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Minimal Invasive Aortic Valve Replacement Through Right Mini_Thoracotomy Versus Conventional Approach In The Egypt

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ABSTRACT

Background: Full median sternotomy was established a long time ago as the standard approach for all varieties of heart surgery. Although that, it may cause significant surgical trauma and morbidity, so minimally invasive cardiac surgery for aortic valve replacement via partial sternotomy, para-sternal approach and anterior mini-thoracotomy is used trying to improve the outcome .

Objective: to check the outcome of minimally invasive aortic valve surgery through a right mini-thoracotomy, and its rule in minimizing the surgical access, achieving better wound appearance, decreasing post-operative discomfort and better postoperative recovery with the same safety and results like conventional surgery .

Methods: our study was performed in the Armed Forces Hospitals El Maddi& El Galaa and kobry elkobba, Egypt. Between January 2015 to March 2017, sixty patients were diagnosed with AVD requiring aortic valve surgery were randomly selected, of them Thirty patients had aortic valve surgery through full median sternotomy with aorto-right atrial cannulation and the other thirty patients had right mini-thoracotomy with femoral cannulation .

Results# Minimally invasive aortic valve replacement (MIAVR) was associated with reduced morbidity and mortality, where there was a safer approach in case of re-operation, better cosmetic outcome, less bleeding post-operative, lower number of blood products usage, less intensive care unit and hospital stays, decreased time until return to full activity and avoiding the incidence of sternal wound infection. That good results were also achievable in high-risk patients .

Conclusion: Minimal Invasive Aortic Valve Replacement Through Right Mini-thoracotomy is an acceptable alternative to Full median sternotomy, has reduced morbidity and potential mortality and good clinical outcome, with two concerns which are the operative cost and the relatively long bypass and cross clamp time which are related to the learning curve of the surgeons .

Keywords: Minimally invasive aortic valve replacement, Right Mini-thoracotomy, morbidity, Outcome, surgical procedures, cost, Egypt.

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INTRODUCTION

Full median sternotomy has been well established as a standard approach for all types of open-heart surgery for many years. Although well established, the full sternotomy incision has been frequently criticized for its length, post-operative pain and possible complications like wound infection and instability (1).

The conventional median sternotomy may cause significant surgical trauma and morbidity. Moreover, obese patients and diabetics are particularly prone to sternal infection and instability. Deep Sternal Wound Infection is a significant cause of morbidity and mortality following median sternotomy in cardiac surgery patients. Hypertrophic scarring is common with midline incisions, and keloid scars are especially likely to develop in the patients of African descent. Scar itching is also a known complication of median sternotomy (2).

Minimally-invasive cardiac valve surgery represents a recent, significant paradigm shift. Traditionalists were initially resistant to such techniques, claiming smaller incisions lead to poor exposure and inferior outcomes (3). The rapid development and refinement of techniques over the past decade have led to the realization that a minimally-invasive approach enables complex valve surgery to be performed with results, at the very least, equivalent to those of conventional (open) valve surgery done in experienced centers (3).

Minimally invasive cardiac surgery for aortic valve replacement has been performed via partial sternotomy, para-sternal approach and anterior mini-thoracotomy (4). The right mini-thoracotomy approach for aortic valve replacement was first described by Rao and Kumar and was rediscovered by Galloway and others. This approach is a modification of the right para-sternal approach reported by Cosgrove and Sabik but the right para-sternal approach has been largely abandoned because of the incidence of chest wall hernia and also because of the incision crossing skin lines (5).

Minimally invasive techniques in cardiac operations require higher surgical abilities to accomplish the same quality compared with the traditional procedures with cardio-pulmonary bypass (CPB) or sternotomy (6).

Minimally-invasive valve surgery has now evolved into a safe, efficient treatment option providing greater patient satisfaction and fewer complications. All Minimally-invasive valve surgery is undertaken only after becoming skilled in performing the conventional operations (3).

