II, n:30). The groups were matched with respect to age, sex, NYHA Class, and ejection fraction. Length of incision, surgical exposure, mean cross clamp time, mean bypass time, ICU stay, hospital stay, overall comorbidity with Sternotomy. Blood loss; pain score; Sepsis, dehiscence, healing and cosmetic quality were studied for comparison.

**Result:** Cardiopulmonary bypass time, mechanical ventilation time, chest tube drainage (mL) and time to normal activity (weeks) were significantly differ in both group. Wound infection in no. of cases (%) and Score of visual analogue scale were not significantly different in both groups.

**Conclusion:** Minimal invasive thoracotomy morbidity in terms of reduced need for reoperation for bleeding, a trend towards shorter hospital stay, less pain and faster return to preoperative function levels than conventional sternotomy-based surgery

**Keywords:** Standard Midline Sternotomy, Minimally Invasive Thoracotomy, Mitral valve Replacement

valve replacement. This kind of approach is mainly used to reduce the morbidity and the cost. It also useful for the earlier hospital discharge and shorten the rehabilitation time.<sup>3,5</sup>

Hence the study was conducted to compare right anterolateral thoracotomy with standard Median Sternotomy for replacement of mitral valve with reference to postoperative infection, blood loss and pain score.

## MATERIAL AND METHODS

Sixty consecutive adult patients with severe mitral valve disease scheduled for elective mitral valve operation were prospectively randomized over a period of 1 year to undergo either minimally invasive surgery (Group I, n:30) or operation through median sternotomy (Group II, n:30). Study was conducted at cardiovascular and thoracic surgery department, Super specialty Hospital, Nagpur during period of May 2015 to June 2016. A detailed clinical examination was carried out with special references to cardiovascular system. Patients were allocated into two groups using who required mitral valve replacement (MVR) according to the ACC/AHA guidelines were included in the study. Matching of study participant was done with respect to age, sex, ejection fraction and NYHA Class. Mean cross clamp time, Length of incision, surgical exposure, mean bypass time, ICU stay, hospital stay, overall comorbidity with Sternotomy. Blood loss; pain score; Sepsis, dehiscence, healing and cosmetic quality were studied for comparison. Their follow up information was obtained prospectively by observing patients in follow up. Permission of Institutional Review Board was obtained for the study.

Incision was made in the right sub-mammary fold in regard to thoracotomy group, starting 3-5 cm from the lateral border of the sternum. Approach was through the fourth intercostals space to reach right chest cavity by gently mobilizing the breast tissue in females. This was followed by Aortic and bicaval cannulation and cardiopulmonary bypass instituted. In order to keep aorta out of the surgeon's field, the aorta was cross clamped using a long curved aortic, After cooling to 32°C and aortic root blood cardioplegia was delivered. Incision was made posterior and parallel to the interatrial groove to open left atrium that accessed the mitral valve. Continuous 2/0 prolene suture was used to replace diseased mitral valve with a prosthetic valve. A single

## INTRODUCTION

In recent years rapid development of surgical techniques and the assistance of advanced instrumentation, results in improved output of cardiac surgery. Minimally invasive cardiac valve surgery is gaining acceptance. Mitral valve operations have been performed through Median Sternotomy since the early days of cardiopulmonary bypass. Postoperative instability/osteomyelitis of the sternum significantly associated with Median Sternotomy, which is generally used as a standard access for mitral valve operations. Large scar especially in young women may have adverse cosmetic and psychological consequences. Risk of postoperative morbidity and mortality in patients of cardiac surgery increases the especially when associated with other comorbid conditions like diabetes.<sup>1-4</sup>

With the introduction of minimally invasive coronary bypass procedures, interest has been rekindled in minimally invasive mitral operations. Right anterolateral thoracotomy approach to mitral valve is a routine procedure. Right anterolateral thoracotomy has been recommended as an alternative approach to standard Median Sternotomy for patients undergoing mitral

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**How to cite this article:** Ashsih Badkhal, Amol Thakre, Umesh Joge, Umesh Kawlkar. Comparison of standard Midline sternotomy and minimally invasive thoracotomy for mitral valve replacement. International Journal of Contemporary Medical Research 2016;3(11):3218-3221.

layer of 3/0 silk suture closed the left atriotomy and through the suture line de airing was performed before removing the aortic cross clamp. The heart was allowed to take over the circulation after re-warming to 37°C. Before giving the protamine De cannulation was done and the suture line secured. A small drain was kept after complete closure of pericardium by continuous sutures. A separate thoracic drain was left and chest closed in layers.

Patients were kept on overnight ventilation. After completely assessing the general condition and hemodynamics of the patients along with baseline investigations and blood gases, Post extubation patients were shifted from ICU. Acenocoumarol was started as oral anticoagulant on second postoperative day to maintain an International normalized ratio (INR) of 2.0 to 2.5. Intravenous antibiotics were administered during hospitalization and changed according to clinical situation.

