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POSTOPERATIVE CHEST PAIN AND COSMETIC OUTCOMES IN MINI-STERNOTOMY VERSUS STANDARD STERNOTOMY IN AORTIC VALVE REPLACEMENT

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ABSTRACT

Background: For decades, the traditional median sternotomy has been the treatment of choice in aortic valve surgery; however, numerous researchers have worked to develop less invasive procedures, and the partial upper mini-sternotomy is the most prevalent minimally invasive procedure.

Objective: To compare outcomes, in patients who undergo mini-sternotomy, and patients who undergo standard sternotomy, in aortic valve replacement operations.

Patients and Methods: This Randomized controlled clinical trial study included A fifty patients who were admitted to the Zagazig University hospital, Cardiothoracic surgery department In the period between January 2021 to August 2021, Patients were split into two groups, each with 25 patients: Group "A" had aortic valve surgery by mini-sternotomy, while Group "B" got aortic valve surgery via open surgery. Aortic valve surgery was performed via a conventional median sternotomy in Group "B." An ECG was performed to see whether there was any ischemia present, as well as laboratory tests and a chest x-ray.

Results: At all periods, VAS was substantially higher in the complete sternotomy group. Wound length was significantly shorter in mini-sternotomy group than in full sternotomy group, however: regarding post operative NYHA there were significant improvement in both groups but better improvement in Mini group.

Conclusions: MIAVR is a safe and effective procedure and is performed with comparable morbidity to conventional AVR. MIAVR results in substantially improved postoperative respiratory functioning, post operative chest pain, and cosmetic results.

Keywords: Mini Sternotomy, Full Sternotomy, Aortic Valve Replacement

INTRODUCTION

Standard sternotomy is the access of choice for aortic valve surgery, however, its wound length, post operative chest pain, wound infection, and thoracic wall instability, are the commonest undesirable outcomes. [(1)] Mini-sternotomy is the commonest minimally invasive technique utilized in the aortic valve surgery, due to its bitter cosmotic consequence, with early patient recovery post operatively.[(2)] Upper partial sternotomy has shown a similar or even higher benefit than standard sternotomy in terms of, less respiratory problems, less post operative chest pain, less wound complications, and better cosmetic results. [(3) (4)]

PATIENTS AND METHODS

Fifty patients with AVD who needed aortic valve surgery were chosen at random. The research was carried out in the Cardiothoracic Department of Zagazig University Hospital. Twenty-five patients had standard sternotomy for aortic valve surgery, whereas the other twenty-five patients underwent mini-sternotomy J shape to the third right intercostal space with aortic and single venous cannulation.

All subjects provided written informed consent, and study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (International review board IRB#6628/30-12-2020). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

We considered the following Inclusion criteria: Age > 16. Patients who are candidates for isolated aortic valve replacement, either Aortic valve stenosis or aortic valve regurgitation, or both. **Exclusion criteria:** Patients suffering from severe coronary artery disease. Renal failure sufferers. Patients experiencing cardiogenic shock or cardiopulmonary resuscitation prior to surgery. Patients who have had a redo or combination valve surgery. Patients with abnormalities of the chest or vertebral walls. Aortic root dilatation is required in patients with a small aortic annulus. Infectious endocarditis.

Technique:

For all patients, the intraoperative anesthetic approach was the same: a 20 gauge non-dominant radial artery cannula was placed utilizing local anesthesia. The first blood sample was taken from the arterial line for preoperative baseline activated clotting time (ACT) analysis, and the second was taken for preoperative baseline arterial blood gas (ABG) analysis.

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Two grey peripheral venous cannulas were used for monitoring, followed by Fentanyl 5-10 mic/kg and Rocuronium (Esmeron) 0.6-1.2 mg/kg as a loading dosage and 0.1-0.2 mg/kg as a maintenance dose for endotracheal intubation. and a propofol hypnotic dose of 1-2.5 mg/kg augmented hypnotic dosage. The trachea was intubated orally with an adequately sized endotracheal tube after complete muscular relaxation. Inhalational Isoflurane 0.5-1.0 percent was used to maintain anesthesia in all patients Following induction.

