Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 28s (2025)
https://www.jneonatalsurg.com

Minimally Invasive Combined Aortic and Mitral Valve Surgeries via Upper Ministernotomy

Ismail Maged Elnaggar[1], Ehab Mohammed Elshihi[2], Hesham Mostafa Alkady[3], Ahmed Hamdy Mahmoud Hassanien Allam[4], Ahmed Mohammed El Wakeel[5]

[1,2,3,*4,5]Department of Cardiothoracic Surgery, Faculty of Medicine, Cairo University

[*]**Corresponding author:**

Ahmed Hamdy Mahmoud Hassanien Allam

Email ID: ahmedallamq9@gmail.com

Cite this paper as: Ismail Maged Elnaggar, Ehab Mohammed Elshihi, Hesham Mostafa Alkady, Ahmed Hamdy Mahmoud Hassanien Allam, Ahmed Mohammed El Wakeel, (2025) Minimally Invasive Combined Aortic and Mitral Valve Surgeries via Upper Ministernotomy. *Journal of Neonatal Surgery*, 14 (28s), 1020-1031.

ABSTRACT

Background: A minimally invasive cardiac surgery gained a wide acceptance worldwide with comparable results to conventional surgery through full median sternotomy. There is now extension of minimally invasive techniques to involve more complex procedures such as combined aortic and mitral valve surgeries.

Patients and methods: In this study we present two groups of patients receiving combined aortic and mitral valve surgeries in the period between October 2022 and January 2024 at Cairo University as well other hospitals. Group A included 30 patients that were operated upon through upper ministernotomy while group B included 30 patients that were operated upon via full median sternotomy. Both groups were matched according to propensity matching scoring system build upon preoperative patient characteristics.

Results: According to our study Patients in group A showed similar mortality compared to group B (3.3% P > 1). Patients in group A as compared with group B were less likely to receive postoperative red cell transfusion (1.33 ± 0.48 versus 1.90 ± 0.71, P <0.001, respectively), both groups shared similar incidences of postoperative morbidities. Patients in group A as compared with group B experienced 7-minutes longer aortic cross-clamping time and 10-minutes longer cardiopulmonary bypass time, but showed shorter postoperative hospitalization time.

Conclusion: Combined aortic and mitral valve surgery through upper ministernotomy is safe and effective minimally invasive technique.

Keywords: *Mitral valve, aortic valve, minimally invasive, double valve surgery.*

1. INTRODUCTION

Median sternotomy has been used as the gold standard approach for cardiac surgery since 1957.

It provides excellent exposure and control of the entire operative field. It has been proved to be safe and efficient and is used for the surgical treatment of all congenital and acquired heart diseases resulting in low failure rates and excellent long-term outcomes.

However, since the 1990s, minimally invasive cardiac surgery (MICS) has gained wide acceptance due to patient (less trauma and improved cosmesis) and economic (faster recovery and shorter hospital stay) demand and following the development of new instruments, devices, monitoring and cannulation techniques: the first attempt of a minimally invasive aortic valve procedure was done through a parasternal approach over the 3rd and 4th cartilages with division of the ribs, which was followed by thoracotomy and partial sternotomy.[1]

The advantages of MICS are less trauma, less bleeding, less pain and less wound infections that allow faster recovery with shorter length of stay resulting also in decreased healthcare costs. Nowadays, the upper ministernotomy approach is widely accepted with favorable long-term outcomes even in elderly patients when compared with sternotomy. However, MICS is always accompanied by a learning curve with initially prolonged operative times.[2]

Upper ministernotomy provides good exposure of the aorta, pulmonary trunk, roof of left atrium and part of right atrium. It allows easy and rapid conversion to full sternotomy in case of emergency or bleeding. It also permits usage of conventional instruments.

2. AIM OF THE WORK

The aim of our study is to compare early postoperative outcome after combined surgery for mitral and aortic valve pathology by either conventional OR upper ministernotomy approaches.

3. PATIENTS AND METHODS

This a prospective and retrospective study aiming at determining the early outcome, combined aortic and mitral valve surgeries using two different approaches namely upper ministernotomy and conventional median sternotomy.

The study was conducted at Kasr Al Ainy Hospitals, Cairo University as well as other hospitals between October 2022 and January 2024.

All minimally invasive cases were performed by the same surgeon. The choice to perform either approach was dependent on surgeon preference.

Primary outcomes:

Effect of minimally invasive approach (upper ministernotomy) on early outcome following aortic and mitral valve surgery including need of inotropic support, post op bleeding, operative mortality, cerebrovascular stroke, renal failure and post operative surgical site infection.

Secondary outcome parameters:

To determine if minimally invasive combined aortic and mitral valve surgery through upper ministernotomy is effective and safe.

Patient population:

60 cases of patients who underwent mitral and aortic valve surgery using upper ministernotomy approach and conventional approach were included in this study: Group (A) including 30 patients of combined aortic and mitral valve surgeries operated upon through upper ministernotomy. Group (B) (controlled group) included 30 patients of combined aortic and mitral valve surgeries operated upon through conventional full median sternotomy.

