Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2022.179158.2697 Volume 30, Issue 1, January 2024

Manuscript ID ZUMJ-2212-2697 (R1)
DOI 10.21608/ZUMJ.2022.179158.2697

Original article

Assessment of Early Outcome of Antrolateral Thoracotomy Approach for Mitral Valve surgeries

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Submit Date 2022-12-11

Revise Date 2022-12-18

Accept Date 2022-12-29

ABSTRACT

Background: **Background:** Mitral valve surgeries have been traditionally approached through median sternotomy. Recently, minimally invasive mitral valve surgery has gained approval by many surgeons with favored postoperative outcomes.

Patients and Methods: A prospective comparative analysis included 46 patients who had mitral valve disease. The patients were randomly assigned into : group (A) were operated through the less invasive right anterolateral thoracotomy approach and group (B) were operated through traditional median sternotomy approach. All patients were followed up to assess the postoperative outcome of both approaches.

Results: The final analysis included 23 patients in each group. There was statistically high significant difference regarding skin incision length (8.2 ± 1.85 cm in group A and 19.66 ± 2.46 cm in group B) and total operation time (173.66 ± 65.99 minutes in group A and 229.7 ± 83.6 minutes in group B). There was significant difference ($p<0.05$) between both groups in the need for mechanical ventilation, postoperative blood loss and transfusion, postoperative pain, hospital stay duration and operative cost.

Conclusion: Minimally invasive anterolateral thoracotomy approach for mitral valve surgery offers better outcomes over the traditional median sterontomy approach regarding cosmoses, postoperative complications and hospital costs.

Keywords: median sternotomy, mitral valve surgery, minimally invasive, limited anterolateral thoracotomy.

INTRODUCTION:

Sternal dehiscence following sternotomy may result in deep sternotomy wound infections (mediastinitis). Sternotomy wound bleeding is an important predisposing factor for sterntomy infections, that may lead to mortality and morbidity. [1,2,3] .Minimally invasive approaches have gained popularity among cardiac surgeons. They offer better cosmoses, lesser incidence of postoperative wound infection, less pain, less postoperative bleeding, earlier hospital discharge and earlier recovery to the daily activities. [4,5] .Minimally invasive techniques have been developed for mitral valve surgery. Right limited anterolateral thoracotomy is one of the most accepted and widespread approaches. It offers excellent and effortless exposure . [5,6] .Transoesophageal echo use in minimally invasive approach has a great value in the intravenous cannulation and de-airing. It is also important for diagnosis of peri-prosthetic leakage, aortic dissection and left ventricular distension that may be hard to be detected because of small incision. [7,8] Hence , this study was performed to compare the right anterolateral

thoracotomy approach with median sternotomy approach for surgery of mitral valve in the early postoperative period and their short term results as regard postoperative need for mechanical ventilation, blood loss, wound infection, pain, , hospital stay duration and recovery

METHODS

Ethical Statement: The institutional review board of Zagazig University approved the study (approval number is 5928/ 11-3-2020). An informed consent was signed from all patients involved in the study.

Study Design and Population: The study was conducted in a tertiary health institutions (Zagazig University Hospitals) in the duration between beginning of 2020 till the beginning of 2022. Initially, 56 patients who had Mitral valve disease needing mitral valve surgery (replacement or repair) were screened for the study. All patients having mitral valve disease with or without tricuspid valve disease requiring surgery for mitral valve were included in this study.

Exclusion criteria were patients who had combined cardiac disease (combined mitral and tricuspid valves disease is the only exception as mentioned in inclusion criteria), patients who had ischemic mitral valve disease, patients who had left atrial thrombus diagnosed be preoperative echocardiography or detected on time of surgery and patients complaining from significant pulmonary, renal, hematological, hepatic, endocrine, metabolic or neurologic pathology. The final analysis included 46 patients. They were divided equally to either limited right anterolateal thoracotomy approach group A (n = 23) and Median sternotomy approach group B (n = 23)

