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## Original Article

# Retrospective Study of Redo Mitral Valve Surgery in Cardiothoracic Surgery Department Al-Hussein University Hospital

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## ABSTRACT

**Background:** Cardiac surgery became more common. This led to increased redo-surgeries with expected increase of overall complications after the redo. The used approach could affect overall outcome. However, this is not addressed well in literature.

**Aim of the work:** To examine the overall outcome of patients underwent redo-mitral valve replacement [redo-MVR].

**Patients and methods:** This study is a retrospective comparative study that was conducted in Cardiothoracic Surgery Department, Al-Hussein University Hospital in the last three years [from January, 1st, 2017 to the end of December 2019]. Collected data included patient demographics, surgical approach and overall short-term outcome.

**Results:** The current study included 37 patients; the mean age was 45.19±9.16 years. The most common indication for redo was pannus formation [48.6%], followed by thrombosis [45.9%]. There was no significant difference between preoperative and postoperative heart rhythm. Redo sternotomy was the commonest, reported in all patients, and femoral bypass done for 3 patients. Trans-atrial approach reported in 24 patients [64.86%] while Trans-septal approach reported in 13 patients [35.14%]. No significant difference between preoperative and postoperative echo data [Ejection Friction, left atrial dimension or left ventricle end diastolic dimension]. However, there was significant reduction of left ventricle end-systolic dimension [LVESD], pulmonary artery systolic pressure [PASP] and pressure gradient [PG] cross mitral valve after operation. Reoperation for bleeding was not reported in any cases, while need for new pacemaker reported in 2 patients [5.41%], new postoperative neurological dysfunction reported in new heart failure or need to dialysis in two patients [5.41%]. The postoperative arrhythmia was reported in 7 patients [18.9%] and mortality was occurred in three patients [10.8%].

**Conclusion:** The results of the current study showed that, both transseptal and transatrial approaches are comparable and no one is superior to the other.

**Keywords:** Mitral Valve; Reoperation; Transseptal; Tansatrial; Outcome.

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## INTRODUCTION

The mitral valve is consisted of several components. It contains two leaflets, tendinous chords and the papillary muscles. In addition, it had an annular attachment located at the junction between the atria and the ventricles [1]. The annulus defines the junctional zone which separates the left atrium from the left ventricle, and attaches to the mitral valve [2]. In a normal valve, the leaflets have fan-shaped threads that extend from the papillary muscles and ends into the leaflets. [3]. Regurgitation of the mitral valve [MR] is even more predominant. Although rheumatic heart disease has decreased, MR is the second most common valve disease in European adults [4]. When the probability of a successful repair is high, surgical repair should be performed as much as possible [5].

In general, mitral valve repair had a better prognosis than mitral valve replacement [MVR] when operated at the first place. However, MVR is still required in some patients where mitral valve repair is precisely not possible. On the other hand, many patients will require redo-MVR upon due to many indications that will be noticed during the follow-up. Many approaches had been advocated to prevent the potential complications of redo-sternotomy such as damage to the previous grafts and hemorrhage. These approaches include right thoracotomy, mini-thoracotomy, and port-access surgery. An alternative promising choice is trans-apical transcatheter MV-in-valve implantation, which propose a more safe approach for patients at risk [6].

The main complications for redo surgery include infective endocarditis, paravalvular leak, prosthetic patient mismatch, valve thrombosis and valve degeneration [Bio prosthesis] [7]. Prosthetic valve thrombosis is considered a rare but critical complication of the valve replacement [8]. Other complications include re-exploration for bleeding, supra-ventricular arrhythmias, permanent pacemaker, endocarditis, hemofiltration and cerebrovascular event [7].

## THE AIM OF THE WORK

The aim of this work is to study the overall outcome of patients underwent redo-mitral valve replacement [redo-MVR] at Cardiothoracic Surgery Department Al-Hussein University Hospital in last three years over lighting indication of redo and approach to mitral valve.

## PATIENTS AND METHODS

This study is a retrospective comparative study that was conducted in Cardiothoracic Surgery Department, Al-Hussein University Hospital in the last three years [from January 1<sup>st</sup>, 2017, to the end of December 2019].

## Inclusion criteria

This retrospective study included all patients who underwent redo-mitral valve replacement with either mechanical or bioprosthetic valves.

