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Right Minithoracotomy Versus Upper Mini-Sternotomy in Minimally Invasive Aortic Valve Replacement Surgeries

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Abstract

Background: 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. Potential advantages of minimally invasive aortic valve replacement (MIAVR) arise from the concept that patient morbidity and potential mortality could be reduced without compromising the excellent results of the conventional procedure which include improved cosmetic results, safer access in the case of re-operation, less post-operative bleeding, fewer blood transfusions, lower intensive care unit and in-hospital stays.

Aim of Study: To compare intraoperative and immediate postoperative outcomes of mini-sternotomy versus mini-thoracotomy as less invasive techniques in patients with isolated aortic valve disease requiring surgery according to inclusion criteria.

Patients and Methods: Fifty patients with aortic valve disease randomized into two equal groups; group "A" underwent aortic valve surgery through a minimally invasivemini-sternotomy. Group "B" underwent aortic valve surgery through right anterior thoracotomy. The Pain was evaluated on first, second and fifth day post-operatively. Echo-cardiographic data were performed pre-operatively and at the 3rd month after discharge in all patients. Aortic and double stage venous canulationwith antegrade blood cardioplegia was adopted in group"A", while in group "B" aorto-femoral and fem-fem arterial and venous cannulation was adopted with antegrade blood cardioplegia.

Results: There was no statistical difference between the two groups pre-operatively regarding their age, sex, NYHA class, echo data and spirometric study. There was one case of mortality in mini-sternotomy group Few post-operative complications occurred in both groups. Total hospital stay, ICU stay, post-operative bleeding, inotropic requirement, ventilatory support, blood transfusion was less in group "B" mini-thoracotomy group, with better cosmetic appearance, more cost effective.

Conclusion: Right mini-thoracotomy minimally invasive technique for aortic valve replacement provides excellent exposure of the aortic valve and offers a better cosmetic scar. In addition, minimally invasive right mini-thoracotomy is as safe as mini-sternotomy for aortic valve surgery, with fewer complications and post-operative pain, less ICU and hospital stay, fast recovery to work with limited movement restriction after surgery. However using mini-sternotomy approach decrease cardiopulmonary bypass (CBP) time.

Key Words: *Minimally invasive — Right mini-thoracotomy — Median sternotomy — Aortic valve surgery.*

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Introduction

AORTIC valve disease is the most common valvular heart disease in developed countries and its incidence is likely to increase with age and rheumatic heart disease [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].

The Mini sternotomy (MS) approach represents the most common technique used for Minimally invasive AVR. The MS approach is achieved through 6 to 10cm midline vertical skin incision, performing a partial J sternotomy at the third to fifth intercostal space [5].

MIAVR via right mini thoracotomy (RT) is performed through five to seven 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.

All patients scheduled for RT should undergo computed tomography scan without contrast enhancement to evaluate the anatomic relationship among the intercostal spaces, ascending aorta, and aortic valve [3].

Aim of the work:

To compare intraoperative and immediate postoperative outcomes of mini-sternotomy versus mini-thoracotomy as less invasive techniques in patients with isolated aortic valve disease requiring surgery according to inclusion criteria.

Patients and Methods

It is comparative prospective cohort study, our study was conducted on (50) patients who are planned to undergo isolated aortic valve replacement at cardiothoracic surgery department in Ain Shams University hospital and Armed Forces hospitals in the duration between January 2020 to December 2021. Patients criteria suited the minimally invasive approach for AVR. Theywill be divided into two groups: First one will include (25) patients who will have AVR viamini-sternotomy, group 2 will include (25) patients who will undergo AVR via Rt anterior Thoracotomy approach.

Inclusion criteria:

Patients with isolated Aortic valve disease, both sexes included withacceptance of patients to participate in this study and approval of Ethical Committee.

Exclusion criteria:

Concomitant aortic valve plus other cardiac procedure, patients with redo-surgery, patients' refusal to be included in the study, patients with infective endocarditis on the Aortic valve with potential formation of Aortic root abscess, patients with dilated Aortic root or ascending Aorta, patients with chest wall deformity like marked pectus excavatum or carinatum due to expected difficulty in accessing the Aortic valve from the mini-incisions, patients with significant co-morbidities such as chronic kidney disease with EGFR less than 90 and elevated liver enzymes above normal or neurological insult.

Study Methods:

All patients were subjected to the following:

Pre-operatively:

History taking, clinical examination, full laboratory investigations, electrocardiogram (ECG), radiological examination, echocardiography and respiratory function tests (RFTs).