Surgical Technique: Two surgeons with more than 3 years experience in cardiothoracic surgery operated all patients. TEE was a mandatory step manipulated by anesthetist. All operations were performed on heparin bonded closed circuit cardiopulmonary bypass. **Antibiotic Prophylaxis:** Within 60 minutes before the skin incision, 1 gm cefazolin was given for all patients as an intravenous infusion over 30 minutes.**Group "A" (anterolateral thoracotomy approach):**Patients lied in supine position. The right shoulder was elevated 30-50 degree and the right arm was positioned at the patient's side. Patients in this group were intubated with a double lumen endotracheal tube. It was replaced by a single lumen endotracheal tube after completion of the surgical procedure and before the transfer of the patient to the intensive care unit.Seven to twelve centimeters skin incision was placed just lateral to the right sternal border over the fourth intercostal space in males and in the inframammary crease in females. The pericardium was incised under direct vision, 2 cm anterior to the phrenic nerve and was extended superiorly to the aortic reflection. The pericardium was tucked to incision edges using silk sutures, to present the heart rotated counter-clockwise. Thus, displacing the left atrium laterally and ventrally allowing direct-vision and access to the aortic origin, atriocaval junction, and right superior pulmonary vein. **Cannulation& Initiation of CPB :**Cannulation of the femoral artery and femoral vein was performed prior to mediastinal dissection. TEE guidance was mandatory in all patients to ensure correct intraluminal direction of the venous cannula. An antegrade cardioplegia and vent cannula was inserted in the ascending aorta. Antegrade crystalloid cardioplegia was used in addition to systemic cooling to 28 celesius degrees in addition to iced saline bath to keep the myocardium temperature at 15 celesius degrees. The ascending aorta was occluded with an external clamp. After cardiac arrest on cardiopulmonary bypass, the left atrium was incised just next to the interatrial groove. The view of the left atrial cavity and mitral valve was generally optimum and sufficient to perform of the mitral valve surgery. After completion of the mitral valve surgery and tricuspid valve repair -if indicated-, the left atrium was closed in the standard fashion. Weaning from cardiopulmonary bypass was performed as usual. A DC Shock of 10-30 joules was administered using the pediatric paddles if the heart continued to fibrillate.**Group "B" (median Sternotomy approach):** The patient was lying supine. Intubation was done by single lumen endotracheal tube. The operation was performed through standard median sternotomy approach cardiopulmonary bypass. In both group, the muscle and soft tissue layers were closed carefully in an anatomically. The skin layer was closed using running, monofilament absorbable sutures. Then all patients were transferred to postcardiac surgery intensive care unit on mechanical ventilation and inotropic support or other drug infusions (s) if needed.**Postoperative Follow-Up:**Early postoperative (during the hospital stay): clinical examination of the wound, routine laboratory investigations, and follow-up plain chest X-ray.

Statistical analysis : The program used for statistical analysis was SPSS version 20. Quantitative data were analyzed using mean, standard deviation (SD), median, and inter-quartile range (IQR), while frequency and percentage were used with qualitative data. Student t-test was used to compare means of different groups, while Fischer exact test to compare frequencies. Box plot was performed. The corresponding distribution tables were consulted to get the "P" (probability value).

Statistical significance was accepted at a P-value ≤0.05while a P-value > 0.05 was considered insignificant.

RESULTS

Results of our study showed no significant difference (p>0.05) between both studied groups regarding demographic data (table 1).Preoperative echocardiography data were presented in table 2. They show no significant difference (p>0.05) regarding valve lesion, ejection fraction, left atrial dimension and pulmonary artery pressure among patients of both groups. Table(3) showed that there was a high statistically significant difference in the length of skin incision between both groups. Additionally, there was a statistically significant difference between both groups regarding the total operation time (p<0.05). However, there were no significant difference (p>0.05) regarding other recorded intraoperative data: coss clamp time, total bypass time, DC shock number during weaning from bypass and need for inotropic support.The differentiaon of performed procedure was presented in diagram 1. In group A: 13 patients (56%) had mitral valve replacement, 10 patients (21%) had mitral valve replacement and tricuspid repair and 2 patients (8.6%) had mitral repair.In group B: 8 patients (52%) had Mitral valve replacement, 15 patients (34%) had mitral valve replacement and tricuspid repair and no patients (0%) had mitral repair. Regarding postoperative data, there was a high statistically significant difference (p<0.001) regarding need prolonged for mechanical ventilation and blood loss in both groups. Moreover, there was a significant difference (p<0.05) between both groups regarding blood transfusion units. Additionaly, on follow up of the patients, more post-operative pain, longer total hospital stay and higher total operative cost was detected in group (B) showing a high statistically significant difference (p<0.001). There was no significant difference between both groups regarding superficial wound infection (p>0.05). All these data are presented in Table 4.