To obtain two matched groups a propensity matching scoring system using preoperative characteristics was applied on 110 cases received conventional aortic and mitral valve surgeries. For obtaining this matching 30 cases were selected in group B to be compared to group A.

Patients were selected according to the following inclusion and exclusion criteria:

Inclusion criteria: Patients who underwent combined aortic and mitral valve surgeries.

Exclusion criteria: Redo cases and combined surgeries. Patients with associated other valve lesions (pulmonary valve disease, tricuspid valve disease) and CABG operation.

Preoperative data:

Patients were subjected on admission to the following: History taking regarding Age, gender, Body mass index, NYHA class, CCS class, DM, COPD, preoperative atrial fibrillation, renal impairment, valve pathology, Previous cerebrovascular stroke, Peripheral vascular disease, liver impairment, full general and local clinical examination.

Investigations: all patients received echocardiography was performed to establish LV Function (LA size, ESV, EDV, EF, left atrial thrombus), Valve pathology, patients above the age of 45 yrs received coronary angio to exclude ischemic hesrt disease.

Intra Operative data:

The anesthetic protocol as well as the patient position is the same in all cases regardless of the surgical approach: In cases done through upper partial sternotomy, a skin incision of 7 to 8 cm starting 1 cm below the suprasternal notch and ending opposite the 3rd intercostal space. An upper inverted T-shaped partial sternotomy. The pericardium is opened.After full heparinization, a multi -stage venous cannula is placed into the right femoral vein under trans esophageal echocardiographic (TEE) guidance. An aortic cannula is placed through a controlling purse string suture into the aorta just proximal to the takeoff of the innominate artery. Cardiopulmonary bypass is established, the lungs are collapsed.

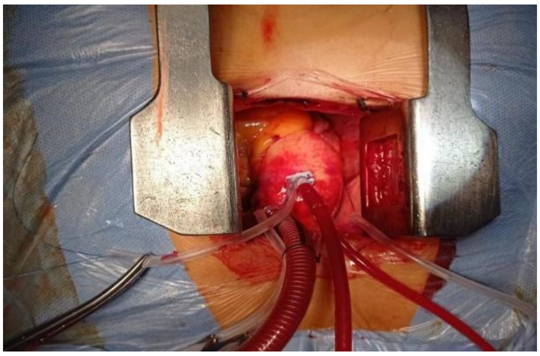

Fig. 1: showing aortic cannulation and antegrade cardioplegia cannula

The aorta is cross-clamped just proximal to the aortic cannula if no aortic regurge. Antegrade cardioplegia is delivered proximal to the clamp. Once the heart is arrested, the aorta is incised above the valve. The valve is inspected and debrided but The aortic prosthesis is not inserted at this time. The dome of the left atrium is opened, a small vent is put into the left atrium to achieve a bloodless field.

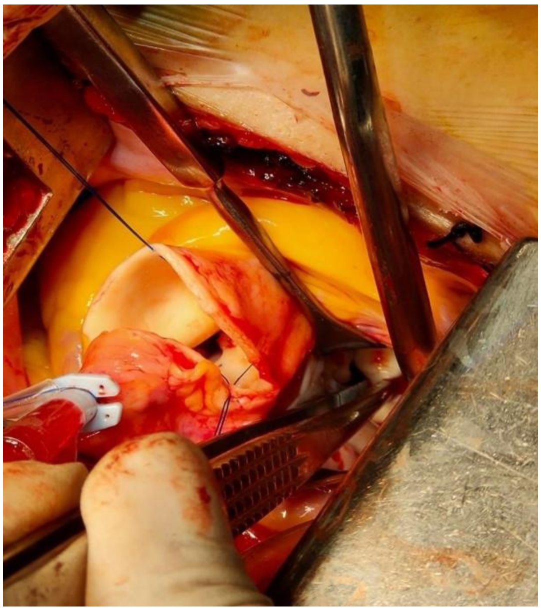

Fig. 2: Intraoperative photo showing the aortic valve through the aortotomy incision as well as the mitral valve through the opened doom of the left atrium via the upper mini-sternotomy approach.

The annulus of MV is calibrated, with a sizer that matches to the specific prosthesis. The mitral valve pathology is dealt with first by either repair or replacement

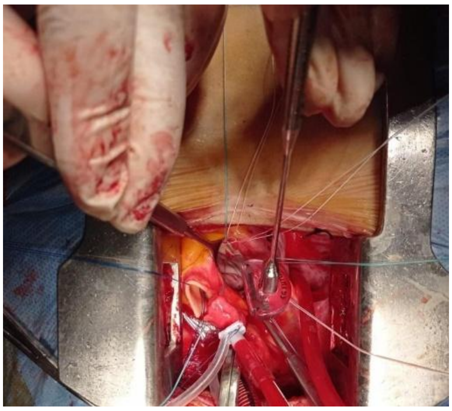

Fig. 3: The annulus is calibrated, with a sizer that corresponds to the specific prosthesis.