Potential advantages of minimally invasive aortic valve replacement arise from the concept that patient morbidity and potential mortality could be reduced without compromising the excellent results of the conventional procedure and 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, as well as the absence of sternal wound infection (7).

After cardiac operations, pain and quality of life are important end points for all patients that reflect the individual's physical and psychological health (8).

Aim of work

The **aim** to evaluates to check the outcome of minimally invasive aortic valve surgery through a right mini-

thoracotomy, and its rule in minimizing the surgical access, achieving better wound appearance, decreasing post-operative discomfort and better postoperative recovery with the same safety and results like conventional surgery.

METHODS

our study was performed in the Armed Forces Hospitals El Maddi& El Galaa and kobry elkobba, Egypt. Between January 2015 to March 2017, sixty patients were diagnosed with AVD requiring aortic valve surgery were randomly selected, of them Thirty patients had aortic valve surgery through full median sternotomy with aorto-right atrial cannulation and the other thirty patients had right mini-thoracotomy with femoral cannulation.

Inclusion criteria

Adult Patients with isolated aortic valve disease requiring surgery.

Exclusion criteria

Combined aortic and other valvular disease.
Hemodynamically significant coronary disease.
Bilateral external iliac or femoral artery stenosis.
Severely calcific ascending aorta (porcelain aorta).
Complex aortic root surgery i.e., in case of small aortic annulus.

Preoperative Assessment

All patients of the study had:
Routine medical history and detailed clinical examination with emphasis on: presence of comorbidity (diabetes, age >75, immunosuppression), NYHA class. Routine laboratory investigations including CBC, liver and kidney function tests, coagulation profile, ESR and blood cultures with emphasis on the presence of anemia and renal failure.
Electrocardiogram (ECG)
Chest x ray posteroanterior (and lateral views for redo cases).
Transthoracic and transesophageal echocardiography
Cardiac catheterization in males above age of forty years old, postmenopausal females, and in patients known to have ischemic heart disease (IHD) or have multiple risk factors for IHD. Spirometry study was performed 24 hours prior to surgery, during the morning in sitting position with the nose clip on.

Pre-operative preparation and anesthetic technique

were the same for the two groups according to our hospital protocol except of that group A have a double lumen endotracheal intubation and two external chest defibrillator pads were used
Transesophageal echocardiography (TOE) was used in all patients for assessment of aortic valve and Ejection fraction, heart filling, deairing, and cannula site. Afterward, the patients were prepared using betadine.

Surgical technique

Group "A" (Right Mini-thoracotomy)

Femoral cannulation, A 3–4-cm transverse femoral incision is done then femoral artery and vein cannulation are done using proline 5/0 and Seldinger technique.

Incision and Exposure, 5-6 cm skin incision from the right sternal border to the right antero-lateral portion of the chest wall. Pectoralis muscle is cauterized then the intercostal muscles in 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). Soft tissue retractor and rib retractor ere used to have a good exposure (in thin patients we may use only rib retractor without the need for soft tissue retractor).
Being careful to avoid phrenic nerve injury, the pericardium is opened 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.

Procedure, After the CPB is established, vacuum is used to improve the venous drainage, A Y-shape aortic root catheter is placed in the aortic root.
The flexible aortic-cross clamp is applied directly through the right anterior thoracotomy. Cardioplegia is given and the patient temperature was decreased to 34 °C. Identify the level of the aortotomy relative to the origin of the right coronary artery (1.5 cm above RCA origin). We open the aorta in a standard fashion, resect the aortic valve leaflets and debride any remaining calcium using rongeur in one hand and suction in the other, then we put the valve using Braided 2-0 interrupted mattress sutures with pledgets, close the aortotomy in two layers.Place a single RV pacing wire and tunnel it out the anterior chest wall via the left para-sternal space then Place a skin grounding wire. Start deairing and 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. Give protamine, remove cannulas, tie the purse string and the groin incision usually closed in a standard fashion.After proper hemostasis, two twenty-eight chest drains are placed through the ports into the pericardium and right pleural space We give a bolus of local anesthesia into the ICS. Transected rib reconstructed with stainless steel wire in a figure of eight fashion and Place two pericostal sutures for rib re-approximation using vicryle 2. The pectoralis muscle and the subcutaneous tissue was then closed by continuous absorbable 2/0 sutures, followed by the skin which was closed by 4/0 subcuticular suture.
Group "B" (Full Median Sternotomy)
The incision is begun approximately 2 cm below the sternal notch and extended approximately 2 cm beyond the distal tip of the xiphoid process and using the electrocautery down to the sternum then the sternum is divided in a cephalad to caudal direction.The pericardium is opened, then using silk as stay sutures . Aortobicaval cannulation was then performed and double way aortic root cannula was inserted for cardioplegia administration and de-airing.After initiating cardiopulmonary bypass, the procedure is the same as in the mini-thoracotomy group.After dealing with the aortic valve lesion and weaning from the cardiopulmonary bypass, decannulation and hemostasis was obtained, placing

