

## Surgical outcomes of heart valves replacement: A study of tertiary specialised cardiac center

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### Original Article

#### Abstract

**BACKGROUND:** Heart valve disease is a significant and increasing global problem in the developing world. The aim of this study is to evaluate the incidence of postoperative complications and mortality in patients who underwent heart valve replacement.

**METHODS:** In this prospective study, 320 adult cases (186 females and 134 males, mean age of:  $45.7 \pm 15.0$ ) with valvular heart diseases who underwent heart valve replacement at our center, from June 2011 to January 2012 were enrolled. All the required demographic, echocardiographic, and electrocardiogram data were studied. The incidence of intraoperative and early postoperative complications and mortality were evaluated.

**RESULTS:** Among total, 96.3% of the cases underwent elective surgery. Mitral valve replacement surgery was occurred the most in 58.8% of the cases. In 11.3% of the cases, bioprosthetic valves and in 88.8% of the patients prosthetic valves were required. Early postoperative complications were occurred in 85 patients (26.6%), including: valve-related events: 7 cases, postoperative arrhythmia: 24 patients, worsening function of the repaired valve: 16 cases and general complications: 38 patients. Mortality was occurred in 25 patients (7.8%), 10 cases due to cardiac problems versus 15 patients due to non-cardiac problems. There were significant correlations between age, simultaneous valve repair and replacement, the anatomic site of the valve and the incidence of postoperative complications. Age, history of diabetes mellitus (DM), hypertension (HTN), and high grade of functional capacity were reported the significant causes of postoperative mortality.

**CONCLUSION:** Age, DM, HTN, functional capacity and multivalve disease are significant predictors of post-valvular surgery morbidity and mortality.

**Keywords:** Heart Valve Diseases, Cardiac Surgery, Heart Valves

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#### Introduction

Valvular heart disease (VHD) is one of the most important cardiovascular diseases which its prevalence differs regarding age; gender and different societies.<sup>1</sup> There are various etiologies of VHD including rheumatic, degenerative, traumatic, congenital, and infectious heart diseases. VHD remains common in developing countries, because the increase in prevalence of rheumatic heart

diseases.<sup>2</sup> Rheumatic heart disease is caused by infection with group A beta-hemolytic streptococcus bacteria, and it occurs when the patient does not receive proper medical treatment. The prevalence of VHD has been also increased during the past years in industrialized countries due to increase in prevalence of degenerative valve diseases.<sup>3</sup> Surgery performs a main role in order to treat the patients with VHDs, which lead to less

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mortality and better quality-of-life. Heart valve replacement is the second most common type of heart surgery after coronary artery bypass graft surgery.<sup>4</sup> Different postoperative complications are associated with this procedure. In past studies, the rate of mortality following heart valve replacement was reported from 4.3% to 14%.<sup>1</sup> There are different rates of prevalence and incidence of VHDs between industrialized and developing countries and limited number of studies have been conducted regarding VHDs in Iran as a developing country, therefore, we conducted this study in order to determine the rates of postoperative complications and mortality in patients underwent heart valve replacement surgery in one of the tertiary center in our country.

### Materials and Methods

After approval of the study protocol was granted by the Institutional Review Board, this prospective cross-sectional study was conducted at Rajaie Cardiovascular Medical and Research Center, Tehran, Iran, from June 2011 to January 2012. This paper represents the results of the dissertation. There were 436 cases that underwent heart valve replacement surgery during this time interval; however 116 patients were excluded from this study due to exclusion criteria including concomitant coronary artery bypass graft surgery or other cardiac operations and simultaneous repair of complex congenital heart defects. Therefore, 320 adult cases (186 female and 134 male patients) with a mean age of:  $45.7 \pm 15.0$  were enrolled in this study. The data gathering forms were designed based on scoring system for reporting mortality and morbidity after cardiac valve interventions, European association for cardio-thoracic surgery.<sup>5</sup> All the required data, including present and history of the patients, echocardiographic data and preoperative and postoperative electrocardiogram parameters were studied. The incidence of intraoperative and early postoperative (in hospital) complications including; valve-related events (paravalvular leakage, thrombosis, endocarditis, and mismatch), worsening function of simultaneously repaired valve, arrhythmia and general complications [cerebrovascular accident (CVA), deep vein thrombosis, re-exploration due to massive bleeding and tamponade, myocardial ischemia]; and mortality were also evaluated for all the cases. Statistical analyses were performed with SPSS for Windows (version 15, SPSS Inc., Chicago, IL, USA). Differences were analyzed with Student's t-test for the values of a scaling term and Pearson's

chi-square test for nominal values.  $P < 0.05$  was considered to be statistically significant.