Aortic valve annulus is calibrated and inserting of aortic prosthesis done

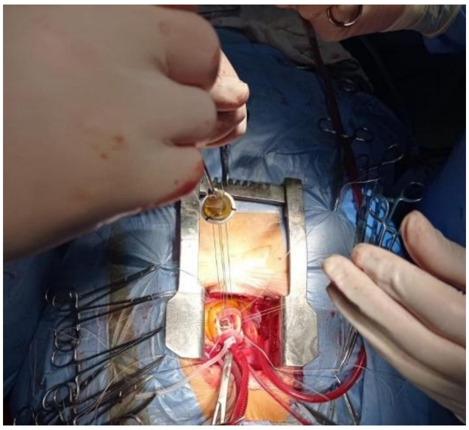

Fig. 4: The valve sutures are passed through the valve sewing ring

The aortotomy is closed in two layers followed by closure of the left atrial dome in one layer before deairing and declamping then hemostasis. After separating from bypass and removing all cannulas, hemostasis was done, the sternum is reapproximated with stainless steel wires that are left in place permanently. In conventional cases, after the full median sternotomy and full heparinization, aorto bicaval cannulation is performed and CPB is established. Cardioplegia is achieved via cold blood delivered into the aortic root or coronary ostia (in case of severe aortic regurgitation). The pathological aortic valve is now excised through a transverse aortotomy and then the mitral pathology is dealt with through left atriotomy. Finally, the aortic valve is replaced and both the aortotomy and left atriotomy incisions are closed.

A record was made of the following: Ischemic time (in minutes). Bypass time (in minutes). Total operative time (in minutes). Type of valve (mechanical, tissue valve, size of the valve). Type of surgery (repair or replacement).

Postoperative data

Patients were transferred to ICU while being mechanically ventilated with monitoring of the blood pressure, central venous pressure, pulse (rate, rhythm), blood loss and urine output. Need for inotropic support in different concentrations. Weaning from mechanical ventilation was done when criteria of weaning were met.

The following data were recorded: Period of mechanical ventilation. Duration of hospital and ICU stay. Duration of inotropic support, need for blood transfusion. Incidence of postoperative complications: conversion to full sternotomy, re-exploration for bleeding, cerebrovascular stroke, renal failure necessitating dialysis, heart block requiring PPM, deep sternal wound infection and operative mortality. Patients were discharged from hospital when: The wound was clean, sternum was stable with stable cardiovascular status, normal laboratory findings and satisfactory echocardiographic results. Patients were given a card including valve type & size and for follow up.

Statistical methods:

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired t test. For comparing categorical data, Chi square (x2) test was performed. Exact test was used instead when the expected frequency is less than 5. P-values less than 0.05 were considered as statistically significant**.** Matching of both groups through a propensity matching scoring system according to preoperative data.

4. RESULTS

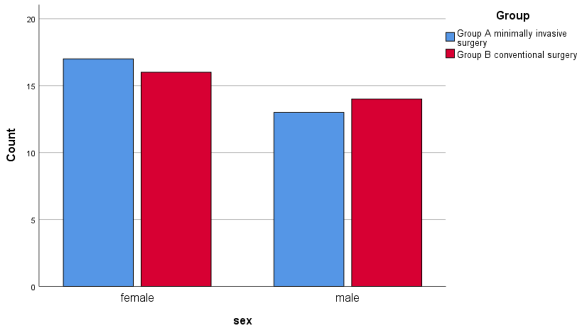

Fig. 5: Sex Distribution across both groups

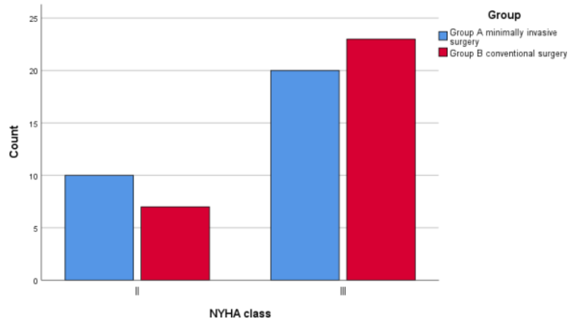

Fig. 6: NYHAA Class distribution across groups

Table 1: Demographic Data

		Group A minimally invasive surgery		Group B conventional surgery		P value
		Mean	SD	Mean	SD	
age		54.27	4.53	53.07	4.21	0.292
Body mass index (kg/m2)		27.77	1.85	27.67	1.52	0.820
sex	female	56.7%		53.3%		0.795
	male	43.3%		46.7%		

Table 2: Clinical details

		Group A minimally invasive surgery		Group B conventional surgery		P value
		Count	%	Count	%	
NYHA class	II	10	33.3%	7	23.3%	0.390
	III	20	66.7%	23	76.7%	
Diabetes mellitus	yes	3	10.0%	4	13.3%	1
	no	27	90.0%	26	86.7%	
Atrial fibrillation	yes	6	20.0%	8	26.7%	0.542
	no	24	80.0%	22	73.3%	
Renal impairment	yes	2	6.7%	1	3.3%	1
	no	28	93.3%	29	96.7%	
Previous cerebrovascular stroke	yes	2	6.7%	3	10.0%	1
	no	28	93.3%	27	90.0%	
Peripheral vascular disease	yes	1	3.3%	1	3.3%	1
	no	29	96.7%	29	96.7%	
Chronic obstructive pulmonary disease	yes	2	6.7%	2	6.7%	1
	no	28	93.3%	28	93.3%	
Left atrial thrombus	yes	1	3.3%	2	6.7%	1
	no	29	96.7%	28	93.3%	

