ORIGINAL ARTICLE

Outcome of Double Vs. Single Valve Replacement For Rheumatic Heart Disease

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ABSTRACT

Objective: To compare the follow-up results of double valve replacement (DVR) i.e. mitral valve replacement (MVR) and aortic valve replacement (AVR) vs. isolated MVR or AVR for rheumatic heart disease.

Study Design: An interventional qausi-experimental study.

Place and Duration of Study: Department of Cardiac Surgery, Punjab Institute of Cardiology, Lahore, from September 1994 till December 2007.

Methodology: Prospective follow-up of 493 patients with mechanical heart valves was carried out using clinical assessment, international normalized ratio and echocardiography. Patients were divided into three groups: group I having MVR, group II having AVR and group III having DVR. Survival, time and causes of mortality, and frequency of valve thrombosis, haemorrhage and cerebrovascular haemorrhage was noted in the three groups and described as proportions. Actuarial survival was analyzed by Kaplan-Meier method.

Results: There were 493 with 287 (58.3%) in group I, 87 (17.6%) in group II and 119 (24.1%) in group III. Total follow-up was 2429.2 patient (pt)-years. Of 77 (15.6%) deaths, 19 (3.8%) were in-hospital and 58 (11.8%) were late. In-hospital mortality was highest 4 (4.6%) in group II followed by 5 (4.2%) group III and 10 (3.5%) group I. Late deaths were 39 (13.4%) in group I, 9 (10.2%) in group II and 10 (8.3%) in group III. The total actuarial survival was 84.4% with survival of 83%, 85.1%, 87.4% in groups I, II and III respectively. On follow-up valve thrombosis occurred in 12 (0.49%/pt-years) patients; 9 (0.67%/pt-years) group I, 1 (0.22%/pt-years) in group II and 2 (0.31%/pt-years) in group III. Severe haemorrhage occurred in 19 (0.78%/pt-years); 14 in (1.04%/pt-years) in group I, 3 (0.66%/pt-years) group II and 2 (0.31%/pt-years) in group III. Cerebrovascular accidents occurred in 34 (1.3%/pt-years); 26 (1.95%/pt-years) in group I and 4 in groups II (0.89%/pt-years) and III (0.62%/pt-years) each.

Conclusion: In patients with rheumatic heart disease having combined mitral and aortic valve disease DVR should be performed whenever indicated as it has similar in-hospital mortality and better late survival as compared to isolated aortic or mitral valve replacement.

Key words: *Rheumatic heart disease. Prosthetic heart valves. Double valve replacement. Hospital mortality. Valve thrombosis. Survival.*

INTRODUCTION

Rheumatic heart disease (RHD) is still prevalent in the Third World countries with a reported incidence of 5.7 in 1000 in Pakistan.[1] It has a rapid progression leading to death and disability in a young age.[2] As a result of the almost complete eradication of rheumatic fever in industrialized countries, the mitral-aortic valve diseases are less frequent.[3]

Surgery for combined mitral and aortic valve disease was introduced for the first time in the early 1960s[4] and because of a high operative mortality some reluctance remained over the preceding decade to refer a patient for double valve surgery.[4] Hospital mortality rate of combined aortic and mitral valve operation ranges from 5-15%[5-7] with a 10-year survival rate of 50-70%.[8,9] Ten-year survival after aortic valve replacement (AVR) was better at 72.1% than after double valve replacement (DVR 62.3%) or mitral valve replacement (MVR 54.4%) alone.[10]

DVR has been advocated as a standard surgical option in patients requiring surgery for mitral and aortic valve disease.[11-13] However, aortic valve replacement with mitral valve repair has been advocated by contemporary series.[5,14,15] Patients having rheumatic mitral valve disease are predisposed to late mitral valve failure. Young age, rheumatic mitral stenosis and regurgitation, leaflet calcification or severe subvalvular disease are identified as factors leading to late MV failure. Hence, replacement instead of repair is recommended.[16,17]

Due to younger age and severe disease at the time of presentation, it is preferred to conduct double valve replacement instead of aortic valve replacement and mitral valve repair. This study was designed to compare the follow-up results of single valve replacement MVR or AVR vs. DVR (MVR with AVR) in patients with rheumatic heart disease.