## Exclusion criteria

Alternative mitral valve intervention [e.g. mitral valve repair, mitral valvuloplasty, open or closed mitral commissurotomy] without MVR, coronary artery bypass graft [CABG], end stage renal or hepatic diseases.

## Methods

Patients were identified and data was collected from medical records.

### The Preoperative assessment included

- Detailed history.
- Full clinical examination.
- Investigation including: Laboratory work up, chest x ray, electrocardiography [ECG] for heart rhythm and presence of permanent pacemaker, transthoracic echocardiography and trans-esophageal echo for assessment of ejection fraction, other valvular lesions, left atrial size and detection of left atrial thrombus.
- Indications of redo-surgery.

### Intraoperative assessment

Included total operation time, total bypass time, cross clamp time, type of cardioplegia, [femoral bypass with or without], need for a temporary or permanent pacemaker after surgery patients need for the inotropic support or not and other intraoperative complications.

### Postoperative assessment included

- Full intensive care unit [ICU] monitoring.
- Postoperative cardiac rhythm, need for transfusion and incidence of postoperative complications such as myocardial infarction, cerebrovascular accident, renal failure, respiratory failure, sternal infection, pneumonia and early mortality.
- ICU medication including the need for inotropic support.
- Hospital stay.

- Early postoperative laboratory investigations, electrocardiogram [ECG] and echocardiography before discharge from hospital.
- The favorable outcome was assigned to patients with absent in-hospital mortality and improved clinical signs after surgery, including reductions of preoperative medications. Otherwise, the outcome was assigned as unfavorable.

**Statistical analysis of data**

Data were analyzed using statistical package for social sciences [SPSS] version 19 [SPSS Inc, Chicago, USA], running on IBM compatible computer. Independent samples [f] test and chi square tests were used to compare groups. For all tests p value <0.05 were considered significant.

**RESULTS**

The current work included 37 patients; their age ranged between 27 to 63 years; the mean age was 45.19 ± 9.16 years. In addition, 14[37.8%] patients were males and 23 [62.2%] were females. Smoking was reported in 13 subjects [35.1%] and 5 [13.51%] had history of diabetes, while 5 [13.51%] had history of hypertension. The most common indication was pannus formation [reported in 18 patients; 48.6%], followed by thrombosis in 17 patients [45.9%], then paravalvular leak in 2 patients [5.5%] and prosthetic valve dysfunction not reported in any patients. No patients had grade I “New York Heart Association” [NYHA] class, 2 [5.5%] were grade II, 18 [48.6%] were grade III and 17 [45.9%] were grade IV. The surgical technique was redo-sternotomy among all patients. Three out of them [8.11%] had femoral bypass. The approach was trans-atrial among 24 patients [64.86%] and trans-septal among 13 [35.14%].

In the current work, there was no significant difference after redo surgery regarding sinus rhythm, ejection fraction,

left atrial [LA] dimension and left ventricle end diastolic dimension [LVEDD]. However, there was significant decrease of LVESD, PASP and PG gross mitral valve after surgery when compared to corresponding values before surgery [Table 1].

Regarding operative parameters, the bypass time ranged between 88 to 105 minutes. The cross-clamp time [MV replace] ranged between 68 to 80 minutes. The prosthesis size ranged between 27 to 33, while weaning from bypass was ranged between 27 to 35 minutes. The type of prosthesis was mechanical [100%] [Table 2].

As regard postoperative assessment, the postoperative Ventilation time it ranged between 0.75 to 4 [days], the mean value was 1.51 ± 1.00 days. In addition, ICU stays ranged between 3 to 5 days; the mean value was 3.86±0.82 days. The total duration of hospital stay ranged between 7 to 11 days; the mean value was 8.81±1.43 days [Table 3].

As regard to postoperative in hospital complications, the reoperation for bleeding not reported in any cases, while need for new pacemaker reported in 2 patients [5.41%], new postoperative neurological dysfunction, reported in 2 patients [5.41%], new heart failure or need to dialysis in 3 patients [8.1%], postoperative arrhythmia was reported in 4 patients [10.81%] and mortality was occurred in 3 patients [8.10%] [Table 4].

The outcome was favorable among 20 patients [54.1%] and unfavorable among 17 [45.9%]. Favorable outcome, regardless of the approach, was significantly associated with younger age. No significant associations were observed with patient gender, history of pulmonary disease or diabetes, indications of redo surgery and NYHA class. In addition, there were no associations between favorable outcome and ejection fraction, surgical technique, operative data, ICU stay duration, or type of prosthesis. Favorable outcome was linked to high percentage of smoking [Table 5].