Table 3: Echocardiographic findings

	Group A minimally invasive surgery		Group B conventional surgery		P value
	Mean	SD	Mean	SD	
LVEDD (mm)	62.83	1.70	63.50	2.16	0.190

LVESD (mm)		39.13	3.32	38.47	2.87	0.409
LAD (mm)		55.00	2.51	54.97	1.73	0.952
EF%		53.07	3.82	52.93	2.86	0.879
valve pathology	degenerative	6.7%		10.0%		1
	Rheumatic	93.3%		90.0%		

Table 4: Types of valves used

		Group A minimally invasive surgery		Group B conventional surgery		P value
		Count	%	Count	%	
Aortic valve prosthesis	biological	1	3.3%	2	6.7%	1
	Mechanical	29	96.7%	28	93.3%	
Mitral valve prosthesis	biological	1	3.3%	3	10.0%	0.569
	Mechanical	23	76.7%	20	66.7%	
	mitral valve repair	6	20.0%	7	23.3%	

Table 5: Valve size

	Group A minimally invasive surgery		Group B conventional surgery		P value
	Mean	SD	Mean	SD	
aortic valve size	21.53	1.74	21.34	1.70	0.422
mitral valve size	28.13	1.25	28.00	1.26	0.411

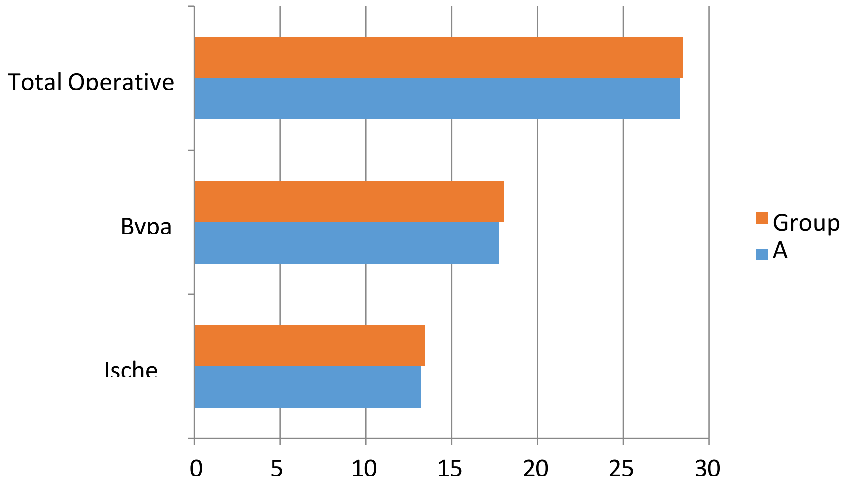

Fig. 7: Intraoperative timings (in minutes) of both groups

Table 6: Operative timings comparison between the two groups

	Group A minimally invasive surgery		Group B conventional surgery		P value
	Mean	SD	Mean	SD	
Cross-clamp time (minutes)	134.23	8.14	131.77	4.92	0.162
CPB time (minutes)	180.60	7.38	177.53	4.15	0.053
Total operative time (minutes)	284.57	4.65	282.70	3.65	0.089

Table 7: Duration of mechanical ventilation, inotropic support requirement, total ICU stay and hospital stay.

	Group A minimally invasive surgery		Group B conventional surgery		P value
	Mean	SD	Mean	SD	
Mechanical ventilation (hours)	4.52	0.49	6.09	0.34	<0.001
Duration of inotropic support (hours)	12.20	1.49	11.73	1.36	0.211
ICU stay (days)	3.07	0.83	3.50	1.01	0.074
Hospital stay (days)	7.93	1.41	11.03	2.33	<0.001

Table 8: Postoperative chest tube drainage and the amount of blood units transfused

	Group A minimally invasive surgery		Group B conventional surgery		P value
	Mean	SD	Mean	SD	
Chest tube drainage (cm3)	238.67	85.08	356.87	97.94	<0.001
Need for blood transfusion (units)	1.33	0.48	1.90	0.71	<0.001