### Results

Among 320 adult cases, 186 (58.1%) were females and 134 (41.9%) were males with a mean age of:  $45.7 \pm 15.0$  years (minimum: 14 years, maximum: 83 years). Preoperative demographic data were analyzed, and the mean value of body mass index (BMI) among cases was  $24.8 \text{ kg/m}^2$ , and 43.1% of the patients had normal BMI (range from 18.5 to  $25.0 \text{ kg/m}^2$ ). Fifty-five patients (17.2%) had a history of hypertension (HTN), 20 cases (6.3%) had a history of diabetes mellitus (DM), 16 patients (5%) suffered from CVA, and 6 patients (1.9%) suffered from chronic renal failure before surgery. Among total, 205 patients (64%) had a history of cardiac interventions and percutaneous trans-venous mitral commissurotomy was the most frequent intervention (45 cases). Regarding New York Heart Association Functional Classification (FC), 92 cases (28.8%) were in FC I, 119 patients (37.2%) were in FC II, 95 cases (29.7%) were in FC III and 14 patients (4.4%) were in FC IV. The preoperative echocardiography revealed that 94 cases (29.4%) had normal left ventricular (LV) systolic function, 144 cases (45%) had mild [ejection fraction (EF)  $\geq 45\text{-}50\%$ ], 57 cases (17.8%) had moderate ( $35\% < \text{EF} < 45\%$ ) and 25 cases (7.8%) had severe ( $\text{EF} \leq 35\%$ ) LV dysfunction based on the preoperative echocardiography reports. Regarding right ventricular (RV) systolic function, 78 cases (24.4%) had normal RV function, however, 83 cases had mild [ $17 \text{ mm} \leq \text{tricuspid annular plane systolic excursion (TAPSE)} < 20 \text{ mm}$  and S velocity  $\geq 9 \text{ cm/s}$ ], 129 cases had moderate TAPSE ( $\geq 15\text{-}17 \text{ mm}$  or S velocity  $> 7\text{-}9 \text{ cm/s}$ ) and 30 cases had severe TAPSE ( $< 15 \text{ mm}$  or S velocity  $\leq 7 \text{ cm/s}$ ) RV dysfunction. About 125 cases (39.1%) had a history of one time cardiac surgery, while 14 cases (4.4%) had  $\geq 2$  times history of cardiac operations. Elective surgery was performed for 308 cases (96.3%), while 12 patients (3.7%) required emergent valve replacement. The frequencies of different procedures regarding the types of the operated valves have been demonstrated in table 1. Regarding the number of the operated valves for 69 patients (21.6%), 2 valves were replaced and in 5 cases (1.6%) 3 valves were replaced. Biologic valves were used in 36 cases (11.2%) while metallic valves were used in 284 patients (88.8%). Postoperative complications were occurred in 85 patients (26.6%), including: valve-related events (7 cases), arrhythmia

(24 cases), worsening function of the repaired valve (16 cases) and general complications (38 cases). The relationships between the incidence of postoperative complications and different factors including demographic data and type of the repaired valves have been demonstrated in tables 2 and 3. Mortality was occurred in 25 patients (7.8%) before discharge due to cardiac problems: 10 cases (3.1%) including arrhythmia: 6 patients (1.9%), heart failure and cardiogenic shock: 4 cases (1.3%) and non-cardiac problems: 15 cases (4.7%) including bleeding due to coagulopathy: 6 patients (1.9%), CVA or encephalopathy: 2 cases (0.6%), respiratory failure: 3 cases (0.9%), septicemia: 3 cases (0.9%) and multi-organ failure: 1 (0.3%). The relationships between the incidence of postoperative mortality and different factors including demographic data and type of the repaired valve have been demonstrated in tables 4 and 5.

