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Upper mini-sternotomy versus right anterior mini-thoracotomy for Aoric valve replacement

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Abstract---Background: Because of the continuous trend towards less invasive procedures, cardiac operations have become increasingly more sophisticated and complex minimally invasive techniques in cardiac operations require higher surgical abilities to accomplish the same quality compared with the traditional procedures with cardiopulmonary bypass (CPB) or sternotomy. Objective: To compare the procedure and early postoperative outcome of minimally invasive approaches, limited upper ministernotomy approach with the right anterior minithoracotomy approach. Patients and Methods: Fifty patients with aortic valve disease randomized in this study and divided into two equal groups, and randomly assigned into two equal groups; Group A Ministernotomy group requiring aortic valve surgery.

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The surgical approach was through the limited upper ministernotomy (6-8cm). Group B Minithoracotomy group requiring aortic valve surgery through right anterior minithoracotomy(5-7cm). Results: There was no statistically significant difference in the cross-clamp time, total bypass time, total operation time. Regarding the length of the skin incision. The mechanical ventilation time was similar, the blood loss and the blood transfusion required was also similar, as well as the ICU stay, as regard postoperative pain, total hospital stay, and the pakage cost effective there was no statistically significant difference in both groups. Conclusions: Refinements in surgical techniques have reduced morbidity and mortality related to valve operations. Minimally invasive aortic valve surgery has evolved into a well tolerated, efficient surgical treatment option in experienced centers, providing greater patient satisfaction and lower complication rates.

Keywords---aortic valve replacement (AVR), mini sternotomy (MS), minimally invasive aortic valve replacement (MIAVR).

Introduction

Aortic valve disease is the most common valvular heart disease in developed countries and its incidence is likely to increase with age[1]. Aortic valve replacement (AVR) through a full sternotomy (FS) is the conventional approach for the treatment of aortic valve disease and data reported from the Society of Thoracic Surgeon (STS) database have shown a dramatically in-hospital mortality reduction from 3.4% in 1997 to 2.6% in 2006 for isolated AVR[2]. Despite these excellent results, there have been an increasing number of cases performed via minimally invasive aortic valve replacement (MIAVR). This approach has now become an established alternative to FS in order to reduce the "invasiveness" of the surgical procedure, while maintaining the same efficacy, quality and safety of a conventional approach[3]. Minimally invasive aortic valve replacement (MIAVR) has been increasingly accepted in the surgical community as a potential alternative to conventional sternotomy, with advantages of reduced trauma, improved cosmesis and reduced hospitalization[4].

Compared with conventional surgery, MIAVR has been shown to provide faster recovery, shorter hospital stay, improved cosmoses and less wound infection. In addition, MIAVR has shown to improve postoperative respiratory function due to the preservation of sternum, and reduction of postoperative pain, blood loss and blood transfusions related to the reduction of surgical dissection. Finally, MIAVR requires fewer rehabilitation resources and consequently associated costs are reduced[5]. The Mini sternotomy (MS) approach represents the most common technique used for Minimally invasive AVR. The MS approach is achieved through 6 to 10 cm midline vertical skin incision, performing a partial J sternotomy at the third to fifth intercostal space[6]. MIAVR via right mini thoracotomy (RT) is performed through a 5 to 7 cm skin incision placed at the level of the second intercostal space without rib resection. After sacrificing the right internal thoracic artery, a soft tissue retractor is inserted into the thoracotomy and direct aortic cannulation is performed using flexible cannulas[7]. So, this study was to compare the procedure and early postoperative outcome (6 months post operatively) of the minimally invasive approaches through limited upper sternotomy (ministernotomy) technique and anterior minithoracotomy.

Patients and Methods

The study was performed at Cairo university hospitals (Kasr Alainy) and Armed forces hospitals. Twenty five patients underwent aortic valve surgery via right minithoracotomy approach., the other 25 patients via upper ministerontomy approach J shape to 3rd right intercostal space, with direct distal ascending aorta cannulation and Femoral vein cannulation. The case study was prospective for 1.5 years, from June 2016 to February 2018.

Inclusion criteria

Patients with isolated aortic valve requiring surgery.

