

A Sternal Sparing Approach to Mitral Valve Replacement – Comparative Study

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ABSTRACT

Background: A variety of techniques including Mini-sternotomy, right anterior mini-thoracotomy, Port Access approach (Heartport), indirect endoscopic techniques and robotic techniques have been described to reduce incision size in mitral valve surgery. We used a mini-thoracotomy technique (Right Antero Lateral Thoracotomy - RALT) for mitral valve patients and compared our results with the conventional technique (mid sternotomy).

Methods: We randomly allocated 100 consecutive patients presenting to our practice for mitral valve surgery between two groups. The first group (test group) consisted of 50 patients in which mitral valve surgery was performed via mini-right anterolateral thoracotomy (RALT group) approach. The control group (50 patients) underwent classical mitral valve surgery through median sternotomy (MS group). Standard aortic and bicaval cannulation with antegrade blood cardioplegia was adopted in both groups.

Results: The mean age of patients in RALT group was 31.8 ± 6.2 years and in MS group was 32.2 ± 7.8 years. The two groups were comparable with respect to age, sex, mitral valve lesion, ejection fraction and NYHA class. The mean CPB time (min) and mean aortic clamp time (min) were significantly less in MS group as compared to RALT group. However, the mean total operative time in RALT and MS group was almost similar. The average blood loss (in ml) via Mediastinal drains was significantly higher in MS group, requiring more blood transfusion as compared to RALT group ($p < 0.001$). The mean extubation time in RALT group was 5.2 ± 0.5 hours and 9.5 ± 2.2 hours in MS group, which was statistically significant in lower in RALT ($P < 0.001$). In MS group, 11 patients (22%) suffered from postoperative complications versus 10 patients (20%) in the RALT group, with no significant difference between the groups. There was no reported mortality in both the group.

Conclusions: The cosmetic appearance in RALT group was excellent, that rivals that of robotically assisted techniques and the patients' wounds were scarcely apparent in the female patients. The study demonstrates the efficacy and safety of this technique, with excellent cosmetic results and no additional cost or risk to the patients.

Keywords: Right anterolateral thoracotomy, Median sternotomy, mitral valve replacement

Available Online: 30th September 2020

Article History

Received: 28.04.2020

Accepted: 14.05.2020

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INTRODUCTION

Rapid development of technology and advancement in instrumentation in recent years has resulted in increased cardiac surgical performance and better patient outcomes. A variety of techniques including Mini-sternotomy, right anterior mini-thoracotomy, Port Access approach (Heartport), indirect endoscopic techniques and robotic techniques have been described to reduce reduce surgical incision size in mitral

valve surgery. The last three procedures are costly, involve a relatively long training curve and leave the patient with multiple small scars in the chest and groin. Median sternotomy (MS) is the standard technique for surgical treatment of cardiac diseases with proven excellent long-term outcomes.¹

Access this article online	
Website: www.iabcr.org	Quick Response code 
DOI: 10.21276/iabcr.2020.6.3.04	

How to cite this article: Haseen MA, Srivastava A. A Sternal Sparing Approach to Mitral Valve Replacement – Comparative Study. Int Arch BioMed Clin Res. 2020;6(3):CS1–CS4.

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

However, it carries the risk of deep sternal wound infection, delayed recovery, and increased hospital stay.² Right anterolateral thoracotomy (RALT) is a less invasive approach to mitral valve surgery, offering improved mitral valve surgical access with favorable cosmetic outcomes, posing a good choice for young female patients.³ RALT is especially useful for patients with hostile mediastinum (i.e. previously opened mediastinum with severe heart and posterior sternal adhesions).⁴

Sternotomy, however, remains the most common method for open heart surgery due to its good exposure of all cardiac chambers and great vessels.⁵ Therefore, the aim of the present study was to compare immediate and short-term results and outcome following mitral valve replacement (MVR) using RALT versus MS approach.