### STATISTICAL ANALYSIS

All the data was analyzed in epinfo software. Mean and Standard Deviation was calculated for quantitative variable and percentage was calculated for categorical variables. Independent sample t test and Chi square test were used for statistical analysis to

compare the two groups. P value was less than or equal to 0.05 was recorded as significant.

### RESULTS

All patients were operated for mitral valve disorder and underwent mitral valve replacement. Total 30 patients were included in each group. Table 1 lists demographics and baseline details of patient's like age, gender, class, and valve etiology, diagnosis and ejection fraction. All above parameters were comparable in both groups.

Total duration of surgery and aortic clamp time in both were more in group I (minimally invasive surgery) as compared to group II (median sternotomy) but it was not statistical significant (p value >0.05).

A cardiopulmonary bypass time was more in group I (minimally invasive surgery) as compared to group II. It was statistical significant. Mechanical ventilation time required was more in group II (median sternotomy) as compared to group I (minimally invasive surgery) The difference was statistical significant. Blood transfusion (unit) was required more in group II (median sternotomy) but not significantly. Chest tube drainage (ml) was significantly more in group II (median sternotomy).

	Group I, N: 30 (%)	Group II, N: 30 (%)	P value
Age (years)			
Mean ± SD	59.3 ± 12.7	60.2 ± 13.2	> 0.05 (NS)
Range	34-84	35-83	
Sex			
Male	16 (53.3)	13 (43.3)	> 0.05 (NS)
Female	14 (46.6)	17 (56.6)	
Etiology			
Rheumatic valve disease	26 (86.67)	28 (93.33)	> 0.05 (NS)
Degenerative disease	04 (13.33)	02 (6.67)	
Diagnosis			
Mitral stenosis	07 (23.33)	08 (26.67)	> 0.05 (NS)
Mitral insufficiency	10 (33.34)	11 (36.67)	
Mixed lesions	13 (43.33)	11 (36.67)	
Ejection fraction			
Mean ± SD	55.1 ± 10.1	57.4 ± 9.7	> 0.05 (NS)
Range	43 -75	35 - 76	
New York Heart Association class			
Class I	04 (13.33)	05 (16.6)	> 0.05 (NS)
Class II	21 (70)	20 (66.6)	
Class III	04 (13.33)	03 (10.0)	
Class IV	01 (3.34)	02 (6.6)	

**Table-1: Demographic variables of the two patients groups**

	Group I (Minimally invasive surgery)	Group II (median sternotomy)	P value
Operation duration	240.1 ± 38.7	230.3 ± 36.5	>0.05 (NS)
Aortic clamp time (min)	70.1 ± 16.8	68.2 ± 15.7	>0.05 (NS)
Cardiopulmonary bypass time	142.5 ± 25.1	126.7 ± 27.2	<0.05 (S)
Mechanical ventilation time	4 ± 1.3	6.3 ± 2.7	<0.05 (S)
Chest tube drainage (mL)	165 ± 23	325 ± 50	<0.05 (S)
Blood transfusion (unit)	1.3 ± 1.2	2.3 ± 4.1	>0.05 (NS)
ICU stay (days)	1.4 ± 0.8	1.8 ± 1.3	>0.05 (NS)
Wound infection in no. of cases (%)	1(3.3%)	3 (10%)	> 0.05 (NS)
Hospital stay (days)	7.5 ± 1.5	10.2 ± 2.9	<0.05 (S)
Score of visual analogue scale	41.2 ± 15.2	46.3 ± 13.9	>0.05 (NS)
Time to normal activity (weeks)	7.2 ± 5	12.3 ± 3	<0.05 (S)

**Table-2: Intraoperative and Postoperative Variables**

Duration of ICU stay was  $1.8 \pm 1.3$  days in sternotomy and  $1.4 \pm 0.8$  hours in minimal invasive groups ( $P > 0.05$ ). Difference in Duration in post operative hospital stay was statistically significant ( $P < 0.05$ ) with  $10.2 \pm 2.9$  days and  $7.5 \pm 1.5$  days for sternotomy and minimal invasive group respectively.

Subjectively, postoperative pain (Score of VAS) was similar between the two groups, except that pain tended to resolve more quickly in minimal invasive group. Wound infection was seen in 3 cases in sternotomy group as compared to invasive group ( $p > 0.05$ ). Patients returned to normal activity more quickly with invasive group than sternotomy with significant difference. ( $p < 0.05$ ) (table-2).