Pre-operative preparation:

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 0.03-0.07mg/Kg midazolam

Intra-operative procedures:

Anesthetic technique:

The intra-operative anesthetic technique was the same for all patients with some difference in (group A) and consisted of a 20-gauge non-dominant radial artery cannula was inserted using local anesthesia. Insertion of Two gray peripheral venous cannula, Monitoring started using three leads ECG, then Fentanyl 5-10p g/Kg, and endotracheal intubation was facilitated with the use of Pancuronium 0.02mg/Kg and a supplemented hypnotic does of propofol 0.5-1mg/Kg. Additional dose of Fentanyl 100-200p g was given in an on need bases. After full muscle relaxation, the trachea was intubated orally with an appropriate sized endotracheal tube. Anesthesia in all patients was maintained with inhalational Isuflorane 0.5-1.0%.

After induction, a triple lumen (7.0 or 8.5 Fr) central venous catheter plus a single lumen percutaneous sheath (8.5 Fr) were inserted into the right internal jugular vein. A urethral catheter was also inserted. TOE in minimally invasive cases was a mandatory step manipulated by the anesthetist.

Surgical technique:

- Group "A" (ministernotomy group):

Our technique for ministernotomy started with incision 2cm below the suprasternal notch extending down to level of 4th interspace. The sternum was incised by the ordinary saw in the midline till the 4th interspace where the incision was extended to the right in a J- shaped fashion sparing the right internal mammary artery. In all patients arterial cannulation was performed in distal ascending aorta and venous cannulation was through appendage of right atrium. Ante grade warm cardioplegia was used for myocardial protection in all patients. Exposure of the aortic valve is facilitated by traction sutures taken in the edges of the aortotomy as well as the commissures of the valve.

The following data were recorded for intraoperative statistical analysis: Length of skin incision in both groups, exposure of aortic valve, weaning from bypass, aortic cross clamp time: This is the ischemic time recorded from applying the aortic clamp until removal of the clamp.

Total bypass time: This is the time from initiating the cardiopulmonary bypass until weaning from the cardiopulmonary bypass. Total operation time: This is the time calculated from the beginning of the skin incision to the end of skin closure. Conversion to median sternotomy in group A.

- Group "B" (Right anterior Mini-thoracotomy group).

Anesthesia and patient preparation:

The procedure is performed in a standard operating room with each team member positioned according to existing protocols for conventional aortic valve surgery. Two percutaneous sheath introducers are placed in the jugular vein. A standard 3-lumen (7.0 or 8.5 Fr) venous introducer is used for drug administration and central venous pressure monitoring. Another percutaneous sheath (8.5 Fr) introducer is placed in the same right jugular vein for eventual insertion of endocavitary pacemaker leads, when necessary.

Two defibrillator pads are placed across the chest wall with the right pad placed under the patient's right shoulder and left pad over the anterior left chest wall. Attention is paid to these pads after skin preparation when occasionally the pads may be detached from the skin in case of very abundant application of antiseptic solutions. The patient is placed in a supine position (Fig. 2).

Transesophageal echocardiography (TOE) is used for assessment of aortic valve and cardiac function, ventricular filling, intra-cardiac air, and peripheral venous cannula insertion. Afterward, the patient's skin is prepared with antiseptic solutions according to intra-operative protocol.

The patient is draped exposing the anterior and right lateral chest wall and both groin areas. An adhesive aseptic strip is then applied to the exposed areas, thus, minimizing the possible risk of contamination. It may also be important to mark the incision site with a pen prior to this preparation.

Femoral cannulation:

A transverse 3-4cm incision along the inguinal fold over the pulsating femoral artery is made to expose the vessels. Limited dissection and exposure of the anterior aspect of the femoral vessels is recommended. Purse string sutures with proline 5/0 taken over the artery and vein. When heparin is administered, femoral artery and vein cannulation are performed utilizing a Seldinger technique. We perform arterial cannulation first; the cannula should never be forced and should advance easily. The cannula is then secured over the vessel with a tourniquet and connected to the CPB arterial line (Fig. 1).

Insert femoral venous guidewire from the femoral vein into the superior vena cava (SVC) under visualization with the TEE probe adjusted to a bicaval view. Verify wire location in SVC prior to passing cannula is very important. With the guidewire held in place, the introducer sheath is removed. The venous cannula is then advanced into the femoral vein and positioned so that the tip of a double-stage cannula is above the cavo-atrial junction in the superior vena cava. The guidewire is slowly withdrawn while holding the cannula in place. The venous cannula is then de-aired by partially unclamping and expelling blood and any residual air from the lumen before connecting to the venous line of the CPB circuit. One silk stay suture is placed on the skin as a tourniquet over the cannula body to fix it in place and prevent dislodgement (Fig. 2).