Cardiopulmonary bypass (CPB):

Membrane oxygenators were employed in this experiment. During CPB, the hematocrit was maintained at approximately 28%. Systemic cooling to 28 degrees Celsius was used to preserve the myocardium. In case of Aortic valve stenosis, antegrade warm blood cardioplegia is fed into the ascending aorta via a cardioplegia cannula with pressure, or directly into the coronary ostia in case of Aortic valve regurge. Within 1-3 minutes, an induced cardiac standstill was typically obtained. Cardioplegia was administered every 30-40 minutes at a dosage of 10 **ml/Kg**.

Group "A" (MIAVS); J shaped mini-sternotomy:

On the operating table, the patient was positioned in a supine posture with his or her arms by his or her side. Under the shoulders, a sandbag was placed.

The patient was then wrapped in the traditional manner, with the chest skin and groin regions exposed. a 5-8 cm midline kin incision from one finger below the sternal notch to the level of the 3rd intercostal space, then dissection with an electrocautery blade until the sternal periosteum is reached In the upper manubrium, a conventional sternal saw was engaged, directed caudally, and ultimately turned a side to the right into the 3rd intercostal gap. Electrocautery was used to reduce bleeding from the sternal periosteum. The cross arm of a tiny sternal retractor was positioned in the lower end of the Incision and the retractor was gently opened.

Aortic cannulation was done with a 20 or 22 straight aortic cannula, followed by single venous cannulation and aortic root cannulation for cardioplegia delivery and de-airing.

After initiating cardiopulmonary bypass, and after dealing with the aortic valve lesion by either repair or replacement, placing chest tube was done by inserting a retrosternal tube, and pleural tubes if needed before coming off bypass. Retrosternal tubes not removed before 48hr of procedure. weaning from the cardiopulmonary bypass, decannulation and hemostasis was obtained, pacing wires was then inserted. The sternum was then approximated using Five heavy stainless-steel wires which was passed through the sternum. The twisted wires were then carefully turned down into the sternum so that they do not protrude externally. The Linea Alba is approximated with heavy absorbable suture as was the pectoralis fascia. The subcutaneous tissue was then closed by continuous absorbable 2/0 sutures, followed by the skin which was closed by 3/0 subcuticular suture.

Group "B" (Full Sternotomy):

In a supine posture, the patient was put. Palpation was used to locate the sternal notch and the distal point of the xiphoid process, and the incision was started 2 cm below The incision was made in the sternal notch and prolonged 2 cm beyond the distal tip of the xiphoid process, with electrocautery utilized to extend it to the sternal periosteum. The incision was then widened in the midline using electrocautery between the insertion sites of the pectoralis major muscle. The Linea Alba was divided above the suprasternal ligament at the xiphoid, and a plane behind the sternum was created by blunt finger dissection. The sternum was then divided in a cephalad to caudal direction by hooking the nose-plate of the saw underneath the suprasternal ligament, and by lifting the sternum upwards and asking the anesthesiologist to deflate the lungs, it was safer to avoid injury of the underlying pleura. Bleeding from sternal periosteum was then controlled by electrocautery Bone wax was used in cases with excessive marrow bleeding. a sternal retractor with broad blades was placed and opened slowly, with the cross arm of the retractor positioned in the upper end of the incision.

Postoperative follow up and evaluation

All patients were evaluated thoroughly during their intensive care unit stay and during their hospital stay. Intensive care unit evaluation: weaning of mechanical ventilation Continuous positive airway pressure (CPAP) and pressure support (10-15 cm H20) modes were used progressively.