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METHODOLOGY

Prospective follow-up of 493 patients was carried out at the Punjab Institute of Cardiology, Lahore, Pakistan between September 1994 and December 2007. This included clinical assessment, international normalized ratio (INR) measurement, and echocardiography. All consecutive patients undergoing mechanical heart valve replacement for rheumatic heart disease by the same surgeon were included. Patients undergoing valve replacement for non-rheumatic and/or congenital causes like bicuspid aortic valve were excluded. The patients were divided into three groups, group I underwent mitral valve replacement (MVR), group II aortic valve replacement (AVR), and group III underwent double valve replacement (DVR) i.e. combined aortic and mitral valve replacement.

Cardiopulmonary bypass was established using a membrane oxygenator, moderate systemic hypothermia. Myocardial preservation was done with blood cardioplegia repeated every 20-25 minutes. The types of mechanical valves used were (Starr-Edwards, St. Jude Medical, Carbomedics and Sorin). Till December 2003 ball and cage (Starr Edward valve) was used and since then we are using bileaflet valves. Standard left atrial exposure for mitral valve replacement (MVR) using semi-continuous 3-4 prolene sutures (2-0 Ethicon Prolene Ethicon INC, USA) was done in all patients undergoing MVR. Transseptal approach was used and posterior mitral leaflet (PML) was preserved as required. Ten patients also required a tricuspid valve repair. In patients with aortic valve disease undergoing aortic valve replacement (AVR) an oblique aortotomy was used to expose the aortic valve. AVR was done with interrupted, pledgletted Ethicon Ethibond Excel 2-0 sutures (Johnson & Johnson Intl. USA). In double valve replacement DVR (AVR+MVR) after excising the aortic valve the mitral valve was excised. After completing the operation and de-airing the heart cross clamp was released and patients were weaned from CPB. There has been no difference in operative methods since the study started.

All patients were shifted to cardiac surgical intensive care. After removal of chest drains on first postoperative day, injectable unfractionated heparin (UFH) 5000 unit subcutaneously 8 hourly and oral Warfarin was commenced. This was continued till INR was greater than 2 when heparin was omitted. Patients were maintained on an INR ranging between 2.5-3.5. All patients were assessed by 2D and color Doppler echocardiography (Toshiba 6000 Power Vision) pre-operatively and postoperatively in ICU and prior to discharge.

The primary endpoint was mortality (early and late). Early mortality was death within 30 days postoperatively or during the same hospital admission. The secondary endpoints were early and late complications. Early complications included pericardial effusion sufficient to cause hemodynamic compromise requiring pericardiocentesis, and wound infection during hospital stay. Late complications comprised anticoagulant-related events, such as valve thrombosis, central nervous system complications and bleeding. Valve thrombosis was defined as any thrombus in the absence of infection, attached to or near a valve, which partly occluded blood flow or interfered with valve function.[18] Central nervous system complications were defined according to guidelines for reporting morbidity and mortality by Edmunds *et al.*[18]

Females of child bearing age contemplating pregnancy were followed-up until completion of the gestational period. During the early years of the study, they were given 5,000 IU of subcutaneous heparin 6-8 hourly in the 1st 12 weeks, followed by oral warfarin therapy until the last 15 days of pregnancy, when they were admitted and switched to heparin therapy. Warfarin was restarted 24 hours after delivery at the pre-delivery dosage, alongwith heparin until INR > 2. This practice has changed, and warfarin is currently continued until 36 weeks when the patient is admitted and switched to intravenous heparin to maintain an activated partial thromboplastin time > twice the control level.