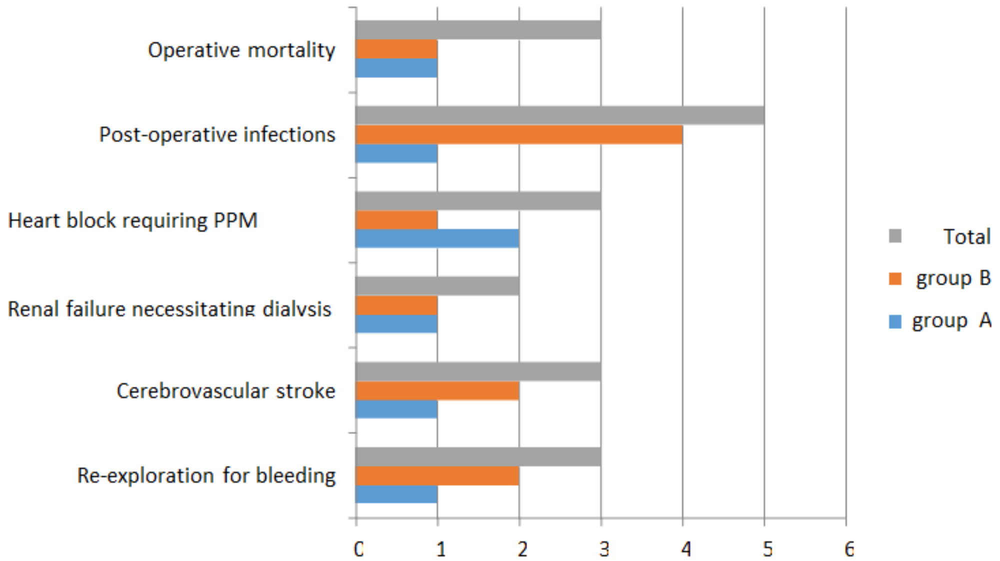

Fig. 8: Major complications: Group Comparison

Table 9: Post operative complications and statistical significance across both groups

		Group A minimally invasive surgery		Group B conventional surgery		P value
		Count	%	Count	%	
Re-exploration for bleeding	yes	1	3.3%	2	6.7%	1
	no	29	96.7%	28	93.3%	
Cerebrovascular stroke	yes	1	3.3%	2	6.7%	1
	no	29	96.7%	28	93.3%	
Renal failure necessitating dialysis	yes	1	3.3%	1	3.3%	
	no	29	96.7%	29	96.7%	1
Heart block requiring PPM	yes	2	6.7%	1	3.3%	1
	no	28	93.3%	29	96.7%	
Post-operative infections	yes	1	3.3%	4	13.3%	0.353
	no	29	96.7%	26	86.7%	
Operative mortality	yes	1	3.3%	1	3.3%	1
	no	29	96.7%	29	96.7%	

5. DISCUSSION

Preoperative Evaluation:

We attempted to match both groups of our study in regards to preoperative data as our main end points were early postoperative outcomes.

1. **Demographics**

a) Age:

The mean age in our study 54.27 ± 4.53 in group A, while in group B was 53.07 ± 4.21 with no statistical significance between both groups

Antonio Lio (2016)[3] in his study minimally invasive approach for aortic and mitral valve surgery with a mean age of 66 ± 12 years. This is most likely due to the higher prevalence of rheumatic valve disease in our population while in the other studies the main pathology was degenerative valve disease presenting at later ages.

b) Sex:

Our study population had a strong female prevalence with no statistical difference between groups A and B (56.7% and 53.3% respectively) which was consistent with previous studies regarding the sex distribution of minimally invasive technique were more females show interest to the small incisions and cosmetic appearance.

Antonio Lio (2016)[3] reported a female predominance of 68.2% of his study. 54% of the patients were females in the minimally invasive group in the study by **Joseph Lamelas** [4].

c) BSA:

The mean BSA (kg/m2) in our study in group A was 27.77 ± 1.85 while in group B the mean was 27.67 ± 1.52.

This BSA was matching with the sizes of implanted prosthesis to avoid patient prothesis mismatch in both groups with no statistical significance difference.

This was similar to that reported by **Dong Zhao (2019)**[5] who reported a mean BSA of 4.1% for RT group and 11 % for FS group

2. **Clinical Picture:**

A) DM:

Regarding diabetes, A total of 7 of the 60 patients in our study had **Diabetes mellitus**. Those were 3 patients (10.0%) in group A compared to 4 patients (13.3% in group B. (no statistical significance) This was considered higher than the disease burden in the general population. Which was not reflected on postoperative sternal wound infections in both groups.

Dong Zhao (2019)[5] in his study reported 40% to be diabetic.

Similarly, **Michael Seitz (2017)** [6] in his study of Minimally Invasive Aortic Valve Replacement **A** reported DM at 18.9% RAMT and 17.0% in the sternotomy group.

b) Cardinal symptom:

Regarding the clinical presentation, the main symptom was Dyspnea on exertion with the majority of patients NYHAA class II-III, showing **Class II** (33.3%) in group A and (23.3%) in Group B. **Class III**: showing (66.7%) in group A and (76.7%) in group B. There was no statistical significance between either group in our study.

Gloria Faerber [7] who had right mini thoracotomy for aortic plus mitral with or without tricuspid valve surgery also reported 20% of patients were class I-II in the RMT group while in sternotomy group were 23% of patients and class III- IV patients were 80% in RMT and 77% in sternotomy group.

c) Rhythm Disturbance

Chronic AF, considered the most common rhythm disturbance in patients with aortic and mitral valve pathology, was present with total of 14 patients: 6 patients from group A (20.0%) and 8 of group B (26.7%) (p value = 0.542, no statistical significance).

Antonio Lio[3] reported AF in 11.6 % of patients in his study, while **Gloria Faerber 2020** [7] in her study on the prevalence of AF in double valve patients reported a value as high as 44%. This is mainly due to the much higher mean age in his study (82 years) which is a known factor for increased incidence of AF specially in aortic stenosis.

3. **Echocardiographic Findings**

Contractility

Regarding the LV Ejection Fraction in our study the mean value in group A was (53.07 ± 3.82) while in group B was (52.93 ± 2.86) (no statistical significance across both groups).