Ventilatory support was gradually decreased at a rate of 1-2 cm H20 CPAP and pressure support was gradually reduced at a rate of 1-2 cm H20 CPAP and pressure support was gradually reduced at a rate of 1-2 cm (PS) decrements. Post-operative blood loss during the ICU stay and till the chest tubes were removed was calculated in both groups. Patients was evaluated after surgery by Chest X-ray postero-anterior view. Pain score measured 1st, 2nd, 3rd, 4rd days postoperatively, Wound sequel, NYHA score.

Statistic analysis

The data collected during the history, basic clinical examination, laboratory tests, and outcome assessments was coded, entered, and analyzed using Microsoft Excel software. The data was analyzed using the Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software. The following tests were used to determine the significance of differences depending on the kind of data: Chi square

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test for difference and association of qualitative variables; Chi square test for difference and association of quantitative variables (X2). To assess differences between quantitative independent groups, the t test was employed. The P value for significant findings was set at 0.05, while the P value for highly significant results was set at 0.001.

RESULTS

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

			Full	Mini	t/ X^2	P
Age			46.68±6.83	48.0±6.76	0.686	0.496
BMI			25.92±1.75	26.12±1.75	0.021	0.992
Sex	**Male**	**N**	13	15	0.32	0.56
		%	52.0%	60.0%		
	Female	**N**	12	10		
		%	48.0%	40.0%		

Table 1; revealed that the age distribution across groups was 46.68±6.83 and 48.0±6.76, respectively, with no significant difference between groups. There was also no significant difference between groups in terms of BMI or sex distribution.

Table (2): Comorbidities distribution between studied groups

DM	**-VE**	**N**	19	17	0.39	0.52
		%	76.0%	68.0%		
	+VE	**N**	6	8		
		%	24.0%	32.0%		
HTN	**-VE**	**N**	14	17	0.76	0.38
		%	56.0%	68.0%		
	+VE	**N**	11	8		
		%	44.0%	32.0%		
Dyslipidemia	**-VE**	**N**	21	19	0.50	0.48
		%	84.0%	76.0%		
	+VE	**N**	4	6		
		%	16.0%	24.0%		
Total		**N**	25	25		
		%	100.0%	100.0%		

Table 2; There was no significant difference or relationship between groups in terms of comorbidities, with HTN being the most common comorbidity across both groups.

Table (3): Pain assessed VAS and wound length distribution between studied groups.

	Full	Mini	t	P
Wound length	17.52±2.58	6.48±2.14	34.82	0.00**
VAS_6	3.72±0.73	2.96±0.78	3.518	0.001**
VAS_12	2.24±0.77	1.80±0.60	2.375	0.025*
VAS_24	1.48±0.42	1.08±0.39	2.297	0.032*
VAS_48	1.20±0.41	0.48±0.17	3.582	0.001**

Table 3: wound length was significantly shorter in Mini group, and VAS was significantly higher among full sternotomy group at all times.

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Table (4): NYHA distribution at pre and post between studied groups.

			Group		X^2	P	Group		X^2	P	P1	P2
			Full	Mini			Full	Mini				
NYHA	I	N	4	4			14	22	5.87	0.049*	0.00**	0.00**
		%	16.0%	16.0%			56.0%	88.0%				
	II	N	11	13			7	2				
		%	44.0%	52.0%	0.50	0.91	28.0%	8.0%				
	III	N	7	5			3	1				
		%	28.0%	20.0%			12.0%	4.0%				
	IV	N	3	3			1	0				
		%	12.0%	12.0%			4.0%	0.0%				

P1 (pre and post at full group)
P2 (pre and post at mini group)
No significant difference between groups at pre but post was significantly better in Mini group and there was significant change and improvement at both groups between pre and post.