**Table 1.** The frequencies of different valve replacement procedures

Operated valve	Frequency	Percent
MVR	120	37.5
AVR	72	22.5
PVR	44	13.8
TVR	10	3.1
MVR-AVR	56	17.5
MVR-TVR	7	2.2
MVR-AVR-TVR	5	1.6
AVR-PVR	1	0.3
AVR-TVR	2	0.6
PVR-TVR	3	0.9
Total	320	100

MVR: Mitral valve replacement; AVR: Aortic valve replacement; PVR: Pulmonary valve replacement; TVR: Tricuspid valve replacement

**Table 2.** The relationship between the incidence of postoperative complications and demographic data

Evaluated factors	Valve related events n (%)	P	Worsening function of repaired valve		Arrhythmia n (%)		General events n (%)	
			n (%)	P	n (%)	P	n (%)	P
Gender								
Male	2 (3.4)	0.471	5 (8.5)	0.377	6 (10.1)	0.081	16 (27.1)	0.976
Female	5 (5.0)		11 (11.0)		18 (18.0)		22 (22.0)	
Age								
< 25	3 (20.0)	< 0.001	2 (13.3)	0.254	1 (6.7)	0.180	3 (20.0)	0.063
25-45	8 (21.6)		2 (5.4)		8 (21.6)		11 (29.7)	
45-65	18 (21.4)		9 (10.7)		11 (13.1)		17 (20.2)	
65-75	1 (5.9)		3 (50.0)		4 (23.5)		6 (35.3)	
> 75	1 (16.7)		-		-		1 (16.7)	
Systolic function/dysfunction								
Normal	3 (6.1)	0.463	12 (24.5)	0.365	15 (30.6)	0.632	8 (16.3)	0.632
Mild	3 (4.2)		3 (4.2)		2 (2.8)		21 (29.6)	
Moderate	-		1 (3.6)		6 (21.4)		9 (32.1)	
Severe	1 (9.1)		-		1 (9.1)		-	
Type of prosthetic valve								
Biologic	-	0.341	3 (18.7)	0.330	1 (6.2)	0.254	4 (25.0)	0.880
Metallic	7 (4.9)		13 (9.1)		23 (16.1)		34 (23.8)	
History of cardiac OP								
No	4 (4.4)	0.840	9 (10.0)	0.250	13 (14.4)	0.944	18 (20.0)	0.100
1 time	3 (5.1)		5 (8.5)		10 (16.9)		16 (27.1)	
≥ 2 times	-		2 (20.0)		1 (10.0)		4 (40.0)	

OP: Operation

**Table 3.** The relationship between the incidence of postoperative complications and type of the repaired valve

Postoperative complications	Frequency	Type of the repaired valve					Type of the repaired valve					P
		AVR	MVR	PVR	TVR	MVR-AVR	MVR-AVR-TVR	AVR-TVR	MVR-TVR	PVR-TVR		
Valve related events	7	1	4	0	0	2	0	0	0	0	0	0.962
Worsening function of repaired valve	16	2	7	2	0	3	0	1	1	0	0	0.227
Arrhythmia	24	3	14	0	1	3	1	0	1	1	1	0.167
General complication	38	7	3	1	3	10	2	1	1	0	0	0.304

AVR: Aortic valve replacement; MVR: Mitral valve replacement; PVR: Pulmonary valve replacement; TVR: Tricuspid valve replacement

**Table 4.** The relationship between the incidence of postoperative mortality and demographic data

Evaluated factors	Mortality [n (%)]	P
Gender		
Male	9 (6.71)	0.555
Female	16 (8.60)	
Age (year)		
< 25	1 (2.38)	< 0.001
25-45	4 (3.84)	
45-65	9 (6.71)	
65-75	7 (24.10)	
> 75	4 (36.30)	
Past medical history		
HTN	9 (16.36)	< 0.001
DM	7 (35.00)	< 0.001
CRF	1 (16.66)	0.415
CVA	1 (6.25)	0.473
NYHA FC		
FC I	5 (5.43)	0.039
FC II	7 (5.88)	
FC III	9 (9.47)	
FC IV	4 (28.57)	
Systolic function/dysfunction		
Normal	6 (6.38)	0.290
Mild	11 (7.63)	
Moderate	4 (7.01)	
Severe	4 (16.00)	
History of operation		
No	13 (7.18)	0.838
1 time	11 (8.80)	
≥ 2 times	1 (7.14)	
Priority of the surgery		
Elective	18 (5.84)	< 0.001
Emergent	7 (58.33)	
Number of repaired valve		
1	17 (6.43)	0.600
2	7 (10.14)	
3	1 (20.00)	

