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Original article

Comparative study: Transseptal approach versus Transatrial approach in mitral valve replacement in redo patients

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ABSTRACT

Background: Previous cardiac operations may complicate mitral valve exposure, as adhesions and loss of mobility in the surrounding tissues may be present. In such cases, the conventional left atrial [LA] incision may not offer satisfactory visualization in the surgical site of the valve. Therefore, several alternative approaches have been proposed for satisfactory visualization of the mitral valve intraoperatively.

Aim of the work: To evaluate the outcome of the transseptal and transatrial approaches for mitral valve replacement in patients undergoing redo mitral valve surgery.

Patients and Methods: This is a prospective study that was conducted at Cardio-thoracic surgery department of Al-Azhar University hospital [Damietta] and other centers during the period from the January 2018 to May 2019. It included 30 patients undergoing redo mitral valve surgery; 15 of them had transseptal approach and 15 with transatrial approach.

Results: Age was comparable between studied groups. There were 6 males [40.0%] in group I and 7 males [46.7%] in group II. Smoking was reported in 8 [53.3%] in group I and 7 [46.7%] in group II. Hypertension and pulmonary disease were reported in 6 [40.0%] versus 7 [46.7%] and 2 [13.3%] versus 3 [20.0%] in groups I and II respectively. Diabetes mellitus was reported in 9 [60.0%] in group I versus 4 [26.7%] in group II. Finally, there was no significant difference between both approaches as regard to intraoperative or postoperative data.

Conclusion: Transatrial approach has been used in most of previous studies; the transseptal approach appears to be equally effective.

Keywords: Transseptal; Transatrial; Redo surgery; Mitral; Replacement.

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* Main subject and any subcategories have been classified according to the research topic.

INTRODUCTION

Mitral valve diseases are among the most prevalent valvular heart diseases and necessitate surgical procedures for the repair or replacement of the mitral valve[1]. Good exposure is strictly required for mitral valve surgical repair, when the original valve is calcified or when a previous implanted synthetic valve prosthesis is removed. Mitral visualization may be inadequate due to left atrial small size and significant hypertrophy of the right ventricle[2]. Prior cardiac surgery may also complicate mitral valve exposure due to probable existence of adhesions and loss of mobility in the surrounding structures. In such situations, the conventional left atrial [LA] incision may not offer acceptable visualization of the valve at surgery. Therefore, several alternative approaches have been introduced to achieve adequate visualization of the mitral valve intraoperatively[3].

Since the introduction of mitral valve surgery, different techniques were tried to exposed the mitral valve, the two most commonly approaches are the left atriotomy, through incision in the interatrial groove, and trans-septal approach through incision in the interatrial septum after opening of the right atrium [4]

Conventional left atriotomy is the standard approach for most surgeons. However, the transseptal [TS] approach can confer better exposure to the mitral valve in cases where the left atrium is small, where there are adhesions caused by previous procedures, where there are concomitant operations requiring right atriotomy[5]. Nevertheless, for all the advantages that the TS approach offers, controversy regarding its outcome still exist. Indeed**,** whereas some studies have shown that the TS approach increases the risk of postoperative sinus nodal dysfunction and atrial fibrillation, others have implicated similar and comparable results for both LA and TS approaches[6].

AIM OF THE WORK

The current research had been designed to evaluate the outcome [safety and complications] of the transseptal and transatrial approaches for mitral valve replacement in patients undergoing redo mitral valve surgery.

PATIENTS AND METHODS

This is a prospective study that was conducted at Cardio-thoracic surgery department of Al-Azhar University hospital [Damietta] and other centers during the period from the 1st of January 2018 to the last of May 2019. It included 30 patients undergoing redo mitral valve surgery; 15 of them had transseptal approach and 15 with transatrial approach.

Patients were ***included*** if they previously underwent mitral valve replacement due to stenosis or regurge and need redo surgery with or without other valve lesions, with preserved left ventricular function. On the other side, patient was ***excluded*** if he/she had ischemic heart disease, severe left ventricle systolic dysfunction [< 40%], severe renal or hepatic dysfunction, and suffering from cerebrovascular accident with residual defect.

After selection, counseling, explaining the procedure to all participants, and obtaining a written consent to participate in the study; all participants were submitted to preoperative assessment in the form of detailed history, full clinical examination, laboratory work up, chest x ray, electrocardiography [ECG] for heart rhythm and presence of permanent pacemaker, transthoracic echocardiography and transesophageal echocardiography for assessment of ejection fraction, other valvular lesions, left atrial size and detection of left atrial thrombus.