DISCUSSION

In the present study, there was no significant difference between the studied groups regarding age, BMI, and sex. This came in agreement with **Amr, (2016)** who found that the same results. [(5)]

There was no significant difference or correlation between groups in terms of comorbidities in the current study, and HTN was the most common comorbidity across both groups. the percent of diabetic patients in the upper mini-sternotomy group was 48 percent, whereas the standard full sternotomy group was 40 percent, with no statistical significance, and that the percent of hypertensive patients in the upper mini-sternotomy group was 60 percent, whereas the standard full sternotomy group was 68 percent, with no statistical significance. [(6)]

VAS was consistently higher in the conventional complete sternotomy group than in the upper mini-sternotomy group, in the present research Interestingly, patients having enjoyed satisfactory immediate postoperative outcome manifested as reducing chest pain secondary to respiratory movement and early return to physical activity. Moreover, skin wound incision for upper mini-sternotomy was cosmetically better. This finding was mostly secondary to the significantly shorter length of skin wound and the lower frequency of sternal wound infection with mini-sternotomy. [(6)] Minimally invasive Aortic valve replacement surgery has been shown to have a quicker recovery time, better aesthetic outcomes, and needs less rehabilitation resources as compared to traditional surgery. The patients in the small group spent less time in the hospital than those in the complete sternotomy group explained this agreement. The small group's quicker intrahospital recovery was aided by maintained chest wall integrity, less sternal wound problems, and simpler postoperative mobility. [(7)]

On the first, second, third, and fourth days till discharge, pain ratings revealed a very significant difference between the upper mini-sternotomy group and the conventional complete sternotomy group. In the upper mini-sternotomy group, the mean first-day pain score was 4.48 1.08, with a range of 3–7, while in the conventional complete sternotomy group, the mean first-day pain score was 6.20 1.04, with a range of 5–8. In the upper mini-sternotomy group, the mean second-day pain score was 1.88 1.09, with a range of 1–4, while in the conventional complete sternotomy group, the mean second-day pain score was 4.56 0.65, with a range of 3–5. The mean third-day pain score in the upper mini-sternotomy group was 1.401.19, with a range of 0–4, and in the conventional complete sternotomy group was 4.08 0.81, with a range of 3–5. The mean pain score on the fourth day till discharge in the upper mini-sternotomy group was 1.16 1.07, with a range of 0–4, and 3.28 0.61, with a range of 2–4, in the conventional complete sternotomy group. **Sarawy et al.** [(6)],

In the current study, post NYHA' was significantly better in Mini group and there was significant change and improvement at both groups between pre and post. Mini-sternotomy patients showed significantly better NYHA scores compared to Full Sternotomy patients. Such improvement could be explained by the short sternal wound thus patient has early in-hospital resumption of normal breathing without limitation Also, patients having

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MS were allowed to sleep freely without limitation to supine position, owing to wound fixity provided by the lower part of the sternum thus excluding the possibility of sternal wound mal-union or overriding edges. [8]

In terms of hospital morbidity, limited access AVR surgery through an upper "J" sternotomy was just as safe as the conventional technique. [9]

Furthermore, the benefits of J shaped upper mini-sternotomy over traditional sternotomy included reduced surgical stress, wound infections, and discomfort, as well as quicker patient recovery and favorable long-term results, especially in elderly patients, as compared to conventional sternotomy and Patients can move around more easily and effectively because of the increased thoracic cage stability. [10]

MIAVR is a safe and effective treatment with a morbidity and mortality rate that is similar to traditional AVR. MIAVR improves ventilator performance, decreases wound infection, lowers hospitalization time, and increases the percentage of patients who are sent home early. [11]

CONCLUSION

Our less intrusive research group had substantially improved postoperative respiratory functioning, post operative chest pain, and cosmetic results. we may conclude that mini-sternotomy for Aortic valve surgery is a safe and successful minimally invasive surgery with numerous technical benefits, excellent clinical results, with few perioperative and short-term problems.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

Conflicting Interest (If present, give more details): No Conflict of Interest

No financial disclosure

-Acknowledgements

Not applicable

Declarations

-Ethics approval and consent to participate

Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (International review board IRB #:6628/30-12-2020). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

-Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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