chest tube was done by inserting one retrosternal tube, and pleural tubes if needed. Pacing wires was then inserted, and then wound closure as usual.

Operative data and parameters:
A record was made of the following:

- Length of skin incision in both groups.
- Exposure of aortic valve.
- Weaning from bypass.
- Aortic cross clamp, total bypass and operation time.
- Conversion to median sternotomy in group A.

Weaning of mechanical ventilation was done gradually as usual in the Intensive care unit.

Post-operative evaluation
Post-operative course follow up divided into three parts first ICU course, immediate or early postoperative while the patients were still in the hospital and three months follow up in the outpatient clinic.
Patients were evaluated in patient for the following: -
•Post-operative blood loss during the ICU stay and till the chest tubes were removed.

- Total intensive care unit stay.
- ICU Morbidities (DVT, fever, arrhythmias, other morbidities).
- Chest X-ray: postero-anterior view.
- Echo-cardiography; intraoperative TEE, at day 5 post-operatively then at 3 months in the OPD.
- Pain score: measured 1st ,3rd 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 sequalae, patient's satisfaction.
- Total hospital stay: The total hospital stay was calculated in both groups.

Outpatient follows up
Outpatient clinic follow up was three months post-operatively for echo-cardiography 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 sequale, patient satisfaction.
- Pain score.
- Total hospital stay.
- Cost effective.

Data entry
Data were gathered and entered into a computer database. To ensure the highest quality of data entry, all data were entered twice in a n independent way and any discrepancies checked and corrected.

RESULTS

In this prospective none randomized study, we compared the surgical, early postoperative and the first 3 months post-operative follow up outcome between the conventional sternotomy versus the anterior mini-thoracotomy group, sixty patients with AVD were operated, in both groups there were no mortalities. The sixty patients were classified into two groups:

- Group A: the anterior mini-thoracotomy group. This group included 30
- Group B: the conventional sternotomy group. This group included 30 patients who

Pre-operative assessment:
A. Demographic data and clinical characteristics of the patients and patients were classified according to the NYHA classification in each group.
The mean NYHA classification of the study group was 2.56 ± 0.72 in group "A", while it was 2.5 ± 0.77 in group "B" ,and there was no statistical significance between both groups as shown in table (1)

Table (1): Demographic data and clinical characteristics of the patients

	Group A	Group B	P value	Sig.
Number	30	30		
Age Range Mean SD	 21-71 49.1 16.1	 24-73 47.6 13.5	 >0.05	 NS
Male %	60%	66.6%	>0.05	NS
BMI Mean SD	 25.2 2.4	 24.9 2.7	>0.05	NS

NYHA				
NYHA I	2(6.6%)	1(3.3%)		
NYHA II	11(36.6%)	15(50%)		
NYHA III	15(50%)	11(36.6%)		
NYHA IV	2(7%)	3(10%)		
Mean ± SD	2.56 ± 0.72	2.5 ± 0.77	>0.05	NS

B. Pre-operative echo-cardiography and spirometry findings:

Pre-operative findings are shown in table (2).
Table (2): pre-operative echo spirometry findings.