Similarly, **Gloria Faerber 2020** [7] reported an EF of 60 ± 10 in the RMT group and 53 ± 15 in FS group. **Fernando A. Atik**[8] reported a mean EF of 55 ± 9.4 in the less invasive group and 50 ±14 in conventional group.

In our study, we have deliberately excluded patients with preoperatively depressed EF to eliminate the effect of this factor on early outcomes. In addition patients undergoing minimally invasive techniques are generally selected with good EF.

Valve pathology in group A percentage of rheumatic valve pathology was 93.3% while degenerative valve 6.7%, in group B percentage of rheumatic valve pathology was 90.0% while degenerative valve 10.0% (no statistical significance across both groups)

On a study of **Joseph Lamelas** 2014 [4] 29.7 % of patients had functional mitral regurgitation, 48.9% had Rheumatic aortic with mitral valve pathology, 2.4 % Radiation induced aortic stenosis and mitral regurgitation, 5.5 % with myxomatous degeneration of mitral valve, and 13.5 % had regurgitation from previous endocarditis. The average age (73 years old) might be a contributing factor to the prevalence of functional mitral regurgitation (29.7%). The higher percentage of females (54%) could be related to the higher prevalence of rheumatic aortic valve disease with mitral valve involvement (48.9%).

While **Lishan Aklog 1998** [9] most of patient 78% had Myxomatous degeneration of mitral valve due to the much higher mean age in his study and only 14% had rheumatic disease, 5%, 2% and 1% Endocarditis, Congenital, Ischemic respectively.

Evaluation of Operative data

1) **Valve Characteristics:**

In our study all cases in both groups underwent aortic valve replacement Concomitant mitral valve replacement was performed in 24 cases (80%) of **group A** and in 23 cases (76.7%) of **group B**, while mitral valve repair was undertaken in 6 cases (20%) of **group A** and in 7 cases (23.3%) of **group B**.

A study by **Priyanka Gosain** 2016 [10] reported a similar result in a study included 569 patients Mitral valve replacement 27 %, Mitral valve repair 27 %, aortic valve replacement 32.8 %,Aortic valve repair 0.3 %, Mitral valve repair + aortic valve replacement 8.9 % and Mitral valve replacement + aortic valve replacement 4%

On other hand, a study of **Dong Zhao 2016** [5] in his study for 98 cases in RT group and 828 cases in FS group reported AVR + MVR for RT 49 patients for RT group (50.0%) and FS group 322 (38.9%), AVR + MVP 10 patients for RT group (10.2%)

and 6 patients in FS group (0.7%) AVR + MVR + TVP 30 patients for RT group (30.6%) 359 patients in FS group (43.4%) and AVR + MVP + TVP 9 patients for RT group (9.2%) 141 patients in FS group (17.0%) with a (P value < 0.001) there was statistical difference between groups.

We conclude that the minimally invasive approach did not preclude mitral repair when indicated.

2) Intraoperative timings:

Ischemia (cross-clamp) time was slightly longer in group A with a mean time of 134.23 minutes ± 8.14 while in group B the mean ischemia time was 131.77 minutes ± 4.92 showing no statistical significance across both groups (p value = 0.162)

Bypass time in group A with a mean time of 180.60 ± 7.38 minutes compared to 177.53 ± 4.15 minutes in group B. Again, these values were no statistically significant across both groups (p value = 0.053)

Total operative time in group A was 284.57 ± 4.65 minutes which showing no statistically significance compared to a mean value of 282.70± 3.65minutes in group B (p value = 0.089)

Similar a study of **Dong Zhao 2016** [5] Operative data showed Bypass time (minutes) (112.2 ± 13.1) in RT group, (102.8 ± 12.5) in FS group with P value < 0.001. Aortic cross clamp time (minutes) 79.4 ± 11.6 in RT group, (72.4 ± 11.75) in FS group P value < 0.001. Operation time (hours) (4.0 ± 0.3) in RT group, (4.1 ± 0.4 5) in FS group P =0.017.

A similar study by **Joseph Lamelas** 2015[4] The median aortic cross clamp and cardiopulmonary bypass times were 116 minutes [interquartile range (IQR), 91-138] and 145 minutes (IQR, 121-178), respectively.

While, **Bakir et al** 2007 [11] in his study revealed that the minimal access group had reduced aortic cross-clamp and cardiopulmonary bypass times compared with conventional group: 61.8 ±16.6 vs. 69.5 ± 16.6 min (*P*-0.05) and 88.8"23.2 vs. 100.2 ± 22.6 min (*P*-0.05), respectively.

A study done by **Ehab Mojammed Kasem 2022** [12] Ischemic and total bypass times were significantly longer in ministernotomy group (64.4 minutes vs. 48.08 minutes and 83.61 minutes vs. 66.97 minutes respectively).