The surgical techniques carried out as described by according to **D'Agostino et al.**[7] and **Botta et al.**[8]

The intraoperative assessment included total operation time, total bypass time, cross clamp time, type of cardioplegia, femoral bypass, need for a temporary or permanent pacemaker after surgery, need for the inotropic support and other intraoperative complications.

The postoperative assessment included monitoring in intensive care unit [ICU], cardiac rhythm, need for transfusion and incidence of postoperative complications [myo-cardial infarction, cerebrovascular accident, renal failure, respiratory failure, sternal infection, pneumonia and early mortality], the need for inotropic support, hospital stay duration, and early postoperative laboratory investigations, ECG and echocardiography just before discharge from hospital.

Statistical analysis of data: The collected data were documented, coded and analyzed by statistical package for social sciences [SPSS] version 19 [IBM®SPSS® Inc., Chicago, USA], for windows. Qualitative data represented as frequency and percentage, while quantitative data, represented by mean, standard deviation [SD], minimum and maximum. For comparison, the independent samples, student's [*t*] test, or Chi Square, Mann Whitney [U] tests were used. $p < 0.05$ was set as the limit of statistical significance[9].

Ethical considerations: The study protocol was approved by the local research and ethics committee of Damietta Faculty of Medicine, and an informed consent was obtained from each patient before participation in the study and after full explanation of the study protocol.

RESULTS

In the present study, age was nearly comparable between both groups [54.8±3.03 years in group I & 55.93±5.28 years in group II]. There were 6 males [40.0%] in group I and 7 males [46.7%] in group II. Smoking was positive for 8 [53.3%] in group I and 7 [46.7%] in group II, while history of hypertension and pulmonary disease were reported for 6 [40.0%] versus 7 [46.7%] and 2 [13.3%] versus 3 [20.0%] in groups I and II respectively. Finally, diabetes mellitus [DM] was positive for 9 [60.0%] in group I versus 4 [26.7%] in group II. The New York Heart Association [NYHA] classification of angina revealed that, there were 3 [20.0%] with no symptoms and no limitation in ordinary physical activity [class I] in group I versus 4 [26.7%] in group II; 2 [13.3%] with mild symptoms [mild shortness of breath and/or angina] and slight limitation during ordinary activity [class II] in group I versus 1 [6.7%] in group II, no cases with marked limitation in activity due to symptoms, even during less-than-ordinary activity [class III] in group I, versus 1 [6.7%] in group II; and 1 [6.7%] with severe limitations [experiences symptoms even while at rest [class IV] in group I versus no cases in group II. Furthermore, dyspnea status pre-surgery revealed that, there were 2 [13.3%] with no limitation of physical activity in group I versus 3 [20.0%] in group II; 5 [33.3%] with slight limitation of ordinary activity versus 4 [26.7%] in group II; 6 [40.0%] with marked limitation of ordinary physical activity in group I versus 6 [40.0%] in group II; and 2 [13.3%] with symptoms at rest or minimal activity in group I versus 2 cases [13.3%] in group II [Table 1].

As regard preoperative heart rhythm, there were 9 [60.0%] with sinus rhythm in group I versus 8 [53.3%] in group II, 6 [40.0%] with Atrial fibrillation/ flutter versus 6 [40.0%], no cases with complete heart block/pacing versus 1 [6.7%] and no cases in studied groups with ventricular fibrillation or ventricular tachycardia and others, respectively. The ejection fraction [EF] grading revealed that, there were 12 [80.0%] with Good [LVEF>50%] in group I versus 11 [73.3%] in group II, 2 [13.3%] with fair [LVEF 30%–50%] versus 3 [20.0%] in group II and 1 [6.7%] with poor [LVEF<30%] in group I versus 1 [6.7%], in group II. In addition, there were 6 cases [40.0%] with redo-sternotomy in group I versus 7 [46.7%] in group II, 6 [40.0%] with femoral bypass versus 6 [40.0%] and 3 [20.0%] with thoracotomy incision in group I versus 2 [13.3%] in group II with non-statistical significant difference [Table 2].