METHODS

This prospective comparative study was conducted at Cardiothoracic and Vascular Surgery Department of Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh from April 2017 to December 2019. All patients presenting to us for MVR were enrolled in the study. Exclusion criteria included patients with right lung pathology, chest wall abnormalities, bleeding disorders, CT ratio > 0.7, LA / LAA clot, associated CAD, post CMV, associated aortic/tricuspid valve lesion and failed to give informed consent were excluded in the study. After enrolment in the study the patients were alternately allocated to Test group (RALT gp) or Control group (MS gp). The preoperative workup included detailed history and clinical examination, routine laboratory investigations, chest X-ray, ECG, Echocardiography and Coronary angiography (for patients > 40 years of age).

In the RALT group the patient was placed in 30° right anterior oblique position (Figure 1). The skin incision from 1 cm medial to right midclavicular line to right anterior axillary line in submammary fold. The thorax was opened in fourth intercostal space. The pericardium was opened longitudinally 2 cm anterior to right phrenic nerve. Adequate exposure was achieved by multiple pericardial stay sutures. CPB in RALT group was instituted using elongated straight aortic cannula (Medtronic USA Inc.) for Aortic cannulation and routine bicaval venous cannulation with mild hypothermia. Antegrade Cardioplegia was given via elongated cardioplegia canula (Medtronic USA Inc.). Surgery was done in routine fashion. Pericardium was closed by interrupted sutures, leaving two drains, one in pericardium and other in right thoracic cavity. Before closure of chest, patient was routinely given 2% bupivacaine as intercostal block. As for the sternotomy group, the approach was through the standard median sternotomy, but otherwise the operative technique was essentially the same as RALT group.

Patients were electively ventilated postoperatively and were extubated if there was no concern of mediastinal bleeding and the patient's respiratory parameters and vitals were stable. Post extubation patients were shifted to step down ICU in 24-48 hours after completely assessing the general condition and hemodynamics of the patients along with baseline investigations and blood gases. Low molecular weight heparin was started in evening after surgery, while oral anticoagulant was started on second postoperative day with acenocoumarol to maintain an International normalized ratio (INR) of 2.5- 3.5. Intravenous antibiotics were

administered during hospitalization and changed according to clinical situation.

All data regarding patients' demography, mean cross clamp time, mean bypass time, ICU stay, hospital stay and overall co morbidity with sternotomy and Sepsis was recorded. Patients are followed up for 1 year in outpatient department. The data analysis was carried out using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL), version 20. For continuous variables Student t test was used and Chi square and Fisher exact test were used for categorical variables. P-value < 0.05 was assumed to be statistically significant.

RESULTS

Total of 100 patients were included in the study and were divided into two groups: RALT group (n = 50) and MS group (n=50). The mean age of patients in RALT group was 31.8 ±6.2 years and in MS group was 32.2 ± 7.8 years. Out of 100 patients, 42 patients were males and 58 were females. In RALT group, 20 patients were males and 30 were females while in MS group, 22 patients were males and 28 were females. In our study, 46 and 44 patients were class III in RALT and MS groups respectively while the remaining patients were class IV. The two groups were comparable with respect to age, sex, mitral valve lesion, ejection fraction and NYHA class (Table 1).

In RALT group, mitral valve replacement (MVR) was done in 48 patients and mitral valve (MV) repair in 02 patients while in MS group MVR was done in 43 patients and MV repair in 7 patients which was comparable (p=0.424). The mean CPB time (min) and mean aortic clamp time (min) were significantly less in MS group as compared to RALT group (table 2). However, the mean total operative time in RALT group (145 ± 15 min) and MS group (149 ± 22 min) was statistically insignificant (P > 0.001). The average blood loss (in ml) was significantly higher in MS group required more blood transfusion as compared to RALT group (p<0.001). The mean extubation time in RALT group was 3.2 ± 0.5 hours and 9.5 ± 2.2 hours in MS group. The mean extubation time was also significantly longer in MS group as compared RALT group (P<0.001).