Incision and exposure:

We make a 5-6cm skin incision beginning at the right sternal border extending to the right antero-lateral portion of the chest wall. the pectoralis muscle is cauterized followed by the intercostals muscle entering into the 2nd or 3rd ICS. Identify the RIMA and vein, ligate with one clip proximally and one clip distally. The costo-chondral rib junction, usually of the inferior rib is divided then transect and dislocate the rib but (we don't resect the rib). We use a soft tissue retractor and rib retractor to obtain further exposure (in thin patients we may use only rib retractor without the need for soft tissue retractor) (Figs. 3,4).

Attention should be paid to meticulous hemostasis at this point as it appears to be much easier to identify and cauterize any oozing vessels at this point in the procedure than prior to thoracotomy closure when many of these vessels may become "silent" and are not always easily recognizable during hemostasis of the incision site before closure.

Excess pericardial fat is removed from the pericardium, being careful not to injure the phrenic nerve. We open the pericardium over the aorta. It is important not to cut the pericardium completely up to its attachment to the aorta superiorly (The pericardium is opened over the ascending aorta and the pericardium is pulled up greatly improving aortic exposure). This will prevent utilizing the pericardium to help elevate the aorta for additional exposure. Tack all pericardial sutures to the skin. Use as many sutures as needed to obtain adequate exposure.

We resect the aortic valve leaflets and debride any remaining calcium using rongeur in one hand and suction in the other. We place valve sutures circumferentially around the annulus of the valve then we size the valve. We place sutures through the sewing ring and seat the valve in position then we tie the suture beginning with the left coronary annulus, proceeding to the right, and then to the non-coronary annulus. Most of the annulus should be tied with a knot pusher. If feasible and comfortable, tie manually. Avoid tension when tying manually which may lead to a tear in the annulus and a paravalvular leak and visualize each knot prior to transecting suture.

After finishing the procedure, close the aortotomy using a mattress closure as first layer and a continuous over-and-over suture line as second layer. It is important to be very meticulous with the left lateral aspect of the suture line since this will be difficult to visualize once the cross-clamp is removed. Stop LV venting as the aortotomy closure is being completed. Place a single RV pacing wire (it's difficult to put it after go off bypass when the heart is filled) and tunnel it out the anterior chest wall via the left para-sternal space then Place a skin grounding wire.

We place the patient in Trendelenburg position, vent the aortic root, fill the heart and ventilate the lungs to aggressively de-air the left ventricle and aorta then we remove the cross clamp and defibrillate the heart as needed utilizing the defibrillations patches. Once the heart is beating we begin ventilation. TEE is used to assess the presence of intra-cardiac air and to determine when it is completely evacuated. When the patient was fully rewarmed and cardiac function restored, we wean the patient from cardiopulmonary bypass. The pericardial retraction sutures should be released before coming off cardiopulmonary bypass. After 50% of protamine is given, remove femoral venous cannula and tie the purse string. Give the remaining protamine, remove arterial cannula, tie the purse string and the groin incision usually closed in a standard fashion.

In the majority of cases postoperatively, the bleeding comes from the chest wall, thus careful hemostasis is crucial and must be checked before chest closure; a dental mirror may be useful tools for this purpose. When the hemostasis is secured, two 28 Fr chest Blake @ silicone drains are placed through the ports into the pericardium and right pleural space (Fig. 5).

Post-operative evaluation of both groups:

All patients were evaluated thoroughly during their intensive care unit stay and during their hospital stay.

Intensive care unit evaluation:

Weaning of mechanical ventilation was done gradually using continuous positive airway pressure (CPAP) and pressure support (10-15cm H2O) modes. Ventilatory support was gradually reducedat a rate of 1-2cm H2O CPAP and pressure support (PS) decrements. Patients were considered candidates for weaning when the following criteria were obtained: Full recovery of sensation, adequate minute ventilation, good arterial blood gas and acid base results, CPAP of 5cm H2O and pressure support of 5cm H2O, fractional inspired oxygen concentration (Fi 02) of 40%, hemodynamic support (medical support) with or without minimal inotropic support, minimal drainage from the chest tubes.

Post-operative evaluation:

Post-operative course follows-up divided into three parts immediate or early post-operative while the patients were still in the hospital, three months and follow-up.