Exclusion criteria

Combined cardiac disease (valvular, congenital or ischemic heart disease). Patients with aortic annulus less than 21 mm or requiring aortic annular enlargement procedures. Patients with previous right thoracotomy. Patients with redo-surgery. Patients exhibiting significant pulmonary, renal, hematologic, hepatic, endocrine, metabolic or neurologic pathology. The patients were divided into two groups Group “A”: Included 25 patients who underwent aortic valve surgery through upper ministerontomy. Group “B”: Included 25 patients who underwent aortic valve surgery through right minithoracotomy. All patients in the study were subjected to full history taking, full clinical examination and Laboratory investigations including Complete blood count (CBC). Liver function tests. Prothrombin time and concentration. Kidney function tests. Fasting blood sugar. Serum electrolytes. Electrocardiogram (ECG) Radiological examination, Plain chest x-ray posteroanterior view in the erect position. Echocardiography.

Spirometric study was performed 24 hours prior to surgery, during the morning in sitting position with the nose clip on. The studies were performed with a computerized pulmonary function system. Measurement of the forced vital capacity (FVC), forced expiratory volume at one second (FEV_1), FEV_1 / FVC, percentage from predicted FVC and FEV_1 were obtained. All patients received their morning dose of cardiac medications. Intramuscular 10-mg morphine sulphate before transfer to the operating theatre was given to all patients. After arrival in the preparation room a 14 gauge peripheral intravenous cannula was inserted using local anesthesia. Sedation was optimized using 0.03-0.07 mg/Kg midazolam.

Post-operative evaluation of both groups

All patients were evaluated thoroughly during their intensive care unit stay and during their hospital stay. Weaning of mechanical ventilation was done gradually using continuous positive airway pressure (CPAP) and pressure support (10-15 cm H2O) modes. Ventilatory support was gradually reduced at a rate of 1-2 cm H2O CPAP and pressure support (PS) decrements.

Postoperative evaluation

Postoperative course follow up divided into three parts immediate or early postoperative while the patients were still in the hospital, three months and six months follow up.

Statistical analysis

Perioperative data were statistically analyzed using statistical package of social science (SPSS), EPIcalc software programs using the arithmetic mean, standard deviation using hypothesis student's "t" tests for quantitative data analysis, while qualitative data (ordinal, categorical) were analyzed using The chi-square test (x2) (Fisher's Exact Test). P value of <0.05 was considered significant and a P value of <0.01 was considered highly significant.

Results

Preoperative assessment

Demographic data and clinical characteristics of the patients

In group "A", age ranged from 20-53 years with a mean of 36.5± 16.5, while in group "B" age ranged from 22-58 years with a mean of 40 ± 18, and there was no statistical significant difference *(P valve >0.05)*. In group "A", there was 12 males (48%) and 13 females (52%), the male number in group "B" was 11 males (44%) and 114 females (56%) with no statistical significant difference *(P value >0.05)*. The mean BMI in group "A" was 22.7 ± 3, and in group "B" it was 23.7 ± 2 and a *P value >0.05*. These data are shown in table (1).

Table 1
Demographic data and clinical characteristics of the patients

	Group A	Group B	P value	Sig.
Number	25	25		
Age Range Mean SD	 20-53 36.5 16.5	 22-58 40 18	 >0.05	 NS
Male %	48%	44%	>0.05	NS
BMI Mean SD	 22.7 3	 23.7 2	>0.05	NS

Clinical classification

Patients were classified according to the NYHA classification, in group “A” 7 patients (28%) were in class I, 12 patients (48%) were in class II, 5 patients (20%) were in class III and 1 patient (4%) was in class IV. In group “B” 9 patients (36%) were in class I, 10 patients (40%) were in class II, 5 patients (20%) were in class III and 1 patient (4%) was in class IV. The mean NYHA classification shows no statistical significant difference as shown in table (2)

Table 2
Preoperative NYHA classification (Number & %)

	Group A	Group B	P value	Sig.
I	7(28%)	9(36%)	>0.05	NS
II	12(48%)	10(40%)	>0.05	NS
III	5(20%)	5(20%)	>0.05	NS
IV	1(4%)	1(4%)	>0.05	NS

Preoperative echocardiographic assessment

Preoperative assessment in group “A” showed that the ejection fraction(EF) in group “A” was 59.5 ± 7.5%, while in group “B” it was 56 ± 6 % with a P value >0.05. The Left ventricle end diastolic dimension in group “A” was 5.6 ± 0.6, and in group “B” it was 5.4 ± 0.7. The Left ventricle end systolic dimension in group “A” was 4.6 ± 0.4, and in group “B” it was 4.5 ± 0.4. The left atrial dimension in group “A” 3.55±0.55, and in group “B” it was 3.75 ± 0.45, pulmonary artery pressure in group “A” was 37 ± 5 , while in group “B” it was 33.5 ± 3.5 with a P value >0.05 with no statistical significant difference between the 2 groups. As shown in table (3)