In the present study, the mean cumulative cross-clamp time was 83.4±6.62 minutes in group I versus 81.8±8.74 minutes in group II and mean cross-clamp time [MV replace] was 73.13±6.08 minutes in group I versus 72.8±6.79 minutes in group II. The mean cumulative bypass time was 99.2±7.66 in group I versus 96.4±10.08 minutes in group II and mean MV replace was 93.9±5.17 minutes in group I versus 92.8±6.35 minutes in group II. The post-operative blood loss at 12 hours was 330.0±50.5 ml in group I versus 300.0±70.1 ml in group II. The intensive therapy unit [ITU] stay was 3.5±1.06 days in group I versus 4.07±1.09 days in group II. Finally, there were 1 [6.7%] with reoperation for bleeding or tamponade in group I versus 1 [6.7%] in group II, and 1 [6.7%] with post-operative neurological dysfunction versus 1 [6.7%] in group II, 1 [6.7%] with hemofiltration [HF]/dialysis postoperatively in group I versus 2 [13.3%] in group II, 2 [13.3%] with systemic inflammatory response syndrome [SIRS] in group I versus 3 [20.0%] in group II and 1 [6.7%] requiring new pacemaker versus 0 [0.0%] in group I versus group II respectively and 2 [13.3%] with ITU readmission versus 1 [6.7%] in groups I and II respectively [Table 3].

Table [1]: Demographic data of the studied cases.

Parameters		Group I [TS] [15]	Group II [TA] [15]	Both groups [30]	X^2	P value
Age [years]		54.8±3.03	55.93±5.28	55.36±4.27	0.72	0.47
Gender	Male	6 [40.0%]	7 [46.7%]	13 [43.3%]	0.37	0.71
	Female	9 [60.0%]	8 [53.3%]	17 [56.7%]		
Cigarette smoking history		8 [53.3%]	7 [46.7%]	15 [50.0%]	0.36	0.71
History of hypertension		6 [40.0%]	7 [46.7%]	13 [43.3%]	0.37	0.71
History of pulmonary disease		2 [13.3%]	3 [20.0%]	5 [10.0%]	0.49	0.62
History of diabetes mellitus		9 [60.0%]	4 [26.7%]	13 [43.3%]	1.8	0.07
NYHA class	No angina	9 [60.0%]	9 [60.0%]	18 [60.0%]		
	Class I	3 [20.0%]	4 [26.7%]	7 [23.3%]		
	Class II	2 [13.3%]	1 [6.7%]	3 [10.0%]	0.47	0.92
	Class III	0 [0.0%]	1 [6.7%]	1 [3.3%]		
	Class IV	1 [6.7%]	0 [0.0%]	1 [3.3%]		
Dyspnea status	limitation of physical activity	2 [13.3%]	3 [20.0%]	5 [16.7%]		
	Slight limitation of ordinary physical activity	5 [33.3%]	4 [26.7%]	9 [30.0%]		
	Marked limitation of ordinary physical activity	6 [40.0%]	6 [40.0%]	12 [40.0%]	0.31	0.96
	Symptoms at rest or minimal activity	2 [13.3%]	2 [13.3%]	4 [13.3%]		

Table [2]: Comparison between the studied cases regarding preoperative heart rhythm

	Parameters	Group I [15]	Group II [15]	Both groups [30]	X^2	P value
Heart Rhythm	Sinus rhythm	9 [60.0%]	8 [53.3%]	17 [56.7%]		
	Atrial fibrillation/flutter	6 [40.0%]	6 [40.0%]	12 [40.0%]		
	Complete heart block/pacing	0 [0.0%]	1 [6.7%]	1 [3.3%]		
	Ventricular fibrillation or ventricular tachycardia	0 [0.0%]	0 [0.0%]	0 [0.0%]	0.15	0.93
	Other abnormal rhythm	0 [0.0%]	0 [0.0%]	0 [0.0%]		
Ejection Fraction	Good [LVEF>50%]	12 [80.0%]	11 [73.3%]	23 [76.7%]		
	Fair [LVEF 30%–50%]	2 [13.3%]	3 [20.0%]	5 [16.7%]	0.24	0.89
	Poor [LVEF<30%]	1 [6.7%]	1 [6.7%]	2 [6.6%]		
Surgical Technique	Redo-sternotomy	6 [40.0%]	7 [46.7%]	13 [43.3%]		
	Femoral bypass	6 [40.0%]	6 40.0%]	12 [40.0%]	0.61	0.96
	Thoracotomy incision	3 [20.0%]	2 [13.3%]	9 [16.7%]		