**Table [1]:** Comparison between preoperative and postoperative heart rhythm

		Preoperative	Postoperative	Test	P
<b>Heart rhythm</b>	Sinus rhythm	24[64.9%]	20[54.1%]	-0.946	0.173
	Atrial fibrillation/flutter	11[29.6%]	15[40.4%]	0.973	0.166
	Complete heart block/pacing	2 [5.5%]	2 [5.5%]	0.0	0.50
<b>Echocardiography</b>	Ejection Friction [%]	50.16 ± 6.1	53.59 ± 9.76	-1.81	0.074
	LA Dimensions [Cm]	5.23 ± 0.69	5 ± 0.58	1.55	0.123
	LVED [Cm]	5.88 ± 0.32	5.88 ± 0.32	0.0	1.00
	LVES [Cm]	4.12 ± 0.31	3.83 ± 0.23	4.57	0.001 *
	PASP [mmHg]	50.35 ± 12.38	42.3 ± 5.3	3.64	0.007 *
	PG Cross Mitral valve [mmHg]	16.03 ± 3.56	4 ± 0.82	20.03	0.001 *

**Table [2]:** Operative assessment data

Parameters		Total [n=37]	
		Average [or number]	Mean ± SD [or %]
Bypass time [min]		88 – 105	92.43 ± 3.44
Cross-clamp time [MV replace]		68 – 80	73.7 ± 3.66
Size of prosthesis		27 – 33	29.92 ± 2.29
Weaning from bypass		27 – 35	30.97 ± 2.59
Prosthesis type	Bioprosthesis	0	0%
	Mechanical	37	100%
Cardiac Supports	Adrenalin	37	100%
	Nor-Adrenalin	3	8.11%
	Dopamine	22	59.46%

**Table [3]:** Post-operative assessment data

Parameters	Total [n=37]	
	Average	Mean ± SD
Ventilation time [in days]	0.75 – 4; [18-96 H]	1.51 ± 1.00
ICU stay [in days]	3 – 5	3.86 ± 0.82
Total duration of hospital stay [in days]	7 – 11	8.81 ± 1.43

**Table [4]:** Postoperative in hospital complications

Variables	Number	%
Reoperation for bleeding or tamponade	0	0%
Patients requiring new pacemaker	2	5.41%
New post-op neurological dysfunction	2	5.41%
New HF/dialysis postoperatively	3	8.12%
Mortality	3	8.12%
Post-operative arrhythmia	4	10.81%

**Table [5]:** Association between favorable outcome and studied variables

		Unfavorable	Favorable	Test	P
Age		52.82±4.90	48.05±6.54	2.47	0.018*
Sex	Male	4[23.5%]	10[50.0%]	2.93	0.09
	Female	13[76.5%]	10[50.0%]		
Smoking		3[17.6%]	10[50.0%]	4.22	0.040*
History of Hypertension		3[17.6%]	2[10.0%]	3.46	0.06
History of Diabetes		3[17.6%]	2[10.0%]	0.03	0.85
Redo indications	Thrombosis	10[58.8%]	7[35.0%]	1.43	0.69
	Pannus formation	10[58.8%]	8[40.0%]		
	Paravalvular leak	1[5.8%]	1[5.0%]		
	Prosthetic valve dysfunction	0[0.0%]	0[0.0%]		
NYHA Class	Class-I	0[0.0%]	0[0.0%]	6.33	0.17
	Class-II	1[5.8%]	1[5.0%]		
	Class-III	10[58.8%]	8[40.0%]		
	Class-IV	12[70.5%]	5[25.0%]		

## DISCUSSION

Cardiac surgeries are increased all over the world during the past decades. As a result, more patients with mitral valve redo are reported due to different etiologies. This redo surgery is a challenging practice due to its associated higher risk of morbidity and mortality<sup>[9]</sup>. Further evaluations of factors associated with its outcome are

required. Thus, the current work was designed to check for the outcome of redo mitral valve replacement surgery.