The data was analyzed using Statistical Package for Social Sciences version 14.0. Categorical variables were expressed as percentages, and continuous variables were given as mean ± standard deviation. Actuarial survival was analyzed by the Kaplan-Meier method. Events were defined as death and valve-related complications. These events were compared between the three groups by applying chi-square test and p-values were calculated. A p-value of less than 0.05 was taken as significant. Continuous variables like age, weight, body surface area, aortic cross clamp and cardiopulmonary bypass time were compared using ANOVA test. Linearized event rates were calculated by dividing the total number of events by the patient-years of follow-up.

RESULTS

There were 287 patients in group I, 87 in group II and 119 in group III. In group I, the predominant lesion was mitral stenosis occurring in 169 (58.9%) followed by mitral regurgitation 103 (35.9%) and mixed mitral valve disease. In group II, the predominant lesion was aortic regurgitation 48 (55.2%). In group III the most commonly observed lesion was mitral regurgitation and aortic regurgitation 46 (38.7%) followed by mitral stenosis and aortic regurgitation in 28 (23.5%) cases (Table I).

The mean age of the study population was 30±11.6 years which was similar in the three groups. Overall there were 284 (57.6%) males and 209 (42.4%)

Table I: Valve lesions in the three groups.

Groups	Valve lesion	Numbers
Group I (MVR) n=287	MS	169 (58.9%)
	MR	103 (35.9%)
	Mixed MV	15 (5.2%)
Group II (AVR) n=87	AS	34 (39.1%)
	AR	48 (55.2%)
	Mixed AV	5 (5.7%)
Group III (DVR) n=119	MS+AS	21 (17.6%)
	MS+AR	28 (23.5%)
	MR+AS	6 (5%)
	MR+AR	46 (38.7%)
	MS+Mixed AV	12 (10.1%)
	AS+Mixed MV	4 (3.4%)
	AR+Mixed MV	2 (1.7%)

MS=Mitral stenosis; MR=Mitral regurgitation; Mixed MV=Mixed mitral valve disease; AS=Aortic stenosis; AR=Aortic regurgitation; Mixed AV=Mixed aortic valve disease.

females. There were significantly more male patients in groups II and III in contrast to the group I where female predominance was observed ($p < 0.001$). Atrial fibrillation was observed in 240 (48.7%) patients, 180 (62.7%) in group I, 60 (50.4%) in group III and none in group II. In group I, 230 (80.1%) patients were in New York Heart Association (NYHA) functional class III and the remaining were in class II and IV. A similar trend was observed in group III while in group II majority of patients 47 (54%) were in NYHA class II at the time of operation ($p < 0.001$). Associated coronary artery bypass graft (CABG) surgery was performed in 5 (5.7%) patients in group II, 3 (2.5%) in group III and 6 (1.2%) in group I ($p < 0.01$). Body surface area was similar in the three groups. Pre-operative variables are given in Table II.

Table II: Pre- and operative variables.

	Group I (MVR) n=287	Group II (AVR) n=87	Group III (DVR) n=119	p-value
Pre-operative variables				
Age mean years	30.2±11.6	30.3±13.7	29.3±10.3	< 0.086
Gender				
Male	130 (45.3%)	74 (85%)	80 (67.2%)	< 0.0001
Female	157 (54.7%)	13 (15%)	39 (32.8%)	
AF	180 (62.7%)	0	60 (50.4%)	–*
NYHA class				
II	24 (8.4%)	47 (54%)	16 (13.4%)	< 0.001
III	230 (80.1%)	34 (39.1%)	91 (76.5%)	
IV	33 (11.5%)	6 (6.9%)	12 (10.1%)	
Associated CABG	6 (1.2%)	5 (5.7%)	3 (2.5%)	< 0.01
Weight mean kgs.	53.3±13.3	55.5±12.1	56.3±14.1	< 0.055
BSA	1.5±0.2	1.55±0.17	1.54±0.2	< 0.509
Operative variables				
AXC time mean mins	40.4±12.9	67.9±25.3	92.4±21.8	< 0.001
CPB time mean mins	62.1±19.7	97.7±35.8	120.7±28.3	< 0.001
Valve implanted				
Ball and cage	198 (69%)	41 (47.1%)	51 (42.9%)	< 0.001
Single disc	16 (5.6%)	14 (16.1%)	2 (1.7%)	
Bileaflet	73 (25.4%)	32 (36.8%)	66 (55.5%)	