Table 3
Preoperative echocardiographic data

	Group A	Group B	P value	Sig.
Ejection fraction %	59.5 ± 7.5	56 ± 6	>0.05	NS
Left ventricle end diastolic dimension	5.6 ± 0.6	5.4 ± 0.7	>0.05	NS
Left ventricle end systolic dimension	4.6 ± 0.4	4.5 ± 0.4	>0.05	NS
Left atrial dimension	3.55 ± 0.55	3.75 ± 0.45	>0.05	NS
Pulmonary artery pressure	37 ± 5	33.5 ± 3.5	>0.05	NS

Preoperative spirometric study

Preoperative mean forced vital capacity (FVC) in group "A" was 2.45 ± 0.45 (Liters) while the mean percentage of predicted FVC was 85.5 ± 12.5. The mean forced expiratory volume at one second (FEV_1) in group "A" was 2.6 ± 0.7 L and the percentage of the predicted FEV_1 was 79 ± 9 %. The FEV $_1$ to FVC ratio (FEV_1 / FVC) was 101.5 ± 3.5. In group "B", the mean FVC was 2.35 ± 0.25 L, while the mean percentage of predicted FVC (FVC %) was 83 ± 13%. The mean FEV_1 in group "B" was 2.35 ± 0.25L and the percentage of the predicted FEV_1 was 80.5 ± 8.5 And the FEV_1 / FVC was 100.5 ± 7.5 %. The preoperative spirometric study showed no significant statistical difference between the two groups these data are shown in table (4).

Table 4
Preoperative spirometric study in both groups

	Group A	Group B	P value	Sig.
FVC (liters)	2.45 ± 0.45	2.35 ± 0.35	>0.05	NS
FEV1 (liters)	2.3 ± 0.5	2.25 ± 0.65	>0.05	NS
FVC%	85.5 ± 12.5	83 ± 13	>0.05	NS
FEV1%	79 ± 9	80.5 ± 8.5	>0.05	NS
FEV1/FVC	101.5 ± 3.5	100.5 ± 7.5	>0.05	NS

Intra-operative course

The intra-operative surgical data e.g. cross-clamp time and total bypass time were comparable in the study groups. All patients operated in form of aortic valve replacement by prosthetic mechanical valve ranged in size from 19-23. There was no significant difference between the two groups as regards the cross clamp time and the total bypass time. The total bypass time in group "A" was 77 ± 12 min while in group "B" it was 76.5 ± 6.5 minutes. Cross clamp time in group "A" was 60.5 ± 4.5 min while in group "B" it was 64.5 ± 4.5 minutes with a P value more than 0.05 denoting no significant difference as shown in table (5).

Table 5
Cross clamp & total bypass time in both groups

	Group A	Group B	P value	Sig.
Cross clamp (min.)	60.5 ± 4.5	64.5 ± 4.5	>0.05	NS
Total bypass time	77 ± 12	76.5 ± 6.5	>0.05	NS

Post-operative course

All patients in both groups required post-operative mechanical ventilation no patients were extubated in the operating theatre. The ventilation time for group "A" ranged from 2-6 hours, with a mean 4±2 hours. In group "B" the ventilation time ranged from 4-6 hours with a mean 5±1 hours. This shows that there is no statistically significant difference between the two groups as regards post-operative mechanical ventilation time (table 6). The blood drainage and blood transfusion required to keep a hematocrite around 25-30 % was comparable in both groups. In group "A", blood drainage ranged from 100-120ml during the first 24 hour, with a mean ± SD of 110 ± 10 ml/ first 24 hour. In group "B", the blood loss ranged from 150-200 ml during the first 24 hour, with a mean ± SD of 175 ± 25 ml / first 24 hour, this shows that there is no statistically significant difference between the two groups as regards the blood drainage in the first 24 hours as shown in table (6). The amount of blood units transfused to group "A" ranged from 1 to 2 units with a mean of 1.5 ± 0.5 units, while in group "B" it ranged from 2 to 3 units with a mean of 2.5 ± 0.5 units. This shows that there is no statistically significant difference as shown in table (6). The total intensive care unit (ICU) stay was comparable in both groups. In group "A", the ICU stay ranged from 48-60 hours, with a mean of 54 ± 6 hours, while in group "B" the range was 36-48 hours with a mean of 42 ± 6 hours, which shows that the ICU stay shows no statistically significant difference (table 6).