Patients were evaluated after surgery by the following:

Post-operative blood loss during the ICU stay and till the chest tubes were removed was calculated in both groups, total intensive care unit stay, ICU Morbidities (DVT, fever, arrhythmias, other morbidities), chest X-ray: Postero-anterior view, RFTs: Spirometric study was done post-operatively 3 months after discharge from the intensive care unit. The same parametersmeasured pre-operatively are repeated, echo-cardiography; at 3months post-operatively, pain score: Measured 5th day postoperatively, at 3rd months post-operatively by using the VAS, other complications: were also evaluated in both groups e.g. Wound infection, pleural collection, phrenic nerve injury, pericardial effusion, lung collapse, developed arrhythmias, wound sequalea, patient's satisfaction, total hospital stay: The total hospital stay was calculated in bothgroups.

Outpatient follows-up:

Outpatient clinic follow upwas three months post-operatively for echo-cardiographic data, wound sequalae, pain, patient satisfaction, plain chest X-ray. PFTs only compared after 3 months.

Cost effectiveness:

Here we evaluate the patient benefits and the operative financial cost, the end overall cost-effective. The following data were recorded for statistical analysis: Respiratory function tests, echo-cardiographic data, plain chest X-ray, wound sequalae, patient satisfaction, pain score, total hospital stay, cost effective.

Data management and analysis:

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 25). Data was presented and suitable analysis was done according to the type of data obtained for each parameter. $p>0.05$: Non significant (NS), $p<0.05$: Significant (S).

Fig. (1): Exposure of femoral vessels.

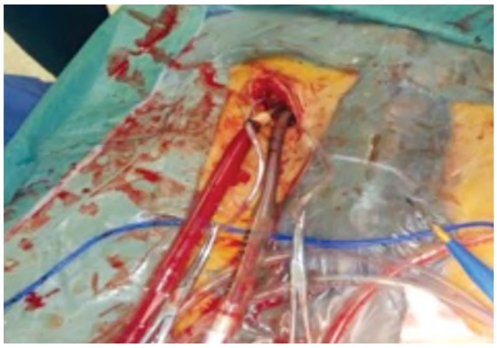

Fig. (2): Cannulation of both femoral artery and vein.

Fig. (3): Using soft tissue retractor.

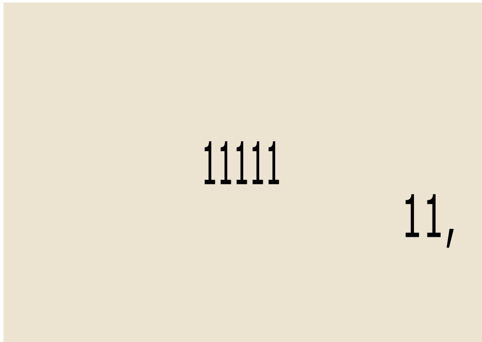

Fig. (4): Using the multiuse retractor without soft tissue retractor only in thin patients.

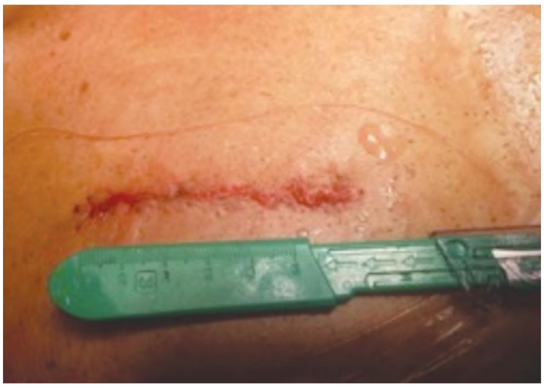

Fig. (5): Length of the wound.

Results

By comparing both groups, we did not find statistically significant difference between them regarding age, gender, BMI, NYHA, Smoking, HTN and DM ($p>0.05$).

Table (2) showing that Pre-operative ECHO findings between two studied groups as illustrated in Table (2); showed no statistically significant difference between both groups for pathology ($p>0.05$) however, the mean pathology regurgitation (28% and 56%), stenosis (52% and 32%) and Mixed (20% and 12%) for Ministernotomy group and Right anterior minithoracotomy group respectively.

There was no statistically significant difference between groups for EF% (55.76±6.31% and 54.36 ±5.14%), LVEDD (5.72 ± 0.67 and 6.08±0.63) cm and LVESD (4.26 0.75 and 4.64±0.75) cm for Ministernotomy group and Right anterior minithoracotomy group respectively.

There was statistically significant higher Mean gradient across aortic valve in Ministernotomy group 32.48±16.75 mmhg than in Right anterior minithoracotomy group 21.04±17.12 mmhg *(p=* 0.021).