HTN: Hypertension; DM: Diabetes mellitus; CRF: Chronic renal failure; CVA: Cerebrovascular accident; NYHA FC: New York Heart Association Functional Classification

**Table 5.** The relationship between the incidence of postoperative mortality and type of the repaired valve

Operated valves	Mortality [n (%)]	P
AVR	7 (9.7)	0.099
AVR-TVR	1 (50.0)	
MVR	9 (7.5)	
MVR-AVR	4 (7.1)	
MVR-AVR-TVR	1 (20.0)	
MVR-TVR	2 (28.6)	
TVR	1 (10.0)	
Total	25	

AVR: Aortic valve replacement; TVR: Tricuspid valve replacement; MVR: Mitral valve replacement

## Discussion

The burden of heart valve disease among adults is enormous in the developing countries. The high prevalence of rheumatic heart disease remains the predominant contributor to heart valve dysfunction, which if uncorrected lead to congestive heart failure and increased morbidity and mortality. Heart valve replacement is the second most common type of heart surgery after coronary artery bypass graft surgery.<sup>4</sup> Geissler et al. declared in their study that 30,000 heart valve replacement surgeries are performed annually due to increase in prevalence of degenerative valve diseases in developed countries.<sup>5</sup> Regarding the increased rate of this type of procedure in this study we evaluated the incidence of complications and mortality following heart valve replacement surgery. Regarding the risk model to predict the incidence of mortality and morbidity after aortic and/or mitral valve replacement or repair in the study of Ambler et al. the significant factors were age, gender, female, BMI > 20 kg/m<sup>2</sup>, renal failure, HTN, diabetes, arrhythmia, EF and the number of previous cardiac surgeries.<sup>6</sup> Similar to our study, the incidence of postoperative events were higher in female patients. In contrast to the study of Ambler et al. the incidence of valve-related events was significantly higher in group of patients with age 25-45 years.<sup>6</sup> The mentioned result may be due to more mitral valve replacement requirement in younger adults that essentially accompanies more complications compared with aortic and pulmonary valve replacement. However, there was no significant relation between preoperative LV EF, type of the prosthetic valve, the number of previous cardiac operations and the incidence of postoperative events. In the study of Shahian et al.<sup>7</sup> and O'Brien et al.<sup>8</sup> the incidence of mortality following heart valve replacement surgery was 4.3-14.0%. In our study, this criteria was occurred in 7.8% of the cases. In the study of Shinn et al. mortality rate was reported in 6.9% of cases who underwent heart valve replacement surgery, and the contributor factors were old age, preoperative renal failure, postoperative pulmonary events and stroke.<sup>9</sup> Based on European system for cardiac operative risk evaluation (Euroscore), significant factors for the incidence of mortality and morbidity following heart valve replacement surgery are: old age, female gender, chronic obstructive pulmonary disease, neurologic dysfunction, history of recent cardiac surgery, renal dysfunction, impaired ventricular function, emergency cardiac surgery, and pulmonary HTN. In our study, mortality rate was higher in

female group with no significant difference. The incidence of mortality was significantly more in old age group (age > 75 years) and patients who underwent emergent procedures. There was a statistically significant relation between the incidence of mortality and the history of HTN and diabetes. Also the type of the prosthetic valve, the anatomic site of the repaired valve and the number of repaired valves were reported as the significant factors for the incidence of mortality.<sup>7,8</sup> In contrast, in our study, no significant relation was reported between the incidence of mortality and the mentioned factors. This difference may be due to the different study population in the study by Shahian et al.<sup>7</sup> The cases in the study of Shahian et al. underwent valve replacement surgery in addition to coronary artery bypass grafting.<sup>7</sup>

### Conclusion

Based on the results, age, presence of DM, HTN, high grade of functional capacity and multivalve disease are significant predictors of post-valvular replacement morbidity and mortality.

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### Conflict of Interests

Authors have no conflict of interests.

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