Table 6
Ventilation, blood loss, blood transfusion and total ICU stay

	Group A	Group B	P value	Sig.
Ventilation (hours)				
Range	2-6	4-12	>0.05	NS
Mean	4	6.2		
SD	2	2		
Blood loss (ml)				
Range	100-120	150-200	>0.05	NS
Mean	110	175		
SD	10	25		
Blood transfusion (unit)				
Range	1-2	2-3	>0.05	NS
Mean	1.5	2.5		
SD	0.5	0.5		
ICU stay (hours)				
Range	48-60	36-48	>0.05	NS
Mean	54	42		
SD	6	6		

Post-operative complications

In group "A", there were 6 patients (24%) with complications. Four patients (16%) developed postoperative arrhythmias, they recovered and return to normal sinus rhythm within six weeks post-discharge. Two patients (8%) had superficial wound infection involving only the skin and responded to frequent dressing and antibiotics. In group "B", 5 cases (20%) suffered from post-operative complications. Three patients (12%) developed postoperative arrhythmias. This complication disappeared 5 days later. One patient (4%) developed right atelectasis with lower lobe collapse, which responded to medical and physiotherapy and totally resolved on the 5th day postoperative. One patient (4%) had superficial wound infection involving only the skin and responded to frequent dressing and antibiotics. There was no statistical significant difference as regard post-operative complications in both groups as shown in table (7).

Table 7
Post-operative complications of both approaches

	Group A	Group B	P value	Sig.
No complications	19(76%)	20(80%)	>0.05	NS
Arrhythmias	4(16%)	3(12%)	>0.05	NS
Lung atelectasis	0	1(4%)	>0.05	NS
Superficial wound infection	2(8%)	1(4%)	>0.05	NS

The total hospital stay was comparable in the two groups; the range of hospital stay in group "A" was 5.5-7.5 days with a mean of 6.5 ± 1 days, while in group "B" the range was 5-7 days with a mean of 6 ± 1 days. There was no statistically significant difference as regard total hospital stay as shown in table (8).

Table 8
Total hospital stay of both groups

	Group A	Group B	P value	Sig.
Total hospital stay				
Range	5.5-7.5	5-7	>0.05	NS
Mean	6.5	6		
SD	1	1		

Pain score

After 3 month the pain score using the visual analogue scale was compared in the two groups. In group (A) the mean pain score was 1.5 ± 0.5. Pain score in group (B) was 1 ± 0.5 with no statistically significant difference as shown in table (9).

Table 9
Pain score after 3 months in both groups

	GROUP A	GROUP B	P value	SIG
Pain score Mean ± SD	1.5 ± 0.5	1 ± 0.5	> 0.05	NS

Post-operative spirometric study

There was no statistically significant different in the FVC, FEV_1%, FEV_1, FVC% and FEV_1/FVC between both group that may be due to preservation of both lungs in group A while opening the right pleural space in group B without compromising the right lung. As shown in (table 10)

Table 10
Post-operative pulmonary functions in both groups (Mean ± SD)

	Group A	Group B	P value	Sig.
FVC (liters)	2.45 ± 0.35	2.2 ± 0.2	>0.05	NS
FEV1 (liters)	2.25 ± 0.55	2.15 ± 0.35	>0.05	NS
FVC%	85.5 ± 13.5	83 ± 11.5	>0.05	NS
FEV1%	79.5 ± 9.5	79.5 ± 8.5	>0.05	NS
FEV1/FVC	101 ± 3	97.5 ± 7.5	>0.05	NS

Discussion

Preoperative Evaluation

In our study, the mean age in group “A” was 36.5±16.5 years, while in group “B”, it was 40±18years. The age groups in our study are relatively younger than the age groups in other studies. Miceli et al[8] reported a mean age of 67.2 ± 12.5 years, also in other studies as Phan et al[9] the mean age was above 50 years. The younger mean age in our series may be attributed to earlier and repeated affection by rheumatic fever, which is endemic in most developing countries including Egypt. There was no statistically significant difference between mean ages in our study groups. Regarding the sex, 52% of patients were female and 48% were male. There was no statistically significant difference between sex distributions in our study groups.