**=p-value unreliable; AF=Atrial fibrillation; AXC=Aortic cross clamp; AVR=Aortic valve replacement; BSA=Body surface area; CPB=Cardiopulmonary bypass; CABG=Coronary artery bypass grafting; DVR=Double valve replacement; MVR=Mitral valve replacement; NYHA=New York Heart Association.*

Mean aortic cross clamp and cardiopulmonary bypass times were maximum in group III followed by groups II and I. Group I patients had greater number of ball and cage valves 198 (69%) as compared to group II 41 (47.1%) and group III 51 (42.9%). The inverse was the case with bileaflet valves which were implanted more frequently in group III 66 (55.5%) followed by group II 32, (36.8%) and group I 73 (25.4%) $p < 0.001$, Table II.

Follow-up ranged from 0.2 to 13.2 years (mean, 4.28 ± 3.66 years; median, 3.41 years), with a total follow-up of 2429.2 patient-years. Total follow-up duration of the study population was 2429.2 patient (pt) years (yrs). Follow-up period of group I was 1333.4 pt-years, of group II was 448.91 pt-yrs and of group III was 646.91 pt-years. Total hospital visits of the study patients were 11543. Of those group I patients had 6724(58.3%) visits, group II had 2055 (17.8%) and group III had 2764 (23.2%) visits.

At the end of follow-up there were 77 (15.6%) deaths; of which 19 (3.8%) were in-hospital and 58 (11.8%) were late deaths. In-hospital mortality was the highest 4 (4.6%) in group II followed by 5 (4.2%) in group III and 10 (3.5%) in group I, $p < 0.005$. Eight (1.6%) patients died of cardiac causes and 11 (2.2%) of non-cardiac causes (Table III).

Table III: Postoperative outcome.

Variable	Group I (MVR) n=287	Group II (AVR) n=87	Group III (DVR) n=119	p-value
Dead				< 0.005
In-hospital	10 (3.5%)	4 (4.6%)	5 (4.2%)	
Follow-up	39 (13.4%)	9 (10.2%)	10 (8.3%)	
Cause of death				–*
Cardiac causes				
Ventricular arrhythmia	3 (1.04%)	3 (3.4%)	4 (3.4%)	
Infective endocarditis				
Early	1 (0.3%)	–	1 (0.8%)	
Late	5 (1.7%)	1 (1.1%)	3 (2.5%)	
Low out put				
Early	–	1 (1.1%)	2 (1.7%)	
Late CCF	1 (0.3%)	2 (2.3%)	–	
Anticoagulation related				
Valve thrombosis	5 (1.7%)	1 (1.1%)	–	
CVA bleed	18 (6.3%)	1 (1.1%)	3 (2.5%)	
CVA thrombosis	6 (2.1%)	2 (2.3%)	1 (0.8%)	
Others	10 (3.5%)	2 (2.3%)	1 (0.8%)	

**=p-value unreliable; CCF=Congestive cardiac failure; CVA=Cerebrovascular accident; MVR=Mitral valve replacement; AVR=Aortic valve replacement; DVR=Double valve replacement.*

Among cardiac deaths, 4 (0.8%) were due to ventricular arrhythmias, 3 (0.6%) had low output syndrome and 1 (0.2%) had early valve failure. Among patients of ventricular arrhythmia, 2 (2.3%) were in group II and 2 (1.7%) in group III. Both patients in the group II had dilated left ventricles. One died on the 2nd post-operative day and the other on the 12th postoperative day. In group III, 1 died on the second postoperative day due to intra-operative myocardial damage and the other died in the ward on the fifth postoperative day secondary to sudden cardiac arrest. Two (1.68%) patients in group III and 1 (1.2%) in group II had low output syndrome. The patient in group II had poor left ventricular systolic function pre-operatively and could not be successfully

Table IV: Follow-up events.