Table 1: Demographic Data of the studied patients:

	Group A	Group B	t-test\	P value	Sig.
Number	**N=23**	**N=23**			
Age					
Range	16-61	29-65			
Mean	42.73	49.8	1.89	0.065	NS
± SD	12.96	12.47			
Male %	4 (17.4%)	6 (26.1%)	Fisher	0.511	NS
	19 (82.6%)	17 (73.9%)			
BMI					
Mean	28.66	27.9	0.538	0.593	NS
± SD	5	4.57			

Table2: Echocardiographic data and valve pathology

	Group A N=23	Group B N=23	t-test\ X^{2*}	P value	Sig.
Single mitral disease	13 (56.5%)	8 (34.7%)			
Double mitral + tricuspid	10 (43.5%)	15 (65.2%)	2.19*	0.139	NS

Ejection fraction %	61.68 ± 9	61.6 ± 6.7	0.034	0.962	NS
Left atrial dimension	5.18 ± 0.9	5.52 ± 0.82	1.34	0.187	NS
Pulmonary artery pressure	46 ± 14.2	50.2 ± 12.6	1.06	0.295	NS

NS: P-value>0.05 is not significant

Table3: perioperative Data:

	Group A	**Group B**	**t-test**	**P value**	**Sig.**
	Mean ± SD				
Skin incision length	8.2 ± 1.85	19.66 ± 2.46	17.86	< 0.001	HS
Cross clamp time (min.)	94.66 ± 25.5	106.2 ± 27.3	1.48	0.146	NS
Total bypass time	128.3 ± 33.25	137 ± 21.9	1.05	0.301	NS
Total operation time (min.)	173.66 ± 45.99	229.7 ± 63.6	3.42	0.002	S
	N (%)	N (%)	Test	P	Sig.
DC shock (number & %)	1 (4.3%)	3 (13%)	Fisher	0.295	NS
Need for Inotropic support	1 (4.3%)	4 (17.4%)	Fisher	0.155	NS

NS: P-value>0.05 is not significant S: P-value<0.05 is significant HS: P-value<0.001 is high significant.

Table4: Postoperative Data:

	Group A	**Group B**	**MW** **t-test#**	**P value**	**Sig.**
Ventilation (hours) **Range** **Mean ± SD**	 4 - 10 6 ± 1.85	 6 – 24 10.5 ± 2.98	6.15	0.001<	HS
Blood loss (ml) **Range** **Median** **Mean ± SD**	 125 – 400 250 265 ± 78.5	 175 – 1150 450 460 ± 260	3.25	0.001<	HS
Blood transfusion (unit) **Range**	0 – 2	0 – 3			

Median **Mean ± SD**	1 0.2 ± 0.56	2 0.87 ± 1	2.87	0.008	S
ICU stay (day) **Range** **Median** **Mean ± SD**	 1 – 7 3 3 ± 1.92	 2 – 10 3 3.86 ± 2	 1.84	 0.305	 NS
5th day postoperative pain (mm)	11.2 ± 3.7	17.4 ± 5.22	4.65#	0.001<	HS
Superficial wound infection	1 (4.3%)	3 (13%)	Fisher	0.295	NS
Total hospital stay **Range** **Mean ± SD**	 7 - 23 10.4 ± 2.5	 8 - 25 16.6 ± 4.13	 6.16#	 0.001<	 HS
Operative Cost by thousand L.E	50.2 ± 1.1	65.8 ± 0.7	57.4#	0.001<	HS

NS: P-value>0.05 is not significant S: P-value<0.05 is significant HS: P-value<0.001 is high significant.