In MS group, 11 patients (22%) suffered from postoperative complications versus 10 patients (20%) in the RALT group, with no statistical difference between the groups (Table 3). There was no reported mortality in both the group.

Table 1: Demographic, clinical, and echocardiographic characteristics

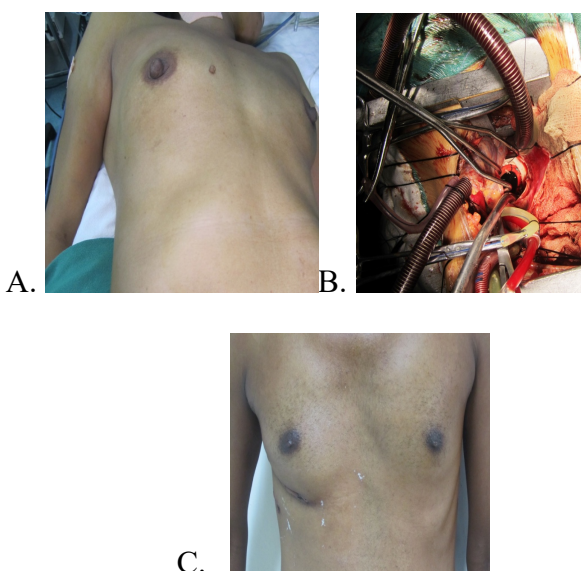
	RALT Group (n = 50)	MS Group (n = 50)	p value
Age (years), mean±SD	31.8 ±6.2	32.2 ± 7.8	0.777
Sex, No. (%)			
Male	20 (40)	22 (44)	0.685
Female	30 (60)	28 (56)	
Mitral valve lesion, No. (%)			
Mitral stenosis (MS)	32 (64)	30 (60)	0.460
Mitral regurgitation (MR)	14 (28)	12 (24)	
MS + MR	4 (8)	8 (16)	
Ejection fraction (%), mean±SD	61 ± 8	59 ± 9	0.243
NYHA class, No. (%)			
III	46 (92)	44 (88)	0.505
IV	4 (8)	6 (12)	

Table 2: Intra- and postoperative outcomes

	RALT Group (n = 50)	MS Group (n = 50)	p value
Procedure			
MVR	48 (96%)	43 (86%)	0.424
MV repair	02 (04%)	7 (14%)	
CPB Time (min)	59 ± 12	54 ± 9	0.020
Aortic clamp time (min)	36 ± 7	32 ± 9	0.014
Total operative time (min)	145 ± 15	149 ± 22	0.061
Blood loss (ml)	392 ± 115	630 ± 203	<0.001
Extubation time (hrs.)	5.2 ± 0.5	9.5 ± 2.2	<0.001

Table 3: Postoperative complications

	RALT Group (n = 50) No. (%)	MS Group (n = 50) No. (%)	P value
Pleural effusion	2 (4)	1 (2)	>.05
RIMA injury	5 (10)	0	>.05
Seizures	1 (2)	0	>.05
wound infection	2 (4)	6 (12)	>.05
CVA	0	2(4)	>.05
Sternal instability	0	1	>.05

**Figure 1: Operative technique****A. Position of patient as placed on operation table.****B Surgical field with all canulae in place and mv****C. Cosmetic results after RALT**