Intra-operative data between two groups showing highly statistically significant lower cross clamp in ministernotomy group (60.8±4.68) min than right anterior minithoracotomy group (85.32±5.62) mins, also lower total bypass in ministernotomy group (86.08±4.46) mins than right anterior minithoracotomy group (114.2±5.87) mins and for operation time ministernotomy group showed statistically significant lower time (187.16±8.56) mins than right anterior minithoracotomy group (244.72±12.36) min

However, for wound length; statistically significant higher length was found in Ministernotomy group 5.76±0.72cm than right anterior minithoracotomy group 5.16±0.55cm.

Table (1): Demographic data between two studied groups.

	Group		Test of significance	
	Mini-sternotomy group	Right anterior minithoracotomy group		
	Mean ± SD N (%)	Mean ± SD N (%)	P- value	Sig.
Age	5332±11.06	52.28±12.26	0354(T)	NS
Sex:				
Male	16 (64%)	21 (84%)	0.107(C)	NS
Female	9 (36%)	4 (16%)		
BMI	24.12±1.42	23.85±0.73	0.400(T)	NS
NYHA:				
2	8 (32%)	9 (36%)	0.86(F)	NS
3	14 (56%)	12 (48%)		
4	3 (12%)	4 (16%)		
Smoking:				
No	13 (52%)	14 (56%)	0.777(C)	NS
Yes	12 (48%)	11 (44%)		
HTN:				
No	10 (40%)	11 (44%)	0.774(C)	NS
Yes	15 (60%)	14 (56%)		
DM:				
No	20 (80%)	20 (80%)	1DO(C)	NS
Yes	5 (20%)	5 (20%)		

M Student t-test.
(C) Chi-Square test.
(F) Fisher's Exact test.

Table (2): Pre-operative ECHO findings between two studied groups.

	Group		Test of significance	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean ± SD N (%)	Mean ± SD N (%)	P- value	Sig.
Pathology:				
Regurge	7 (28%)	14 (56%)	0.165(F)	NS
Stenosis	13 (52%)	8 (32%)		
Mixed	5 (20%)	3 (12%)		
EF %	55.76±631	5436±5.14	0 394M	NS
LVEDD (cm)	5.72±0.67	6.08±0.63	0.053M	NS
LVESD (cm)	4.26±0.75	4.64±0.75	0.079M	NS
Mean gradient across aortic valve (mmhg)	32.48±16.75	21.04±17.12	0.021 M	S

(F) Fisher's Exact test.
M Student t-test.

Table (3): Intra-operative data between two studied groups.

	Group		Test of significance	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean ± SD	Mean ± SD	P- value	Sig.
Cross clamp (mins)	60.8±4.68	8532±5.62	<0D01(F)	S
Total bypass (mins)	86.08±4.46	114.2±5.87	<0.001(T)	S
Operation time (mins)	187 .16±8.56	244.72±12.36	<0.001(T)	S
Valve size	21.16±1.4	21.16±1.4	1.00M	NS
Valve type:				
Mechanical	24 (96%)	24 (96%)	1.00M	NS
Tissue	1 (4%)	1 (4%)		
Wound length (cm)	5.76±0.72	5.16±0.55	0.002M	S

(T) Student t-test. (F) Fisher's Exact test.

Regarding valve type; no statistically significant difference was found between both groups as we used mechanical type in majority of cases (96% in each group).

As shown in Table (4); for post-operative data; statistically significant higher blood loss was found in ministemotomy group (628±128.35) ml than right anterior minithoracotomy group (424±94.78) ml, in the same line higher statistically significant ventilator time and ICU stay was in ministemotomy group (4.92±2.52hr and 2±0 days) respectively than right anterior minithoracotomy group (3.28±0.74 hrs and 1.04±0.2 days respectively).

Table (4): Post-operative data between two studied groups.

	Group		Student t-test	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean ± SD	Mean ± SD	p-value	Sig.
Blood loss (ml)	628±12835	424±94.78	<0.001	S
Ventilator Time (hrs)	4.92±252	3.28±0.74	0.003	S
ICU stay (Days)	2±0	1.04±0.2	<0.001	S

Table (5) illustrated that there was statistically significant lower pain score in 1st and 2nd days for ministemotomy group than right anterior minithoracotomy group ($p<0.05$).

Regarding hospital stay, there was statistically significant higher ministemotomy group hospital stay than right anterior minithoracotomy group ($p<0.05$).

Statistically insignificant difference was reported between both groups for arrhythmia, wound infection, pulmonary complications and mortality (p>0.05).

Table (5): Post-operative follow-up and outcome between two studied groups.