	Group A	Group B	P value	Sig.
Pre-operative echo-cardiography				
Aortic stenosis	11(36.6%)	11(36.6%)	>0.05	NS
Aortic regurge	13 (43.3%)	15(50%)	>0.05	NS
Double lesion	6 (20%)	4(13.3%)	>0.05	NS

Ejection fraction %	63 ± 4.1	61.3 ± 4.3	>0.05	NS
Left ventricle end diastolic dimension	5.5 ± 1.0	5.1 ± 0.27	>0.05	NS
Left ventricle end systolic dimension	3.8 ± 0.69	3.26 ± 0.49	>0.05	NS

Pre-operative spirometry				
FVC (liters)	2.63 ± 0.76	2.87 ± 0.67	>0.05	NS
FEV1 (liters)	2.38 ± 0.71	2.6 ± 0.7	>0.05	NS
FVC%	65.88 ± 13.9 %	65.85 ± 7.23	>0.05	NS
FEV1%	72.77 ± 12.04 %	75.77 ± 10.5	>0.05	NS
FEV1/FVC	90.32 ± 6.4	92.84 ± 4.14	>0.05	NS

C. Intra-operative course

Antegrade cardioplegia is delivered through the aortic root in aortic stenosis or regurgitation if not more than moderate. If LV distension happened, the aorta is opened and cardioplegia is given directly through the coronary ostia. We don't use retrograde cardioplegia in any case in both groups.Myocardial protection was achieved with cold crystalloid cardioplegia (Custodiol) in group "A" while in group "B" we used usual cold crystalloid cardioplegia solutions. Cardioplegia was given in a dose of 15-20 ml/Kg every 30-40 minutes.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 and tissue valve ranged in size from 19-23. In group "A" 22 (73.3%) patients used mechanical valve and 8 (26.6%) patients used tissue valve while in group "B" 25 (83.3%) patients used mechanical valve and 5 (16.6%) patients used tissue valve.There was a big difference between both groups regarding the cross-clamp time and the total bypass time which was much less in group B, with a P value less than 0.01 which showed high statistical significance with minimally invasive group who need more cross camp time and total bypass time which is shown in table (3).

Also, for the mean surgery time in group "A" was 4.2 ± 0.46 hours, while in group "B" the mean surgery time was 3.83 ± 0.46 hours, with a P value <0.01, which is means high statistical significance in the operation time. Part of this difference may because of the of lack of the experiences of the surgeon to the minimal invasive technique, also the instrumentation crowded the small field of the mini-thoracotomy, ((shown in table (3)).

The incision length was compared in both groups. as shown in table (3).

Table (3): cross clamp ,total bypass time, Total surgery time & incision length in both groups.

	Group A	Group B	P value	Sig.
cross clamp & total bypass time				
Cross clamp (min.)	87.8 ± 8.7	60.1 ± 6.5	< 0.01	HS
Total bypass time	118.1 ± 9.6	87 ± 5.77	< 0.01	HS
Total surgery time (mean ± SD) (hours)	4.2 ± 0.46	3.83 ± 0.46	<0.01	HS

incision length				
Range (cm)	5-8	18-23		
Mean ± SD (cm)	5.9 ± 0.46	21.4 ± 1.1	< 0.01	HS

Weaning from cardio-pulmonary bypass was done without difficulty in both groups. Four cases (13%) required DC shock to weaning from bypass in group "A", while in group "B" three cases (10%) required DC shock to weaning from bypass. Three cases (10%) required inotropic support during weaning in group "A", while in group "B" 6 cases (20%) required inotropic support during the weaning from CBP. There was no need for temporary pacing in both groups. In both groups the inotropic support weaned during the first 24 hours. The P value was > 0.05, which means that there is no statistically significant difference regarding the use of DC shock, inotropic support. In group "A" right mini-thoracotomy was used in call cases without the need to conversion to median sternotomy. In group "A" 26 patients (86.6 %) were connected to bypass through cannulation of both femoral artery and vein, while four patients (13.3 %) were connected through direct aortic cannulation and percutaneous femoral vein cannulation because of peripheral arterial disease or small femoral artery. Post-operative course follow up divided into three parts first ICU course, immediate or early postoperative while the patients were still in the hospital and three months follow up.After discharge from the hospital, the post-operative course follow up data collected regularly and compared after three months with comparable of the

pre and post-operative data of the echo-cardiography and respiratory functions at the end of the three months follow up. Also pain score and satisfaction and scar and plain X rays were compared for both groups.