Variable	Group I (MVR) n=287	Group II (AVR) n=87	Group III (DVR) n=119	p-value
Reopening				–*
Tamponade	1 (0.3%)	1 (1.1%)	–	
Bleeding	7 (2.8%)	1 (1.1%)	7 (5.9%)	
Wound infection				–*
Superficial	10 (3.4%)	1 (1.1%)	9 (7.5%)	
Deep	3 (1%)	–	2 (1.7%)	
Anticoagulation related events				
Hemorrhage				
Severe	14 (1.04%/pt-years)	3 (0.66%/pt-years)	2 (0.31%/pt-years)	< 0.001
Moderate	5 (0.37%/pt-years)	4 (0.89%/pt-years)	6 (0.92%/pt-years)	
Minor	72 (5.4%/pt-years)	11 (2.45%/pt-years)	10 (1.54%/pt-years)	
Valve thrombosis				
Early	1 (0.07%/pt-years)	1 (0.22%/pt-years)	2 (0.31%/pt-years)	
Late	8 (0.6%/pt-years)	–	–	–*
CNS complications				
CVA	26 (1.95%/pt-years)	4 (0.89%/pt-years)	4 (0.62%/pt-years)	
TIA	14 (1.04%/pt-years)	3 (0.66%/pt-years)	6 (0.92%/pt-years)	< 0.01
Valve related events				
Valve dehiscence				–*
Immediate	–	–	1 (0.8%)	
Redo surgery	7 (2.4%)	2 (2.3%)	2 (1.7%)	
Pregnancies	43 (15%)	3 (3.4%)	13 (10.9%)	< 0.979
Live births	29 (10.1%)	2 (2.3%)	7 (5.9%)	
Abortions/ D and C	14 (4.9%)	1 (1.1%)	6 (5%)	

**=p-value unreliable; CNS=Central nervous system; CVA=Cerebrovascular accident; MVR=Mitral valve replacement; AVR=Aortic valve replacement; DVR=Double valve replacement; TIA=Transient ischemic attack.*

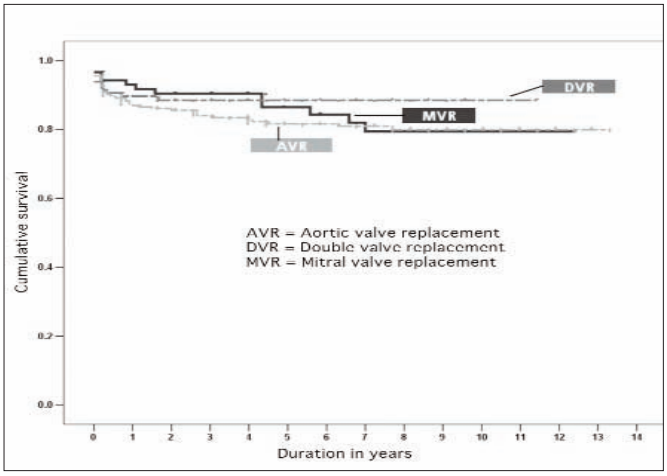

Figure 1: Kaplan-Meier survival curves for the study population.

weaned from cardiopulmonary bypass. Both patients in group III had dilated left ventricles with poor systolic function; one had concomitant CABG and three grafts were applied.