	Group		Test of significance	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean±SD N (%)	*Mean*± SD N (%)	*P*- value	Sig.
Pain score:				
1st day	6.8±058	7 .2±0 .76	0.042(T)	S
2nd day	3.72±0.79	4 .44±0 .77	0.002(T)	S
5th day	2.12±0.53	2.12±053	1.00M	NS
Arrhythmia:				
No	24 (96%)	23 (92%)	1.00(F)	NS
Yes	1 (4%)	2 (8%)		
Wound infection:				
No	24 (96%)	24 (96%)	1.00(F)	NS
Yes	1 (4%)	1 (4%)		
Pulmonary complications:				
Atelectasis	1 (4%)	2 (8%)	1.00(9	NS
Pleural effusion	1 (4%)	1 (4%)	1.00(9	NS
Pneumonia	0 (0%)	0 (0%)		
Hospital stay (Days)	8.08±1.55	656±0.82	<0.001M	S
30 day mortality:				
No	24 (96%)	25 (100%)	1.00(9	NS
Yes	1 (4%)	0 (0%)		

Cr) Student t-test. (F) Fisher's Exact test.

The was statistically insignificant difference was found for Post-operative ECHO findings (Table 6).

Table (6): Post-operative ECHO findings between two studied groups.

	Group		Test of significance	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean ± SD	Mean ± SD	p-value	Sig.
EF %	55.64±6.12	54.28±4.97	0393(T)	NS
LVEDD (cm)	5.71±0.67	6.08±0.63	0.051(T)	NS
LVESD (cm)	4.26±0.76	4.63±0.75	0.086(T)	NS
Mean gradient across aortic valve (mmhg)	6.72±1.1	6.12±1.05	0.055(T)	NS
Paravalvular leak:				
No	24 (96%)	25 (100%)	1.00(F)	NS
Yes	1 (4%)	0 (0%)		
Pericardial effusion:				
No	23 (92%)	24 (96%)	1.00(F)	NS
Yes	2 (8%)	1 (4%)		

Cr) Student t-test. (F) Fisher's Exact test.

There was statistically significant lower cosmosis for ministernotomy group 68.4±6.73% than Right anterior minithoracotomy group 87.2±5.61% (Table 7).

Table (7): Cosmosis % between two studied groups.

	Group		Student t-test	
	Mini-sternotomy group	Right anterior mini-thoracotomy group		
	Mean ± SD	Mean ± SD	p-value	Sig.
Cosmosis %	68.4±6.73	87.2±5.61	<0.001	S

Discussion

Over the past 30 years, cardiac surgery has increasingly used minimally invasive procedures (MIC) with the aim of reducing surgical body trauma and achieving early recovery for the patient **[6].** The perioperative mortality rate in isolated aortic valve replacement (AVR) has decreased from 3.9 to 1.9% according to the database of the Society of Thoracic Surgeons (STS) **[7].** Various techniques for MIC-AVR have been established and further developed and compared to median sternotomy (MS) **[8].**

Compared with conventional full median sternotomy, less-invasive approaches reduce incision size and surgical trauma. It has been reported to reduce morbidity, accelerate recovery, and shorten hospital stay **[9],** with equally durable late outcome **[10].** Several incisions for minimally invasive cardiac surgery have been described: Parasternal incision, right mini-thoracotomy, and partial sternotomy.

In the present study, we aimed to compare intraoperative and immediate postoperative outcomes of mini-sternotomy versus mini-thoracotomy as less invasive techniques in patients with isolated aortic valve disease requiring surgery.

We conducted this study among two groups: The first group enrolled twenty-five patients who had AVR and were treated via right anterior thoracotomy, and group 2 included twenty-five patients who had AVR and were operated on via a mini-sternotomy approach.

In the current study, the patients mean age was 52.80±11.57 years old in harmony with study conducted in Egypt by Bala et al. [11].

However, lower mean age was found in Moursi and Al Fakharany **[12]** study in Egypt (mean age 48±11.2) and higher mean age was reported in Miceli et al. **[13]** study in Italy as their mean age was (67.2±12.8) as well as Bakhtiary et al. **[14]** study in Germany as mean age was (68.1±9.8).

This difference may contribute to the younger onset of cardiovascular valvular diseases in Egypt due to the higher incidence of rheumatic heart disease HTN, DM, and smoking in developing countries, including Egypt, than in developed countries; In our study, the cases were associated with many risk factors, such as HTN (58%), DM (20%), and smoking (46%), without a statistically significant difference between both groups.

In the present study, there was a male predominance, as 74% of cases were male.

In accordance with many studies as Miceli et al. [13], Bakhtiary et al. [14] and Shen et al. [15], but in differ with Bakr et al. [ill as there was equal distribution between males and females, This difference may be due to the lower sample size in their study.