The mean BMI in group “A” was 22.7 ± 3 Kg, and in group “B” was 23.7 ± 2 with no statistically significance, demonstratig that obesity does not increase the risk of death and most complications after cardiac surgery, aside from the unexplained increased risk of reoperation during the same admission. Preoperative clinical assessment of the patients, classified them according to the NYHA classification into four classes. In group “A” 7 patients (28%) were in class I, 12 patients (48%) were in class II, 5 patients (20%) were in class III and 1 patient (4%) was in class IV. In group “B” 9 patients (36%) were in class I, 10 patients (40%) were in class II, 5 patients (20%) were in class III and 1 patient (4%) was in class IV. There was no statistical significant difference between both groups. In other studies like Miceli et al[8] the same date 12% were in class I, 42% were in class II, 42% were in class III and 4% were in class IV. There was no statistical difference. Also in our study the mean was 2.4 ± 0.77 in group A while in group B it was 2.5±0.8, in Phan et al[9] the mean was 2.25 ± 0.67 with no significance difference

The preoperative echocardiographic evaluation in our study showed that the ejection fraction (EF) in group “A” was 59.5 ± 7.5 %, while in group “B” it was 56 ± 6 % Miceli et al[8], study showed that EF 60.3±12.1 is nearly equal for our study. The left atrial dimension in group “A” was 3.55 ± 0.55 and in group “B” it was 3.75 ± 0.45, pulmonary artery pressure in group “A” was 37 ± 5 while in group “B” it was 33.5 ± 3.5 with a P value >0.05. The Left ventricle end diastolic dimension in group “A” was 4.6 ± 0.6, and in group “B” it was 4.4 ± 0.6. The Left ventricle end systolic dimension in group “A” was 3.6 ± 0.4, and in group “B” it was 3.5 ± 0.4, with a P value >0.05 with no statistical difference between the two groups.Yet there is no many studies focused on above echo data rather than the EF, PAP and mention PAP as severe or not as in Phan et al[9].

In our study, preoperative pulmonary function tests study was done to all patients 24 hours prior to surgery, during the morning in sitting position. Preoperative mean forced vital capacity (FVC) in group "A" was 2.45 ± 0.45 (Liters) while the mean percentage of predicted FVC was 85.5 ± 12.5. The mean forced expiratory volume at one second (FEV1) in group "A" was 2.6 ± 0.7 L and the percentage of the predicted FEV1 was 79 ± 9 %.. The FEV 1 to FVC ratio (FEV1 / FVC) was 101.5 ± 3.5. In group "B", the mean FVC was 2.35 ± 0.25 L, while the mean percentage of predicted FVC (FVC %) was 83 ± 13%. The mean FEV1 in group "B" was 2.35±0.25L and the percentage of the predicted FEV1 was 80.5 ± 8.5. And the FEV1 / FVC was 100.5±7.5 %. The preoperative spirometric study showed no significant statistical difference between the two groups.

Intra-operative Evaluation

The length of the incision was compared in the two groups. The mean length of incision in group "A" was 6.96 ± 0.45 cm ranged from 7 to 10 cm. While in group "B" the mean length was 6.5 ± 1.5cm ranged from 5 to 8 cm which shows no significant statistical difference between the two groups (P value > 0.05). Other studies like Miceli et al[8] showed that the skin incision for ministernotomy range from 6-9 cm with mean 7.5 ± 1.5, reported a mean incision length of 7.5 ± 10 cm in minithoracotomy group. There is almost no difference between the two studies in full sternotomy incision.

There was no significant difference between the two groups as regards the cross clamp time and the total bypass time. The total bypass time in group "A" was 77 ± 12 min while in group "B" it was 76.5 ± 6.5 minutes. Cross clamp time in group "A" was 60.5 ± 4.5 min while in group "B" it was 64.5 ± 4.5 minutes with a P value more than 0.05 denoting no significant difference. Other studies as Miceli et al[8] showed that the total bypass time in ministernotomy group was 124 ± 27 min while in conventional group it was 122.5±19.8 minutes. which is very close to our results with no statistical differences.

Postoperative evaluation
ICU evaluation

In our study, no attempt was done for extubating the patient in the operating theatre. All patients in both groups required mechanical ventilation. The ventilation time in group "A" was ranged from 2-6 hours, with a mean 4±2 hours. In group "B" the ventilation time ranged from 4-6 hours with a mean 5±1 hours. This shows that there is no statistically significant difference between the two groups. The total intensive care unit (ICU) stay was comparable in both groups. The total intensive care unit (ICU) stay was comparable in both groups. In group "A", the ICU stay ranged from 1.6-2 days, with a mean of 1.8 ± 0.2 days, while in group "B" the range was 1.5 – 1.8 days with a mean of 1.65 ± 0.15 days, which shows that the ICU stay shows no statistically significant difference. In a study done by Phan et al[9], shows that the ICU stay shows no statistically significant difference.