Intensive care stay

Patients in both groups were transferred to the on mechanical ventilation non of them were extubated inside the operating room. Regarding the mechanical ventilation duration there was a high statistically significant difference between the two groups as regards post-operative mechanical ventilation time (table 4).

Regarding tube drainage and blood required to maintain the patient haematocrit around 25-30 % was comparable in both groups during the first 24 hours, and there was a big significant difference between both groups regarding the tube drainage in the first twenty-four hours post-operatively. We use cell saver in all cases of both groups, and in group "B" they required more blood products than group "A" which was statistically significant as shown in table (4).

The length of the intensive care unit (ICU) stay was compared in both groups, where the length of the ICU stay in the mini-thoracotomy group is much less than the sternotomy group, with high statistical ssignificant difference (table 4).

Table (4): Ventilation, blood loss, blood transfusion and total ICU stay

	Group A	Group B	P value	Sig.
Ventilation duration (in hours)			<0.01	HS
Range	2.5-7	4-9		
Mean	4.16	5.9		
SD	0.9	1.5		
Blood loss (ml)			<0.01	HS
Range	150-500	200-800		
Mean	288.3	486.3		
SD	86.7	177.67		
Blood transfusion (unit)			<0.01	HS
Range	0-3	1-4		
Mean	1.4	2.5		
SD	0.7	0.8		
ICU stay (day)			<0.01	HS
Range	1-3	2-4		
Mean	1.56	2.4		
SD	0.53	0.6		
Re-exploration for bleeding	1 (3.3%)	0 (0.0%)		

Early post- operative course

Post-operative pain score using the visual analogue scale was compared in both groups, as shown in table (5).

All the patients completed the study without any mortality. In group "A", there were 6 patients (20%) who had complications. Three patients (10%) developed post-operative atrial fibrillation (AF), of them two regain normal sinus rhythm within 48 hours post-operative. 2 patients (6.6%) had right atelectasis in the form of right lower lobe collapse, and were managed by physiotherapy and medical treatment and they recovered totally by the fifth day post-operative. One patient (3.3%) got superficial wound infection of the groin and was managed by repeated dressing and antibiotics. In group "B", 13 patients (43.3%) had complications. Of them 4 patients (13.3%) had post-operative arrhythmias. On day 5 three of them regain the normal sinus rhythm. Five patients (16.6%) developed right lower lobe collapse, and were managed by medical treatment and physiotherapy. Four patients (13.3%) got superficial wound infection and was managed by repeated dressing and antibiotics. There was no statistical significant difference between both groups regarding the post-operative complications as shown in table (5).

Table (5):Pain score among the two groups (mean ± SD) & **Post-operative complications.**

	Group A	Group B	P value	Sig.
Pain score among the two groups (mean ± SD)				
Day 1 post-operative	7.6 ± 0.49	9.2 ± 0.76	< 0.01	HS
Day 2 post-operative	5.8 ± 0.69	7.7 ± 0.78	< 0.01	HS
Post-operative complications				
mortality	0(0.0%)	0(0.0%)	>0.05	NS
stroke	0(0.0%)	1 (3.3%)	>0.05	NS
No complications	24(80%)	17(56.6%)	>0.05	NS
Arrhythmias	3(10%)	4(13.3%)	>0.05	NS
Lung atelectasis	2(6.6%)	5(16.6%)	>0.05	NS
Superficial wound infection	1(3.3%)	4(13.3%)	>0.05	NS
Chest wall hernia or subcutaneous emphysema	0(0.0%)	0(0.0%)	>0.05	NS