DISCUSSION

Median sternotomy (MS) is still the gold standard for cardiac surgical treatment, with proven long-term results.¹ The RALT method has been proposed as an alternative strategy with low perioperative morbidity and mortality in order to minimize the substantial risk of postoperative infection and dehiscence following the MS approach for mitral valve surgery.^{6,7} The aim of this study was to compare immediate and short-term results and outcome following mitral valve replacement using RALT versus MS approach. The patients in two groups were similar with respect to mean age, which was 31.8 ± 6.2 years in RALT group and 32.2 ± 7.8 years in MS group. Patients may remain asymptomatic for many years as long as MS is mild and not accompanied

by more than mild MR. Moreover, in developing countries, rheumatic MS manifests 10-30 years after the initial rheumatic insult to the mitral valve. Similar results were reported by Attallah et al⁸ and Malik et al.⁶ In our study, majority of patients were females because of MS and mitral regurgitation (MR) is more common among females with rheumatic fever. This was consistent with the studies done by Malik et al.⁶ Kumar et al^[3], Srivastava et al [9], Mishra et al.¹⁰ and Badkhal et al.¹¹ In our study, both groups were comparable with respect to age, sex, mitral valve lesion, ejection fraction and NYHA class.

In the present study, mitral valve replacement (MVR) was done in 48 patients and mitral valve (MV) repair in 02 patients in RALT group while in MS group, MVR was done in 43 patients and MV repair in 7 patients which was comparable. The mean CPB time (min) and mean aortic clamp time (min) were significantly less in MS group as compared to RALT group in our study. Similar results were reported recently by Attallah et al in 2020.⁸ Similarly, Malik et al⁶ also found the mean CPB time (min) and mean aortic clamp time (min) were significantly less in MS group as compared to RALT group. In another study done by Badkhal et al.¹¹ found the mean aortic clamp time (min) was comparable in RALT and MS group but CPB time was significantly higher in RALT group. More CPB and cross clamp time in RALT group could be attributed to difficult learning curve of this approach compared to routine MS approach.

In the present study, the mean total operative time in RALT group was 145 ± 15 min and 149 ± 22 min in MS group. Compared to other studies inconsistent results were found. In a study by Attallah et al⁸ found the mean operating time was significantly less in MS group as compared to RALT group. Similar to our study, Badkhal et al.¹¹ and Shah et al.¹² found the mean operating time was comparable in both RALT and MS group. In spite of longer CPB and cross clamp time in RALT group, the total surgical time is almost similar in both the groups as it takes less time for opening and closing a thoracotomy viz a viz sternotomy.

In our study, the mean extubation time in RALT group was 5.2 ± 0.5 hours and 9.5 ± 2.2 hours in MS group. The mean extubation time was significantly higher in MS group as compared to RALT group (P<0.001) because of less postoperative pain and minimal effect on respiratory mechanics. Similar to our finding is in line with other studies by Attallah et al⁸, Badkhal et al¹¹, Malik et al.⁶

The average blood loss (in ml) was significantly higher in MS group required blood transfusion as compared to RALT group (p<0.001) in our study. A reduction in postoperative bleeding and transfusion requirements has been suggested as a potential advantage of minimally invasive valve surgery. This benefit is essential given the significant morbidity and mortality associated with transfusions and re-exploration for bleeding.^{13,14} In a study by Attallah et al found in MS group required a significantly higher amount of blood transfusion (2.19 ± 1.1 units vs. 1.41 ± 0.6 units, P < 0.01). Similar result was also reported by Malik et al [6] and Badkhal et al.¹¹

In our study, the most common postoperative complication via RALT was RIMA injury seen in 5 patients followed by pleural effusion in 2 patients and post-operative seizure in 1 patient and mild wound infection in 2 patients. While in MS group, the most common complication was Sternal wound infection seen in 6 patients, sternal instability needing resuturing in 1 patient, mild pleural effusion present in 1 patient, Cerebro vascular accident (CVA) in 2 patients.

Overall on comparing postoperative complications between two groups were comparable. This was consistent with the studies done by Badkhal et al¹¹, Attallah et al⁸ and Malik et al.⁶ There was no reported mortality in both the group in our study.

Our research has generally established RALT 's advantages for mitral valve surgery in terms of comparable operating time, less bleeding, fewer wound infections, lesser pain and favorable cosmesis.

The research has many drawbacks, including the small number of patients and lack of randomization. It is also a single-center case, so it might not be possible to generalize the findings.