On other hand a study by **Gloria Faerber** 2020 [7] had a study of 25 cases done by RMT and 239 done by sternotomy method OP duration (min) 230 ±45 for RMT group, 214 ± 52 for sternotomy group with P value = 0.015. CPB time (min) 181 ± 38 for RMT group. 137 ± 36 for sternotomy group with P value <0.001. Cross-clamp time (min) 106 ± 28 for RMT group. 95 ± 26 for sternotomy group with P value = 0.005

There were no differences in total duration of surgery and cross-clamp time between RMT and sternotomy groups, but RMT patients had longer CPB time. may be a result of taking the patient earlier on CPB for setting the operative field including opening the pericardium, setting up the operative field, and introducing the vent and cardioplegia lines.

Masiello et al. in 2002[11] analyzed retrospectively 200 patients of whom 100 received ministernotomy approach. Operating times were significantly longer in the ministernotomy group (*P*<0.001).

Evaluation of Postoperative Data

Duration of respiratory support and ICU stay

Mechanical Ventilation: The duration of mechanical ventilation was significantly shorter in group A with a mean value of 4.52 ± 0.49 hours while in group B the mean duration was 6.09 ± 0.34 hours showing a statistical significance across both groups (p value = 0.001)

Regarding Inotropic support, of the 30 patients in group A that required inotropic support the mean duration in hours was 12.20 ± 1.49 compared to 11.73 ± 1.36 hours in group B, no statistically significant duration of support in the postoperative period (p values = 0.211).

Considering the total ICU stay in days, group A showed a mean value of 3.07 ± 0.83 days while in group B the duration of ICU stay was longer with a mean value of 3.50 ± 1.03 days, which was no statistically significant (p value =0.074).

Considering the total Hospital stay (days), group A showed a mean value of 7.93 ± 1.41 days while in group B the duration of Hospital stay was longer with a mean value of 11.03± 2.33 days, which was statistically significant (p value < 0.001). which is consistent with the advantages of minimally invasive techniques.

A study done **by Ehab Mohammed Kasem 2022** [12] Duration of mechanical ventilation was significantly shorter in group I: mean 8.04 vs. 10.48 hours. Mini sternotomy group had shorter ICU and total hospital stay.

A similar study by **Gloria Faerber 2020** [7] had a study of 25 cases done by RMT and 239 done by sternotomy method Mechanical ventilation (h) (6 ± 3.2 hours) for RMT group (4.2 ± 1.4 hours) for sternotomy method with P value = 0.022. Hospital stay (d) 16 ±6 RMT group 20 ± 14 for sternotomy method with P value = 0.461

Same as **Antonio Lio 2016** [3] Intensive care unit stay, days (median, IQR) 1 (1–2) Hospital stay, days (median, IQR) 6 (5–8)

On other hand a study of **Dong Zhao 2016** [5] showed Prolonged mechanical ventilation 16 (17.6%) for RT group 10 (11.0%) for sternotomy group with P =0.204, Re-intubation 2 (2.2%) for RT group 3 (3.3%) for sternotomy group with P= 1.000

Blood loss and blood products

We also observed an increase in chest tube drainage in group B compared to group A (238.67 ± 85.08 ml and 356.87 ± 97.94 ml respectively) which was significant despite both groups having acceptable post-operative values.

This, however, was also reflected in the increased need for blood products in group B (1.90 ± 0.71 units per patient) compared to group A (1.33 ± 0.48 units per patient). Since blood transfusion is associated with increased risk of major infection, reduced transfusion requirement may be associated with lower morbidity, utilization of health care resources and care quality. This has been also shown in the most studies addressing minimally invasive approaches due to smaller incisional area.

Early Outcome and Complications

There was no statistical significance between both groups in our study regarding operative mortality or complications.

Morbidities:

In group B, we observed an increased incidence of: Bleeding requiring re-exploration. Post-operative infections were more in group B 13.3% compared to 3.3% for group A. Cerebrovascular stroke (3.3% in group A compared to 6.7% in group B). This was attributed to the increased operative timings and associated coagulopathy, the increased requirement for blood products as well as the prolonged duration of mechanical ventilation and ICU stay. Only one patient in group B required permanent pacemaker insertion.

Mortality:

Only one operative mortality occurred in each group due to profound low cardiac output syndrome resistant to maximal inotropic support and intra-aortic balloon pulsations.

A similar study by **Joseph Lamelas** 2015[4] There were 4 (2.36%) patients that required re-operation for bleeding, and 2 (1.18%) suffered cerebrovascular accidents. The median hospital length of stay was 7 days (IQR, 6-12), and the 30-day mortality was 6 (3.55%).

Same as Antonio Lio 2016 [3] postoperatively, no patient died; 3 patients required placement of a permanent pacemaker. Conversion to full sternotomy was required in 1 case, due to bleeding from the ascending Aorta.