All patients in both groups were admitted one day before surgery. The length of the hospital stay was compared in both groups; the length of hospital stay in group "A" ranges between 5-8 days with a mean of 6.6 ± 0.9 days,

while in group "B" it ranges between 7-11 days with a mean of 8.8 ± 0.8 days. The length of hospital stay in the mini-thoracotomy group was less than the sternotomy group, and this difference is statistically significant.Patient Satisfaction Wound satisfaction was compared in both groups and showed that 27 patients (90%) in group (A) were satisfied from their wound shape and size as they have a very small scar and only 3 patients (10%) were not satisfied from their femoral wound. In group (B) there were 25 patients (83.3%) not satisfied from their wound shape and size and only 5 cases (16.6%) were satisfied from their wound shape and size. The P value was less than 0.01 which means that there is statistically significant difference between both groups.

Post-operative three month follow up:

Incision and patient satisfaction

No one in group (A) had hypertrophic scar but in group (B) 2 patients (6.6%) had hypertrophic scar without any statistical differences between both groups.

Chest -x-ray and Echo-cardiography Findings

Only one patient (3.3%) in group (A)got mild pleural effusion ,but no patient in group B patients got pleural effusion without any statistical significance differences in both groups.Echo-cardiography assessment shows that the ejection fraction (EF) in group "A" was 59.1 ± 3.3 %, while in group "B" it was 57.2 ± 3.2 % with a P value >0.05. The left ventricular end diastolic dimension (LVEDD) was 5.2 ± 0.64 cm in group "A" and in group "B" was 5.1 ± 0.32 cm with p value > 0.05. Meanwhile the left ventricular end systolic dimension (LVESD) was 3.5 ± 0.5 cm in group "A" and 3.4 ± 0.4 cm in group "B".

Comparing the pre- and post-operative trans-thoracic echo-cardiography in group (A) showed no significance in the EF%, left ventricular end diastole and left ventricular end systole and well-functioning aortic prosthesis. As shown in table (6).

Comparing the pre- and post-operative trans-thoracic echo-cardiography in group (B) showed both left ventricular end diastolic, end systolic dimension, ejection fraction post-operatively and well-functioning aortic prosthesis, as shown in table (4).

Table (6): Comparing pre- and post-operative trans-thoracic echo-cardiography in group A and group B

	Pre-operative	Post-operative	P value	SIG
group A				
EF %	63 ± 4.1	59.1 ± 3.3	>0.05	NS
LVEDD (CM)	5.5 ± 1	5.2 ± 0.64	>0.05	NS
LVESD (CM)	3.8 ± 0.69	3.5 ± 0.5	< 0.05	NS
group B				
EF %	61.3 ± 4.3	57.2 ± 3.2	<0.01	NS
LVEDD (CM)	5.1 ± 0.7	5.1 ± 0.32	<0.01	NS
LVESD (CM)	3.2 ± 0.49	3.4 ± 0.4	<0.01	NS

We can predict from previous Echo-cardiography studies for both groups of patients (pre- and post-operative) that minimal invasive approach is feasible for aortic valve surgery without affecting the core of surgery or compromising the surgical target.

Pain score

During the first 3 month the pain score was assessed using the visual analogue scale and was compared in both groups. Group (A) showed mean pain score 1.66 ± 0.47. Meanwhile group (B) showed mean pain score 3.46 ± 0.46 which showed big statistical significance difference.

Cost effectiveness

Any cardiac centre who wants to give a good service with a low cost. That is why we calculate the hospital cost divided into ward, operative and ICU cost per day.

Operative Costs:

Group (A) costs were more than group (B) which was statistically significant difference as shown in table (7).

Table (7): operative costs for both groups (mean ± SD)& package by thousand L.E.