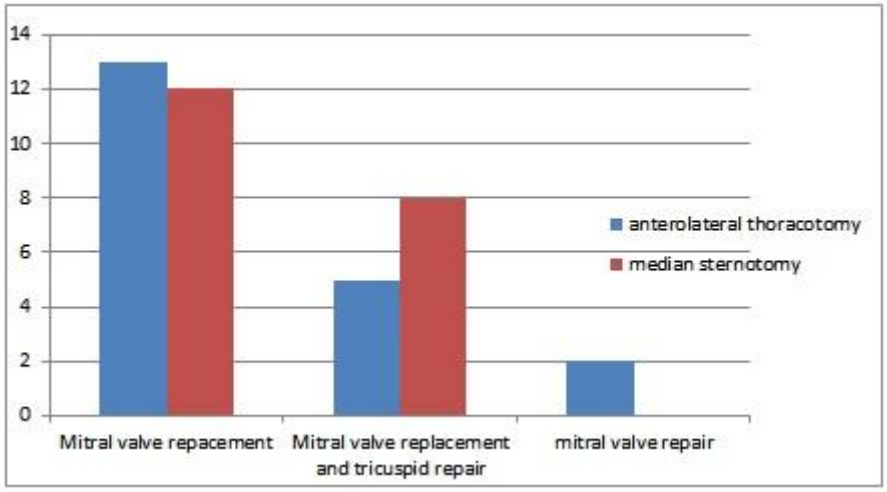

Figure (1) mitral valve replacement

DISCUSSION

Safety and effectiveness of the approach used for valve surgery is the cornerstone of any procedure. Our study compared the postoperative outcome of minimally invasive right anterolateral thoracotomy and median sternotomy approaches for mitral valve surgery.In our study, the mean age range in group (A) was 42.73 ± 12.96 years, while in group (B), it was 49.8 ± 12.47 years. The groups in this study are somehow younger than that in groups in other studies.Previous studies demonstrate that a minimally invasive approach to mitral surgey can be accomplished with low perioperative risk while achieving the same intermediate-term results as the standard sternotomy approach. [9,10] .Results of our study showed that there is high statisticaly significant difference in skin incision length between both

groups. Group (A) showed smaller incision (8.2 ± 1.85 cm) while group (B) showed longer incision (19.66 ± 2.46 cm). Other studies also found a high statistically significant difference ($p<0.01$) in skin incision length between both groups with smaller incision in group A (8.2 ± 1.85 cm). It was noted that decreasing the size of operative incision was linked to less postoperative discomfort and better recovery[6,11,12] . Smaller incision with better cosmotic appearance of the wound scar is considered as an advantage of minimally invasive valve surgery [13,14] . Other literatures reported earlier recovery and return to work with better patient satisfaction.Our results showed a high statistically significant difference between both groups regarding total operation time , with shorter operation time in anterolateral thoracotomy approach group (173.66 ± 65.99 minutes) compared to (229.7 ± 83. 6 minutes) in median sternotomy group. Holman et al. reported a mean operating time of 185±73 minutes in thoracotomy approach [14,15] .

Additionally, there was non significant difference($p<0.05$) in postoperative wound infection in patients included in our study. However, other studies found that thoracotomy wounds were less prone to infection while sternal wounds were more vulnerable to infection. [6,16] There was a high significant differnce between both groups regarding the need prolonged for mechanical ventilation and need for blood transfusion in sternotomy group (B) more than minimally invasive group (A). There was high significant difference ($p<0.01$) between both groups regarding higher blood loss in group (B). Cooley found that the amount of blood drainage is significantly less in patients undergoing minimally invasive heart surgery[17] . Patients in group A experienced less post-operative pain, less total hospital stay duration and less total operative cost. Early ambulation and lesser pain ensures better respiratory functions, lesser morbidities and shorter time needed for rehabilitation. All these factors offer subsequent lower costs on health institutions and shorter hospital stay duration [18,19].

CONCLUSIONS

Limited right anterolateral thoracotomy approach for mitral valve surgery has proven safety, efficacy and feasibility. It shows less morbidities. Additionally , it offers better cosmoses, less wound complications, shorter hospital stay and hence less costs on health authorities. Thus, the minimally invasive right anterolateral thoracotomy approach should be considered when possible for patients requiring mitral valve surgery

FINANCIAL SUPPORT AND SPONSORSHIP
Nil.

CONFLICTS OF INTEREST
There are no conflicts of interest

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To Cite :

Fadaly, A., Shemais, D., mahmoud, G., Elfakharany, K. Assessment of Early Outcome of Antrolateral Thoracotomy Approach for Mitral Valve surgeries. *Zagazig University Medical Journal*, 2024; (223-229): -. doi: 10.21608/zumj.2022.179158.2697