A study of **Dong Zhao 2016** [5] showed:

- Surgical mortality 1 (1.1%) for RT group 2 (2.2%) for sternotomy group with P value = 1.000
- Low cardiac output 3 (3.3%) for RT group 6 (6.6%) for sternotomy group with P= 0.497
- New onset of AF 10 (11.0%) for RT group 23 (25.3%) for sternotomy group with P =0.012
- Acute renal failure 1 (1.1%) for RT group 3 (3.3%) for sternotomy group with P =0.621
- Stroke 1 (1.1%) for RT group 2 (2.2%) for sternotomy group with P =1.000
- Re-operation for bleeding 1 (1.1%) for RT group 2 (2.2%) for sternotomy group with P =1.000
- Wound infection 1 (1.1%) for RT group 3 (3.3%) for sternotomy group with P= 0.621
- Total amount of drainage (mL) 477.6 ± 82.5 for RT group 863.1 ± 109.2 for sternotomy group with P < 0.001
- Red cell transfusion 16 (17.6%) for RT group 34 (37.4%) for sternotomy group with P= 0.003

Bakir et al., (2007) [11] 506 patients: 232 ministernotomy, 274 median sternotomy Early mortality was 2.6% (6 patients) in ministernotomy group and 4.4% (12 patients) in median sternotomy group.

Sharony et al., (2004)[11] 921 consecutive patients underwent isolated AVR; 438 of these had minimally invasive AVR (MIAVR) Hospital mortality and major morbidity were similar in the MIAVR and SS groups: 5.6% vs. 7.3% (*P*=0.45) and 13.3% vs. 14.2% (*P*=0.79), respectively.

Eugene A. Gross [16] The hospital mortality was 1.0% for the sternotomy and 0.0% for the minimally invasive approach. Permanent neurologic perioperative events occurred in 1.0% of patients undergoing sternotomy and 2.0% of the patients undergoing the minimally invasive approach. hospital morbidity was 88% for the sternotomy approach group and 91% for the minimally invasive approach group (*P* =.49)

6. CONCLUSION

We conclude that, combined aortic and mitral valve surgery through upper partial sternotomy with approaching the mitral valve through the dome of the left atrium is safe and effective with the advantages of less postoperative blood loss, need for blood transfusion, and mechanical ventilation time compared with conventional aortic and mitral valve surgeries through full median sternotomy.

REFERENCES

[1] Gundry, S. R., Shattuck, O. H., Razzouk, A. J., Del Rio, M. J., Sardari, F. F., & Bailey, L. L. (1998). Facile minimally invasive cardiac surgery via ministernotomy. The Annals of thoracic surgery, 65(4), 1100-1104.

[2] Murzi, M., Cerillo, A. G., Bevilacqua, S., Gilmanov, D., Farneti, P., & Glauber, M. (2012). Traversing the learning curve in minimally invasive heart valve surgery: a cumulative analysis of an individual surgeon's experience with a right minithoracotomy approach for aortic valve replacement. European journal of cardio-thoracic surgery, 41(6), 1242-1246.

[3] Lio, A., Miceli, A., Ferrarini, M., & Glauber, M. (2016). Minimally invasive approach for aortic and mitral valve surgery. European Journal of Cardio-Thoracic Surgery, 50(6), 1204-1205.

[4] Lamelas, J. (2015). Minimally invasive concomitant aortic and mitral valve surgery: the “Miami Method”. Annals of Cardiothoracic Surgery, 4(1), 33.

[5] Zhao, D., Wei, L., Zhu, S., Zhang, Z., Liu, H., Yang, Y., ... & Wang, C. (2019). Combined mitral and aortic valve procedure via right mini-thoracotomy versus full median sternotomy insights from a single-center study of propensity-matched data. International Heart Journal, 60(2), 336-344.

[6] Seitz, M., Goldblatt, J., Paul, E., Marcus, T., Larobina, M., & Yap, C. H. (2019). Minimally invasive aortic valve replacement via right anterior mini-thoracotomy: propensity matched initial experience. Heart, Lung and Circulation, 28(2), 320-326.

[7] Faerber, G., Tkebuchava, S., Scherag, A., Bley, M., Kirov, H., Diab, M., & Doenst, T. (2022). Right mini-thoracotomy for aortic plus mitral with or without tricuspid valve surgery. The Thoracic and Cardiovascular Surgeon, 70(03), 174-181.

[8] Atik, F. A., Svensson, L. G., Blackstone, E. H., Gillinov, A. M., Rajeswaran, J., & Lytle, B. W. (2011). Less invasive versus conventional double-valve surgery: a propensity-matched comparison. The Journal of Thoracic and Cardiovascular Surgery, 141(6), 1461-1468.

[9] Aklog, L., Adams, D. H., Couper, G. S., Gobezie, R., Sears, S., & Cohn, L. H. (1998). Techniques and results of direct-access minimally invasive mitral valve surgery: a paradigm for the future. The Journal of Thoracic and Cardiovascular Surgery, 116(5), 705-715.

[10] Gosain, P., Larrauri-Reyes, M., Mihos, C. G., Escolar, E., & Santana, O. (2016). Aortic and/or mitral valve surgery in patients with pulmonary hypertension performed via a minimally invasive approach. Interactive CardioVascular and Thoracic Surgery, 22(5), 668-670.

[11] Scarci, M., Young, C., & Fallouh, H. (2009). Is ministernotomy superior to conventional approach for aortic valve replacement?. Interactive CardioVascular and Thoracic Surgery, 9(2), 314-317.

[12] Kassem, E., Refat, A., Salem, A., & Eldib, O. S. (2022). Aortic valve replacement: J-shaped upper sternotomy versus conventional sternotomy. Zagazig University Medical Journal, 28(2), 315-319.