Postoperative studies

Postoperative Spirometry performed to all patients after 3 months from discharge. It was revealed that there was no statistically significant different in the FVC, FEV1%, FEV1, FVC% and FEV1/FVC between both group, Other studies not concerned about pulmonary function tests may be due to preservation of both lungs with no significance difference. Pain level after cardiac operations is relatively low in most patients. Such postoperative pain is bearable; the patients receive sufficient pain medication on request. The thoracic pain is of tolerable intensities if the sternum and the ribs are stable postoperatively. All patients suffered from pain during mobilization and coughing. This can be directly related to the thoracic incision and friction of the split sternum during these maneuvers[10]. Post-operative pain score using the visual analogue scale was compared in the two groups. In group (A) the mean pain score in the first post-operative day was 6 ± 1. This score decreased in the second post-operative day to 3.5 ± 05. Pain score in group (B) during the first 24 hours was 7±1 which decreased to 5 ± 1 in the second post- operative day. This data showed that there is no statistically significant difference.

Postoperative complications

The complications reported in both cases were not statistically different. This may be due to limited number of cases studied. In group “A”, there were 6 patients (24%) with complications. Four patients (16%) developed postoperative arrhythmias, they recovered and return to normal sinus rhythm within six weeks post-discharge. Two patients (8%) had superficial wound infection involving only the skin and responded to frequent dressing and antibiotics. In group “B”, 5 cases (20%) suffered from post-operative complications. Three patients (12%) developed postoperative arrhythmias. This complication disappeared 5 days later. One patient (4%) developed right atelectasis with lower lobe collapse, which responded to medical and physiotherapy and totally resolved on the 5^{th} day postoperative. One patient (4%) had superficial wound infection involving only the skin and responded to frequent dressing and antibiotics. There was no statistical significant difference. The total hospital stay was comparable in the two groups; the range of hospital stay in group “A” was 5.5-7.5 days with a mean of 6.5 ± 1 days, while in group “B” the range was 5-7 days with a mean of 6 ± 1 days. There was no statistically significant difference.

Miceli et al. [8] were the first to perform a direct comparison of RT and MS for minimal access AVR (mini-AVR). They performed an unmatched non-randomized comparison of 406 consecutive patients in which the baseline characteristics of the 2 groups were comparable. The MS approach utilized an upper sternotomy extending from the sternal notch down to the level of the second intercostal space, where it was extended right and left to form a V-shaped hemisternotomy. Both approaches utilized central arterial and peripheral venous cannulation. The authors found that although there was no difference in in-hospital mortality between the 2 approaches (RT = 1.2%, MS = 1.3%; P = 1), RT was associated with reduced postoperative morbidity in terms of reduced ventilation times, reduced intensive care unit and ward length of stay and reduced incidence of postoperative atrial fibrillation (AF). However, the comparison in this study is limited by significant selection bias in the allocation of patients to each treatment group. RT is the default approach for mini-AVR at the study institution with patients only undergoing MS if they do not meet suitability criteria for the favoured approach. Patients only undergo mini-AVR by MS if the aorta is positioned more than 10 cm from the sternum, meaning that patients in the MS group may represent a more technically challenging cohort. The authors acknowledge that this bias might explain the observed difference in morbidity as the increased distance between the aorta and chest wall might have been an index of pulmonary disease. The fact that the surgical team is more familiar with one approach over the other is also a source of bias. This study had some limitations like inclusion of different surgical experience, small patient number, lack of randomization & the relatively-short period of post-operative follow up.

Conclusion

Both minimally invasive techniques, are as safe as full median sternotomy for aortic valve surgery, with fewer complications and postoperative pain, less ICU and hospital stay, as well as excellent exposure of the aortic valve, and fast recovery to work with limited movement restriction after surgery. Anterior minithoracotomy offers a better cosmetic scar. Both minimally invasive approaches should be used as an initial approach for aortic valve surgery. We recommend mandatory usage of intra-operative TEE allowing detection of most importantily air bubbling, para-valvular leakage. Furthermore we recommend adopting minimally invasive ministernotomy and right anterior minithoracotomy as safe and alternative approaches in aortic valve surgery in patients with aortic valve disease requiring surgery.

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