There was one valve failure in group III, he was operated for native valve endocarditis and developed valve dehiscence on the third postoperative day. Emergency re-do MVR was done.

Late deaths were lesser (n=10, 8.3%) in group III as compared to 9(10.2%) in group II and 39 (13.4%) in group I ($p < 0.005$, Table III). Among 58 (11.7%) late deaths, 18 (3.7%) were cardiac, 35 (7%) were anticoagulation related and 5 (1%) were due to miscellaneous causes.

At the end of follow-up period the total actuarial survival of the study population was 84.4%, with survival of 83%, 85.1%, 87.4% in groups I, II and III respectively (Figure 1). Follow-up events are summarized in Table IV.

In 40 (8.1%) patients there were 59 pregnancies during the study period. There were 38 live births and 21 (4.3%) abortions, of which 12 (2.4%) were planned dilatation and curettage (D&C) procedures. Apart from 3 valve thrombosis events leading to 1 death, there were no untoward complications observed during these pregnancies.

DISCUSSION

Combined mitral and aortic valve disease is still prevalent in Pakistan because of the underlying rheumatic heart disease (RHD).[1] Combined mitral and aortic valve disease occurs in 10% patients with rheumatic heart disease.[5] Double valve replacement has been reported to have reduced long-term survival.[14] DVR is a standard surgical option in patients requiring surgery for combined aortic and mitral valve disease.[11,13] Although AVR and mitral valve repair (MVR) has been advocated in patients having rheumatic heart disease. Younger age, mixed mitral valve disease, leaflet calcification or severe subvalvular disease predispose to late mitral valve failure. In our population young patients are seen with severe diffuse calcified valves due to ongoing rheumatic fever which is poorly controlled. Therefore, at the time of presentation these valves are not suitable for MV repair thus relegating the option of MVR. The only option left is DVR.

In the current study an in-hospital mortality of 4.2% and late mortality of 8.3% was observed in patients having

double valve replacement which was comparable to that in single valve replacement either AVR or MVR.

Our results are comparable to previous studies.[2-5,7,11-14] Remadi *et al.*[3] in a study of 254 patients, consisting of 79.5% RHD, reported an operative mortality of 7.05%.[3] The main cause of operative mortality was low cardiac output syndrome owing to the DVR procedure requiring a long operating time. The mean duration of cardio-pulmonary bypass and aortic cross clamp time was more than 120 and 90 minutes respectively. At 22 years freedom from mortality was 45.7% ± 3.6%. The linearized rates of thromboembolic and hemorrhagic events were 1.07% and 0.9% per patient-year respectively. In this study, the cause of in-hospital mortality in patients undergoing DVR was ventricular arrhythmia in 2 (1.7%) and low cardiac output in 2 (1.7%). Low cardiac output due to prolonged operating times could be one reason, but in this series both the patients had regurgitant lesions with dilated poor left ventricles. The CPB and AXC times were similar to Remadi *et al.*[3] The linearized rates of hemorrhage were 18 (2.77%/ pt-years) and thromboembolic events were 12 (1.85%/ patient-years).

John *et al.*[2] reported 30 day hospital death rate of 9.2% and late death of 10% in 456 patients undergoing DVR with predominantly Starr Edwards ball valve prosthesis.[3] The actuarial survival excluding in-hospital mortality was 85.6% at 10 years and 84.4% at 20 years of follow-up. John *et al.*[2] advocated mechanical prosthesis instead of bioprosthesis keeping in view better performance in the long-term owing to superior durability.[2,7] Furthermore, a low-intensity anticoagulant regimen was followed to maintain the target prothrombin time at 1.5 times the control value. Even with this regimen a low occurrence of thromboembolic episodes in their population with the use of the Starr Edwards ball valve prosthesis was observed. The hospital mortality was lower. This could be attributed to the predominant use of bileaflet valves in the DVR group. Ball and cage valves were used mainly in patients with isolated MVR. Furthermore, thrombo-embolic events were also observed more frequently in patients of isolated MVR as compared to DVR and isolated AVR. This could be attributed to the fact that in MVR, more ball and cage valves were used and more often patients were in atrial fibrillation as compared to DVR and AVR.