Minimally invasive surgery has become a safe and successful treatment option with increased patient satisfaction as new technologies, surgical, and anesthetic techniques have improved. The most commonly used incisions in minimally invasive aortic valve replacement are ministernotomy and minithoracotomy [16].

In the present study; the intra-operative data between two groups showed highly statistically significant lower cross clamp time (60.8±4.68 vs 85.32± 5.62min), total bypass (86.08±4.46 vs 114.2±5.87 mins) and operation time (187.16±8.56 vs 244.72± 12.36mins) in ministernotomy group vs right anterior minithoracotomy group ($p<0.05$).

In agreement with Bakr et al. [ill as they found statistically significant lower cross clamp, total bypass, and operation time in mini-upper sternotomy than right anterior minithoracotomy and Mourad and Abd Al Jawad [17] who conducted a retrospective review of 260 patients who underwent mini-AVR, with 132 patients undergoing ministernotomy and 128 patients undergoing minithoracotomy; The mini-sternotomy technique had considerably shorter cross-clamp and total bypass times than the MT strategy.

In the same line other retrospective studies by Semsroth et al. [18] and Semsroth et al. [19] reported significantly longer CPB and cross-clamping time in the right anterior minithoracotomies compared to upper sternotomies group.

On opposite side Bakhtiary et al. [14] found cardiopulmonary bypass time, cross-clamp and operation time were significantly shorter in the right anterior mini-thoracotomy group than in the partial upper sternotomy group. Similar results have already been reported in other studies Miceli et al. [13] Mikus et al. [20], and Shen et al. [15].

The study of Olds et al. [21] enrolled 503 cases, 267 (53.1%) were mini-thoracotomy, 120 (23.8%) were mini-sternotomy, and 116 (23.1%) were conventional sternotomy; they found that the minithoracotomy approach showed decreased operative times besides other benefits in decreasing lengths of stay, decreased incidence of prolonged ventilator time, and a trend toward lower mortality when compared with ministernotomy and conventional sternotomy.

Bakhtiary et al. [14] illustrated that the operating times could be reduced by using a 3D camera, long surgical instruments, and an automated suture closure system Furthermore, operation is performed exclusively by surgeons with excellent surgical skills using minimally invasive surgery. Bakhtiary et al. [14] believe that effective and clear communication among the surgical team as well as a careful planning and preparation of the operation favors the reduction of operating times.

In our study, the wound length was statistically significantly shorter in the right anterior minithoracotomy group than in the ministernotomy group.

In parallel with Mourad and Abd Al Jawad [17] as the wounds in the minithoracotomy group were significantly shorter. However, no statistically significant difference was reported by Bakr et al. [ill but they also found shorter wound in right anterior minithoracotomy approach.

Regarding post-operative data, the present study found statistically significant lower blood loss, ventilator time, ICU stay, and hospital stay in the anterior minithoracotomy group than the ministernotomy group.

In consistence with Shen et al. [15] who discovered that right minithoracotomy group, was linked to a shorter hospital stay and lower transfusion rates and with Miceli et al. [13] reported the median intubation time was lh less in the RAMT group with significantly shorter intensive care and hospital stay.

Our findings were also in harmony with Bakr et al. [in as the hospital stay, ventilation time, and blood loss had better results in the right minithoracotomy group, than ministernotomy group but with no statistically significant difference between both groups.

Bakhtiary et al. [14] cohort, found the median intubation time in the right minithoracotomy group was 4h shorter with significantly shorter hospital stay than in the PUS group. The length of intensive care stay showed no significant difference in the groups.

The smaller incision, preservation of the sternum, and preservation of the costal cartilages would all help with breathing.

Reducing the length of hospital stay is an important aspect of resource use, since intensive care and hospital stays are the main determinants of cost after cardiac surgery.

There was statistically significant lower pain score in 1st and 2nd days for ministemotomy group than right anterior minithoracotomy group ($p<0.05$) in our study; in agreement with Mourad and Abd Al Jawad [17] who demonstrated that the ministernotomy group had substantially lower postoperative pain levels than the MT group.

Also our findings in the same line with Bala et al. [ill whereas in the upper-ministernotomy group, postoperative pain had better results. However, the difference was not significant.

There was statistically significant lower cosmosis for ministernotomy group than right anterior minithoracotomy group.

This finding was supported by Moursi and Al Fakharany [12] as they reported their early experience of AVR by upper ministernotomy and they found upper ministernotomy had benefits related to patients (cosmosis, rapid return to full activity, and reduced complications).

Regarding mortality, we found a statistically insignificant difference between groups ($p>0.05$).