CONCLUSION

The RALT approach offers good exposure for mitral valve surgeries. This approach also offers advantages like lesser blood loss and lesser blood transfusion requirements, less ICU and Hospital stay as well as improved cosmetic results and patient satisfaction. The study demonstrates the safety and efficacy of this technique, with excellent cosmetic results and no additional cost or risk to the patients.

REFERENCES

1. Bonow RO, Carabello BA, Chatterjee K, et al. ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: are part of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (writing Committee to Revise the 1998 guidelines for the management of patients with valvular heart disease) developed in collaboration with the Society of Cardiovascular Anesthesiologists endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons. *J Am Coll Cardiol* 2006; 48: 1–148.
2. Guedes MA, Pomerantzeff PM, Brandao CM, Vieira ML, Grinberg M, Stolf NA. Mitral valve surgery using right anterolateral thoracotomy: Is the aortic cannulation a safety procedure? *Rev Bras Cir Cardiovasc*. 2010; 25(3): 322-5.
3. Kumar AS, Prasad S, Rai S, Saxena DK. Rightthoracotomy revisited. *Tex Heart Inst J*. 1993;20(1): 40-2.
4. Cohn LH. As originally published in 1989: Right thoracotomy, femorofemoral bypass, and deep hypothermia for re-replacement of the mitral valve. Updated in 1997. *Ann Thorac Surg*. 1997 Aug;64(2):578-9.
5. Wang YQ, Chen RK, Ye WW, et al. Open-heart surgery in 48 patients via a small right anterolateral thoracotomy. *Tex Heart Inst J*. 1999; 26(2): 124-8.
6. Malik A, Asghar M, Farman T, Laiq N, Shah SMA, Khan RA. Standard median sternotomy versus right anterolateral thoracotomy for mitral valve replacement. *J Med Sci*. 2015;23(1): 42-45.
7. McClure RS, Cohn LH, Wiegerinck E, et al. Early and late outcomes in minimally invasive mitral valve repair: an eleven-year experience in 707 patients. *J Thorac Cardiovasc Surg*. 2009;137(1): 70-5.
8. Attallah AR, Al-Elwany SE, Ayyad MAK, Abdelwahab AM. Early clinical outcome after right anterolateral thoracotomy as an alternative for median sternotomy for mitral valve replacement. *The Egyptian Cardiothoracic Surgeon* 2020; 2:47 – 54.
9. Srivastava AK, Garg SK, Ganjoo AK. Approach for primary mitral valve surgery: right anterolateral thoracotomy or median sternotomy. *J Heart Valve Dis*. 1998; 7(4): 370-75.
10. Mishra YK, Malhotra R, Mehta Y, Sharma KK, Kasiwal RR, Trehan N. Minimally invasive mitral valve surgery through right anterolateral minithoracotomy. *The Annals of thoracic surgery*. 1999; 68(4): 1520-24.
11. Badkhal A, Thakre A, Joge U, Kawlkar U. Comparison of Standard Midline Sternotomy and Minimally Invasive Thoracotomy for Mitral valve Replacement. *International Journal of Contemporary Medical Research* 2016;3(11):3218-3221.
12. Shah ZA, Ahangar AG, Ganie FA, Wani ML et al. Comparison of Right Anterolateral Thoracotomy with Standard Median Steronotomy for Mitral Valve Replacement. *IntCardiovasc Res J*. 2013;7(1):15-20.
13. Murphy GJ, Reeves BC, Rogers CA, Rizvi SI, Culliford L, Angelini GD. Increased mortality, postoperative morbidity, and cost after red blood cell transfusion in patients having cardiac surgery. *Circulation*. 2007; 116: 2544-52.
14. Modi P, Hassan A, Chitwood WR., Jr. Minimallyinvasive mitral valve surgery: A systematic review and meta-analysis. *European Journal of Cardio-Thoracic Surgery*. 2008; 34(5): 943–952.