## DISCUSSION

Cardiac valve replacement and repair for the adult patient has become an exceedingly effective operative therapy for congenital, infectious, degenerative, and myxomatous lesions of both the aortic and mitral valve. Aortic valve surgery, for example, has transformed the elderly patient with severe symptoms into a productive member of society, including patients well into their 80s. Mitral valve reparative surgery has had a renaissance in the past 10 years, and many patients with mitral regurgitation now have their own valve repaired successfully to effect normal valve function yet preserving the papillary muscle chordal interaction, important for normal cardiac function. Several new observations have arisen during the treatment of patients with isolated valve disease with advancement of minimally invasive cardiac valve surgery.<sup>2,3</sup>

Minimally invasive incisions leads considerable less amount of trauma. It avoided Sternal infections. There is less blood loss from the incision and the operative site. In addition, there is improved cosmesis with these incisions. In many patients, this is of considerable concern. The incisions are relatively small, particularly in the mitral area. Mitral valve repair can be performed through a 6- to 9-cm incision in the lower right parasternal area. Other techniques of minimally invasive surgery under development, which are cosmetically superior. Techniques includes mitral valve surgery were done with smaller transverse incision under the right breast fold.

We studied postoperative infection; blood loss and pain score whether such complications can be addressed by using median sternotomy, with simultaneous comparison to minimal invasive surgery. Mean age, gender, class, and valve etiology, diagnosis and ejection fraction were similar in both groups. Patients having mild mitral stenosis (MS) remained asymptomatic for many years unless it was with mild mitral regurgitation (MR).

In our study mean aortic cross clamp time was  $68.2 \pm 15.7$  minutes in median sternotomy group and  $70.1 \pm 16.8$  minutes in minimal invasive group ( $p > 0.05$ ). The lesser cross clamp time in sternotomy was due to easy accessibility to left atrium even with smaller atrial size. The right mini-thoracotomy approach through mitral valve approach was proved to be easy to learn. It was performed with maximum safety to the patients. This technique provides advantage like better cosmetic result, lower cross-clamp time. The whole procedure can be performed quicker than the standard median sternotomy approach. Similar results were also observed by study done by Mohamed M. El-Fiky<sup>6</sup>; Abdul Malik<sup>7</sup>; Zapolanski A, et al<sup>8</sup> and Grossi EA, et al.<sup>9</sup> One of the potential advantage of minimally invasive valve

surgery leads to reduction in postoperative hemorrhage so minimal requirement of transfusion has been suggested. This benefit is important given the significant morbidity and mortality associated with transfusions and re-exploration for bleeding. In present study blood requirement in minimal invasive group is less as compared to other group. Mohamed M. El-Fiky et al<sup>6</sup> in his study also mentioned that the blood loss is definitely less using minimal invasive approach, probably because of the avoidance of sternotomy. The added advantage of totally eradicating the risk of deep Sternal infection is invaluable.

In present study both groups showed significant difference in duration of postoperative hospital stay ( $P = < 0.05$ ) between the two groups. Early ambulation, with subsequent early appreciation of patient's well-being and faster recovery reduced the overall hospital stay might be the reason. Faster recovery in patients leads to shorter stay in hospital, that helps to reduced cost.

The incidence of septic wound complications is in only one case of minimal invasive surgery and that of 3 cases from median sternotomy group. Other studies of mini-thoracotomy mitral valve surgery that reported wound complications compared to median sternotomy, Grossi et al.<sup>9</sup> reported an incidence of 0.9% and 5.7% for mini-thoracotomy and sternotomy cases, respectively ( $p = 0.05$ ) whereas Felger et al<sup>10</sup>; Yamada et al<sup>11</sup> reported no significant difference among two group about incidence of infection.

Potential benefits of minimal invasive surgery, a reduction in pain and faster return to normal activity is the most consistent finding. Other studies like Cohn LH et al<sup>4</sup>; Glower DD et al<sup>12</sup> and Walther H<sup>13</sup> that reported that postoperative pain levels less as compared to sternotomy and both studies Cohn LH et al<sup>4</sup> and Glower DD<sup>12</sup> reporting time to return to normal activities noted a significant advantage for a minimally invasive approach. In a nonrandomized study, Walther et al. H<sup>13</sup> reported that pain was similar for the first two postoperative days for both procedure. From day 3 onwards there was significant reduction of pain in minimal invasive group with progression of time difference widened with time. Minimal invasive surgery group had better stability of the bony thorax. It leads to earlier recovery of activities of daily living and earlier mobilization. Glower DD et al<sup>12</sup> also reported that patients returned to normal activity earlier as postoperative pain tended to resolve more quickly with a minimally invasive approach and that these than those having a median sternotomy.

## CONCLUSION

There has been a transformation over the last decade, among cardiac surgeons, cardiologists and patients in deciding the approach to cardiac therapies. With the proven safety, efficacy and durability less invasive procedures are demanded. When compared there is less morbidity in terms of reduced need for reoperation for bleeding, a shorter hospital stay, less pain and faster recovery than conventional sternotomy-based surgery. Thus Minimally invasive cardiac surgery is likely to become more widely adopted.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 08-09-2016; **Published online:** 19-11-2016