Results regarding patients age and sex are partially in agreement with Castillo-Sang *et al.*<sup>[10]</sup> who reported that, females represented 63.8% of their patients, and the mean [SD] age was 61.3 [13.9] years. The age of our patients is younger, and this is attributed to different inclusion criteria

and the early heart disease in our patients, due to different factors. In addition, our patients are heterogeneous compared to their patients who had only pulmonary hypertension. Furthermore, Ejiofor *et al.* [11] reported that, the mean age was  $64 \pm 12$  years for redo-mitral valve repair and  $63 \pm 15$  years for prior mitral valve replacement, with 60% being women in both groups.

In the current study, the most common indications were pannus formation [reported in 18 patients; 48.6%], followed by thrombosis in 17 patients [45.9%]. These results are in contradiction to those reported by Castillo-Sang *et al.* [10] who reported that, prosthesis dysfunction was the most common indication [53.6%], followed by myxomatous, calcific, and rheumatic disease [both 34.8%]. Again, this is due to different inclusion criteria. Sampath Kumar *et al.* [12] also reported that the most common indications of redo-MVR were failed MV repair [38%] and valve thrombosis [32%].

Regarding NYHA classification among studied groups, no patients [0%] were grade I, 2 [5.5%] were grade II and 18 [48.6%] were grade III and 17 [45.9%] were grade IV. These results are not in agreement with Onorati *et al.* [13] who reported that 18 [7.3%] were grade I, 81 [32.9%] were grade II and 122 [49.6%] were grade III and 25 [10.2%] were grade IV. Current results are also in agreement with Vohra *et al.* [14] regarding the absence of significant association between NYHA class and outcome. Ejiofor *et al.* [11] found similar findings and explained it by the preserved left ventricular ejection fraction in their patients [more than 60%].

In the current study, there is no significant difference between preoperative and postoperative heart rhythm in studied group; sinus rhythm was reported among 24 [64.9%], atrial fibrillation/flutter among 11 [29.7%] and complete heart block/pacing among 2 [5.5%]. Regarding postoperative heart rhythm, sinus rhythm was reported among 20 [54.1%], atrial fibrillation/flutter among 15 [40.4%] and complete heart block/pacing among 2 [5.5%], one of them need permanent pacemaker. These results are not in agreement with Fukunaga *et al.* [15] who reported that atrial fibrillation was observed in almost 70% of patients of study with no significant difference in sinus rhythm and pacing. Masuda *et al.* [16] found that the majority of patients [96%] with preoperative sinus rhythm remained as such postoperatively, which was not statistically significant. Rezahosseini *et al.* [17] results showed that the postoperative atrial fibrillation was still higher than preoperative atrial fibrillation and left atrial size factors.

Regarding surgical technique, redo sternotomy was the most common, reported in 37 patients [100%], followed by

femoral bypass 2 patients [8.11%]. Regarding the approach, 24 patients [64.86%] were operated through Trans-atrial and 13 [35.14%] through transseptal and there was no significant difference between both approaches, while no patient reported redo via thoracotomy. Patel *et al.* [18] concluded that reoperation of mitral valve surgery via thoracotomy is safe and is associated with lesser ventilation time, reduced ICU and total hospital stay, rapid recovery following surgery, and decreased need for perioperative blood transfusion. Other studies [19, 20] support these results, particularly in the setting of primary mitral valve procedures. The trans-atrial approach may reduce left ventricular apical function, but it is not permanent [21]. For patients with reduced left ventricular ejection fraction or functional mitral regurgitation, this may not be the best approach. In the case of a pre-existing artificial heart valve in the aortic location, this can also be a technical challenge [22], whereas the TS approach may be less challenging, although only limited data are available [23].

Regarding operative parameters, the bypass time ranged between 88 to 105 minutes. The cross-clamp time ranged between 68 to 80 minutes. While Onorati *et al.* [13] reported that cross-clamping time  $87 \pm 37$  min and bypass time  $133 \pm 56$  min. The type of prosthesis was Bio-prosthesis [100%]. The results agree with Kaneko *et al.* [24] who showed the superiority of mechanical valves, especially in younger populations, and reported higher use of such mechanical prosthesis in their patients, as in the current work. While Onorati *et al.* [13] reported that cross-clamping time  $87 \pm 37$  min and bypass time  $133 \pm 56$  min.