Turina *et al.* reported perioperative mortality of 4% with 10 and 20 year survival rates of 61% and 33% in 170 patients undergoing combined aortic and mitral valve surgery.[4] Seventy (41%) patients had RHD. Older age at the time of surgery, higher perioperative NYHA class, higher pulmonary artery resistance, lower cardiac index, lower LVEF, additional tricuspid surgery and aorto-coronary bypass surgery were significantly related to poorer late survival rates. The durability of bioprostheses in their experience was limited as in mitral position two thirds of repeat operations were due to prosthesis degeneration.[4] The re-operation for combined aortic and mitral replacement was associated with higher operative mortality as compared to isolated valve re-operations so bioprostheses use was abandoned in late 1980's by Turina *et al.*[4] On the contrary, Silbermann *et al.* have shown similar survival and event-free survival for isolated AVR.[19] Bioprosthesis were not used in this series because of multi valvular involvement, advanced RHD, younger age of patients and increased cost of bioprosthesis.

Studies comparing DVR vs. AVR and MVR have shown superiority of DVR over AVR and MVR and vice versa.[5,11-14] Kuwaki *et al.* reported no survival advantage of AVR and MVR over DVR with a survival rate at 12 years of 81.4% and 75.9% respectively.[12] In young RHD patients, mechanical valve at aortic position will require life-long anticoagulation even if mitral valve repair is performed.[12] Patients with DVR and AVR and MVR were on long-term anticoagulation leading to lack of difference between the two groups while comparing late cardiac survival in their study.[12] Hamamoto *et al.* reported similar survival 15 years after surgery in DVR and AVR and MVR in RHD patients.[11] Because of lower incidence of valve failure and similar rate of thromboembolic complications between DVR and AVR + MVR, Hamamoto *et al.*[11] recommended that DVR with mechanical valves should be the procedure of choice.[12] Furthermore, mitral valve repair should not be performed in patients with rheumatic heart disease because of higher occurrence of late valve failure.[11] Gillinov *et al.* while comparing DVR with AVR and MVR, reported hospital mortality rate of 5.4% for the latter and 7% for DVR.[5] Late survival was increased by mitral valve repair as compared to, if replacement was performed. They suggested that mitral valve repair is more durable than bioprosthesis and mitral valve amenable to repair should be repaired in a patient with rheumatic double valve disease.[5] This may be the case in the United States. But in Pakistan these patients present late, by which stage they have a complex pathology along with calcification, which makes repair impossible. Talwar *et al.* reported no difference in early mortality in DVR vs. AVR and MVR for rheumatic heart disease patients.[14] Patients undergoing AVR and MVR had better event free survival, higher reoperation rates and lower thrombo-embolic complications as compared to those undergoing DVR. Talwar *et al.* keeping in view better event free survival have suggested AVR and MVR to be the procedure of choice in double valve surgery when- ever mitral valve repair is possible.[14] In this study in-hospital mortality were similar in DVR patients as compared to isolated MVR and AVR. Our population consisted of high risk rheumatic heart disease patients with severely calcified valves not amenable to mitral valve repair.

This study lacks mitral valve repair group for comparison as our patients presented with advanced disease not amenable to mitral valve repair. Mitral valve repair was used initially but the procedure was abandoned due to high early mitral valve failure.

The second limitation is that it is a single-centre single-surgeon study with limited data to give recommendations regarding management of combined mitral and aortic valve disease.

CONCLUSION

In patients of rheumatic heart disease having combined Mitral and Aortic valve disease DVR should be performed whenever indicated as it has similar in-hospital mortality and better late survival as compared to isolated aortic or mitral valve replacement.

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