Table [3]: Comparison between studied cases regarding post-operative assessment

	Parameters	Group I [15]	Group II [15]	Both groups [30]	T test	P value
Intraoperative Assessment	Cumulative cross-clamp time [min]	83.4±6.62	81.8±8.74	82.6±7.66	0.56	0.57
	Cross-clamp time [MV replace]	73.13±6.08	72.8±6.79	72.97±6.34	0.14	0.89
	Cumulative bypass time [min]	99.2±7.66	96.4±10.08	97.8±8.9	0.86	0.39
	Bypass time [MV replace]	93.9±5.17	92.8±6.35	93.36±5.7	0.54	0.59
Postoperative Assessment	Blood loss at 12 hours [mL]	330.0±50.5	300.0±70.1	312.0±63.57	1.49	0.15
	ICU stay in days	3.5±1.06	4.07±1.09	3.8±1.09	1.35	0.19
Postoperative Complications	Reoperation for bleeding or tamponade	1 [6.7%]	1 [6.7%]	2 [6.7%]	-------	-------
	Patients requiring new pacemaker	1 [6.7%]	0 [0.0%]	1 [6.7%]	1.02	0.31
	New post-op neurological dysfunction	1 [6.7%]	1 [6.7%]	2 [6.7%]	-------	-------
	New HF/dialysis postoperatively	1 [6.7%]	2 [13.3%]	3 [10.0%]	0.61	0.54
	SIRS	2 [13.3%]	3 [20.0%]	5 [16.7%]	0.49	0.62
	Patient status at discharge [mortality]	1 [6.7%]	1 [6.7%]	2 [6.7%]	-------	-------
	Sternal wound infection	0 [0.0%]	0 [0.0%]	0 [0.0%]	-------	-------
	ITU readmission	2 [13.3%]	1 [6.7%]	3 [10.0%]	0.61	0.54

DISUCSSION

Redo cardiac surgery is a clinical challenge due to a high incidence of peri-operative complications and mortality[10]. The choice of a minimally invasive intervention to carry out mitral surgery is firmly related to surgeon's preference but the approach success is reliant on patient inclusion criteria, personal expertise capacities, availability of technological appliances, satisfactory training, and wise team-working of the staff, including anesthesiologists, perfusionists and nurses[11]. Minimally invasive surgical approach through right-sided mini-thoracotomy is a valid substitute to a repeated conventional median sternotomy[12].

The incidence and prevalence of structural valve

disease is increasing with advancing age and improved longevity. Surgical repair or replacement of valve is the standard of care for the treatment of significant valvular dysfunction, with bioprosthetic valves constituting more than 50% of approximately 300,000 valves implanted surgically worldwide. Although bioprosthetic heart valves allow freedom from lifelong anticoagulation, they are unfortunately associated with the risk of structural degeneration. The incidence of this structural valve deterioration requiring reintervention is 20%–30% at 10 years and approximately 50% at 15 years. Increasing life expectancy and shorter durability of tissue valves is likely to translate into increasing pool of patients with failing tissue valves requiring repeat intervention. At present, surgical replacement remains virtually the only available treatment for degenerated tissue valves. However, redo surgery for bioprosthetic valve failure carries a high mortality of around 3%–23%. [14] In the present study, redo mitral valve more common at advanced age and in female than male and these results agreed with Gurvitch et al.[13] and Chandra et al.[14] who reported that advancing age, female sex, renal or pulmonary dysfunction, severity and urgency of disease, and number of previous redo surgeries are some of the factors associated with increased risk.

Guerrero et al.[I6done their work on 494 patients and showed that the mean age was 76 years who underwent redo mitral valve and these age was more than age of our study due to large sample size of their study when compared with our study and 60.9% were females.

Failure of mitral valve prostheses in older patients who had multiple comorbidities is a high-risk clinical scenario with redo surgery[15].

Regarding ejection fraction, there were 12 [80.0%] with Good [LVEF>50%] in group I versus 11 [73.3%] in group II, 2 [13.3%] with fair [LVEF 30%–50%] versus 3 [20.0%] and 1 [6.7%] with poor [LVEF<30%] versus 1 [6.7%], respectively. The trans-atrial approach may decrease apical function of left ventricle but it is transient. [16] In patients with already decreased ejection fraction of left ventricle or with functional regurge of mitral valve, it may be a less than optimal approach. It may also be technically difficult if there is a pre-existing prosthetic heart valve in the aortic position [17], whereas the TS approach may be less challenging. However, limited data are available [18].

In conclusion, trans-septal approach seems to be similarly effective and safe as trans-atrial approach. However, long-term researches are required to establish the proportional efficacy of one approach over the other.

Limitations of the study: the main limitations of the present work is the small number of included subjects and the inability to randomize our patients.

Financial and Non-Financial Relationships and Activities of Interest

None

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