Regarding postoperative complications, the reoperation for bleeding not reported in any cases, while need for new pacemaker reported in 2 patients [5.41%], new postoperative neurological dysfunction reported in 2 patients [5.41%], postoperative arrhythmia was reported in 4 patients [10.81%] and mortality was occurred in 3 patients [8.10%] that's was due to difficulty weaning, low cardiac output in spite of supports and finally renal impairment. While Fukunaga *et al.* [15] who reported that patients with renal dysfunction need dialysis were found in 152 [36.7%] patients. The number of patients who required hemodialysis was 6 [1.4%]. Onorati *et al.* [13] reported mortality in 3 patients [6.5%], reoperation for bleeding or tamponade 6 [13.0%] and Need for permanent pacemaker in 2 [4.3%] which in partially agreement with this study.

Favorable outcome was significantly associated with younger age. However, no significant association was observed with patient gender, history of hypertension or diabetes, indications of redo surgery and NYHA class. In addition, no association was reported between favorable

outcome and surgical technique, operative data, ICU stay duration, or type of prosthesis. Unexpectedly, favorable outcome was linked to high percentage of smoking. However, it could be attributed to the fact that, smoking is restricted to males.

On the other side, Sampath Kumar *et al.* [12] reported that the overall mortality rate of reoperation for heart valve disease is higher than that of the initial operation. Their observations showed that the factors leading to higher mortality were active infective endocarditis, a higher grade of preoperative NYHA, and valve thrombosis. These results are in controversy to the current work and could be attributed to different inclusion criteria.

Left ventricular outflow tract [LVOT] obstruction may occur after redo surgical mitral valve replacement [SMVR] due to interference by the surgical implant [25]. Guerrero *et al.* [26] reported that LVOT obstruction was reported in 5.4% patients, and more than mild mitral regurgitation was reported in 4.3%. In-hospital mortality was 6.9% and 30-day mortality was 9%.

The transatrial [TA] approach allows direct access to the mitral valve position, an anatomically short distance and easy to operate, which is attributed to the initial success of this approach, which improves operator familiarity. In fact, with this method, most mitral valve operations can be performed by the surgeon standing on the right or left side of the patient [27]. It is important that the type of mitral valve surgery each patient receives and / or their ability to perform the accompanying labyrinth surgery is not affected by the decision to perform a non-sternotomy [28].

The incidence of one-month postoperative mortality in the current work was 10.8%. This is in line with Castillo-Sang *et al.* [10] who reported an incidence of 10.1% after redo-mitral valve surgery in patients with pulmonary hypertension. In addition, they reported that, postoperative arrhythmia was the most common complications [45.3%] which in line with the current work, despite the difference in percentage of occurrence [18.9% in the current work]. Previous reports suggest that re-MVR is a high-risk procedure with a 5% to 12% operative mortality [14, 29] and a 7-year survival of 69% [30]. This is largely due to the increased technical difficulty inherent in reoperation, the more fragile patients undergoing reoperation, and prosthetic valve endocarditis is a common indication for reoperation [11].

Akay *et al.* [31] reported a reoperative mortality of 6.4% in cohort of 62 patients, and Vohra *et al.* [14] reported a 12% rate in a cohort of 49 patients over a 10-year experience.

Fukunaga *et al.* [15] reported that, the overall rate of hospital death was 5.8% [32/555 redo procedures] and the 30-day mortality was 3.0% [17/555 redo procedures]. Nienaber and Glower [32] compared the mini-transseptal [TS] and the transatrial approaches and found no increase in the incidence of postoperative atrial fibrillation in the former technique. Perhaps the differences between our results and those reported by the Nienaber and Glower [32] study are due to the shorter atrial incision, faster atrial closure time, and lesser injury to the sinus nodal artery in the mini-TS approach. Wang *et al.* [33] concluded that the extending vertical transseptal approach affords excellent exposure of the mitral valve.

The present study had some limitations; data are lacking regarding the type of valves used in the first operation, and the duration before redo surgery.

## CONCLUSION

In conclusion, the results of the current study showed that younger patient had good outcome, pannus formation and thrombosis are the most common indication of redo mitral valve replacement, choice of approach is directly in relation without come either intra/or post-operative assessment.

## Financial and Non-financial Relationships and Activities of Interest

None

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# International Journal

The cover art features a magnifying glass, a globe, and a stethoscope. The background is a light beige color with a faint, repeating pattern of ECG (heart rate) lines. The magnifying glass is positioned on the left side, with its handle extending towards the bottom. The globe is centered in the lower half of the image. The stethoscope is on the right side, with its chest piece near the globe. The overall color scheme is warm, with shades of beige, brown, and blue.

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