	GROUP A	GROUP B	P VALUE	SIG
Operative Cost by thousand L.E	19.82 ± 0.66	14.55 ± 1.06	<0.01	HS
Operative room Cost Mean ± SD	19.82 ± 0.66	14.55 ± 1.06	<0.01	HS
ICU stay cost Range Mean ± SD	2– 6 3± 1.06	4 - 8 4.8 ± 1.2	<0.01	HS
Word stay cost Range Mean ± SD	2.5 – 4 3.3 ± 0.45	3.5 – 5.5 4.4 ± 0.4	<0.01	HS
Total stay cost Range Mean ± SD	24.5 – 30 26.1 ±2.05	21.5 – 27.5 23.7 ± 2.6	<0.01	HS

Cost effectiveness

Although Minimally invasive surgeries are more expensive (+ 5 thousand L.E in our study) it has a less ICU stay, less hospital stay, lower ventilation time, less post-operative morbidities, lower need of blood products, lower post-operative pain, better wound satisfaction , especially between the females ,which give better quality of life and outcome so it has better cost-benefit to the patients and surgeon and the country; as shown in table (8).

Our results need to be compared and supported by more multicentre studies.

Table (8): operative and Post-operative parameters in both groups that shows the upper hand of minimally invasive surgery

	Group A	Group B	P value	Sig.
Length of skin incision (cm)	5.9 ± 0.46	21.4 ± 1.1	<0.01	HS
Mechanical Ventilation (hour)	4.16 ± 0.9	5.9 ± 1.5	<0.01	HS
Blood loss (ml)	288.3 ± 86.7	486.3±177.67	<0.01	HS
Blood transfusion (unit)	1.4 ± 0.7	2.5 ± 0.8	<0.05	S
day 1 postoperative pain (cm)	7.6 ± 0.49	9.2 ± 0.76	<0.01	HS
day 2 postoperative pain (cm)	5.8 ± 0.69	7.7 ± 0.78	<0.01	HS
ICU stay	1.56 ± 0.53	2.4 ± 0.6	<0.01	HS
Total hospital stay (day)	6.6 ± 0.9	8.8 ± 0.8	<0.01	HS
ICU stay cost Range Mean ± SD by thousand L.E	 2 –6 3± 1.06	 4 - 8 4.8 ± 1.2	<0.01	HS
Word stay cost Range Mean ± SD by thousand L.E	 2.5 – 4 3.3 ± 0.45	 3.5 – 5.5 4.4 ± 0.4	<0.01	HS

CONCLUSIONS

Minimal invasion surgical techniques have a great impact in reducing morbidity and mortality in valve surgeries. Minimally invasive aortic valve replacement (MIAVR) nowadays became a well-tolerated, efficient and good option in well experienced centers, as it provides better patient satisfaction and lower morbidity rates.The benefit of MIAVR appears as it decreases the morbidity and mortality affecting the outcome of the surgery and its benefits involves better cosmetic, lower post-operative bleeding, lower blood products needs, easier and safer access in the case of re-operation, lower intensive care unit and in-hospital stays, decreased recovery time until return to full activity, also avoiding sternal wound complications. These benefits are also achievable in high-risk patients. Any new procedure needs repetition and experience before achieving the best outcome. Right mini-thoracotomy AVR represents another approach to aortic valve replacement. Although it is technically more demanding than traditional AVR and consumes more time but it can be performed safely and effectively with an acceptable early outcome. In the mini-thoracotomy group, we had lower blood loss and lower blood products transfusion needed. Shorter hospital stay was significant, and there was lower incidence of morbidities such as wound infection and mediastinitis and has faster post-operative recovery and pulmonary functions.We have two major concerns regards this technique. The first is the operative cost and the second is the relatively long bypass and cross clamp time which are related to the learning curve of the surgeons.We conclude that mini-thoracotomy aortic valve replacement is an acceptable alternative in minimally invasive aortic valve surgery, has many technical advantages and good clinical outcomes.

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.

Recommendations

Furthermore studies needs to be with a bigger number of patients.

Funding: self-funding.

Ethical clearance: cleared by ethical committee in a big faculty of medicine, Egypt.

No conflict of interest.

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