Similarly Bakhtiary et al. [14] reported no significant differences in 30-day mortality (p.1.000) and 1-year mortality ($p=0.543$). Furthermore, Miceli et al. [13], Fattouch et al. [22] and Shen et al. [15] studies reported the same findings.

The trend for estimated survival after 4 years was better in the RAMT group compared to the PUS group (96.3% vs. 92.7%, log rank 0.169) as mentioned in Bakhtiary et al. [14] study.

Miceli et al. [13] also reported higher 1- and 5-year survival rates in the RAMT group than in the PUS group. However, Semsroth et al. [18], Semsroth et al. [19] described a trend toward better survival rates with sternotomy.

So further studies are needed with longer follow-up duration to study long term survival.

Conclusion:

In patients undergoing isolated AVR, the cross—clamping, total bypass, and total operative time are significantly decreased in the ministemotomy approach, which also lowers postoperative pain. On the other side, a right anterior minithoracotomy had a shorter wound length and lowered the requirement for blood transfusions, postoperative ventilation time, ICU stay, and hospital stay. Furthermore, right anterior minithoracotomy and upper-ministernotomy approaches have similar results regarding postoperative outcome and mortality without significant differences.

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مقارنة الشق الايمن للصدر بالشق العلوى لعظمة القص في جراحات استبدال الصمام الاورطى الاقل تدخلا

المقدمـة: نظراً للاتجاه العام فى جميع الجراحات هو الجراحات الاقل تدخلا. فان جراحات القلب اتخذت هذا الاتجاه وأصبحت أكثر دقه وأكثر تعقيداً. وهو ما يتطلب قدرات جراحية اعلى للوصول لنفس الجودة والمقارنة بالفتح التقليدى لعظمة القص واستخدام ماكينة القلب والرئة الصناعية.

الهدف من البحث: مقارنة النتائج أثناء العملية والنتائج الفورية بعد الجراحة للشق العلوى لعظمة القص مقابل الشق الصدرى الجانبى الايمن كتقنيات أقل توغلاً فى المرضى الذين يعانون من مرض الصمام الاورطى الذى يتطلب جراحة وفقًا لمعايير التضمين.

المرضى وطرق البحث: وقد تم اجراء هذا البحث على خمسين مريضاً والذين كانوا يحتاجون الى استبدال الصمام الأورطى وقد انقسموا الى مجموعتين: المجموعة « أ » : المرضى الذين تمت لهم استبدال الصمام الأورطى من خلال شق جزئى علوى لعظمة القص، المجموعة « ب » : المرضى الذين تمت لهم استبدال الصمام الاورطى من خلال فتحة صغيرة بأعلى مقدمه الصدر الايمن.

النتائج: بالنسبة للمقارنة أثناء الجراحة، فانه يوجد اختلاف إحصائى فى زمن غلق الشريان الأبهر، زمن تحويل المريض لجهاز القلب والرئة الصناعى، زمن الجراحة الاجمالى بالنسبه لجراحات الاقل تدخلا من خلال فتحة صغيرة للجانب الايمن من الصدر وربما يعزى هذا الطول الزمنى الى حداثة الخبرات بهذا النوع من الجراحات وضيق الفتحه وتكدسها بالالات الجراحيه. أما بالنسبة لطول الجرح فكان أقل بكثير فى مجموعه الشق الصدرى الامامى». كان هناك اختلاف إحصائى فى بعض القياسات بالعناية المركزة مثل زمن احتياج المريض لجهاز التنفس الصناعى كان أقل فى مجموعه الشق الصدرى الامامى، كذلك قل فقد المريض للدم وكمية نقل الدم و وجود المريض بالرعاية المركزة كان أقل فى نفس المجموعه». أما بالنسبه للمتابعه بعد الجراحه كان هناك اختلاف كبير فى درجة الاحساس بالالم فقد كان أقل فى مجموعه الشق الصدرى الامامى. كذلك قلت فترة الاقامه الكليه فى المستشفى والمضاعفات بالنسبة لمرضى لمجموعه الشق الصدرى الامامى كانت اقل خطورة من نظيرهم من المرضى فى مجموعه الشق الجزئى لعظمه القص.

الخلاصـة: ونخلص بذلك بان جراحة الصمام الاورطى الاقل تدخلا عن طريق فتحة صغيرة أعلى مقدمه الصدر الايمن لن تكون فقط أكثر قبولاً للمريض من الناحية الجمالية للجرح، ولكنها أيضاً تعتبر آمنة وبالاضافه لما لها من نتائج جيدة وأقل نسبه فى تحويلها إلى شق صدرى كامل وكذلك أقل نسبه فى مضاعفات مابعد الجراحه.