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IMPACT OF PULMONARY HYPERTENSION ON SURGICAL OUTCOMES IN PATIENTS WITH RHEUMATIC MITRAL VALVE DISEASE: A DESCRIPTIVE CROSS SECTIONAL STUDY

Farrah Pervaiz, Imtiaz Ahmed Chaudhry, Muhammad Bakhsh, Afsheen Iqbal, Vaqar Ilahi Paracha

Armed Forces Institute of Cardiology / National Institute of Heart Diseases Rawalpindi

ABSTRACT

Objectives: To evaluate the early & late outcomes after mitral valve replacement in patients with rheumatic mitral valve disease and moderate to severe pulmonary arterial hypertension.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: AFIC&NIHD Rawalpindi.

Patients and Methods: We analyzed data of 137 patients with mitral valve replacement during 2013.The study included patients with baseline systolic pulmonary artery pressure (sPAP) more than 40 mmHg who underwent elective MVR for rheumatic mitral valve disease. The preoperative, per operative and post-operative clinical characteristics were recorded to assess the short term outcomes (30 days). Preoperative and postoperative transthoracic echocardiography was performed. Patients were followed up for 1 year to assess the late outcomes.

Results: In this study forty five patients 17(37.8%) males and 28(62.2%) females with a mean age of 34 years (SD ± 10.3) were included with moderate to severe pulmonary hypertension. The total operative mortality was 5(11.1%). Postoperatively, there was a significant reduction in pulmonary artery systolic pressure in these patients.

Conclusion: Mitral valve replacement is safe and effective in patients with moderate to severe pulmonary hypertension and results in significant improvement of pulmonary hypertension, despite relatively higher mortality.

Keywords: Rheumatic heart disease, severe pulmonary hypertension, mitral valve replacement.

INTRODUCTION

Rheumatic heart disease (RHD) is the most common cardiovascular disease in children and young adults in third world countries[1]. Although in developed countries it has declined but it is still a major public health problem in developing countries[2]. In Pakistan RHD is one of the leading causes of premature death and disability[3]. The prevalence of disease is quite high both in urban and rural parts of the country[4,5]. The contributing factors are poverty, overcrowding and poor access to health. RHD results from recurrent attacks of rheumatic fever, which is an inflammatory disease that occurs as a delayed sequel to group A streptococcal pharyngitis[6]. One of the hallmarks of the disease is rheumatic carditis[7]. As the disease is usually recurrent and progressive, rheumatic carditis ultimately leads to different valvular lesions. Mitral valve involvement in Rheumatic heart disease results into mitral regurgitation and mitral stenosis and mitral valve replacement is usually the treatment of choice[9].

Rheumatic mitral valve disease is the most common cause of pulmonary hypertension and considered to be a risk factor for poor outcomes in patients undergoing mitral valve replacement[10]. Pulmonary hypertension increases the preoperative risk in patients undergoing mitral valve surgery, with a reported mortality from 15% to 31%[10,11]. Some of the studies have failed to demonstrate this association, but comparison of these studies is difficult because of differences in patient demographics, definitions of pulmonary hypertension, surgical techniques, associated cardiac diseases, and postoperative care[11].

METHODOLOGY

A descriptive cross sectional study was conducted by analyzing data of 137 patients undergoing mitral valve replacement surgery with rheumatic mitral valve disease at adult

Correspondence: Dr Farrah Pervaiz, Director R&D Dept, AFIC Rawalpindi
Email: farrahpervaiz@yahoo.com

cardiac surgery department AFIC/NIHD, from January to December 2013. The study was approved by the local institutional ethical review board, and all the patients provided written and informed consent. Patients with a baseline systolic pulmonary artery pressure sPAP of at least 40 mmHg who underwent elective MVR for rheumatic mitral valve disease and patients with pregnancy were included in the study. Patients with significant aortic valve disease or coronary artery disease were excluded from the study. Surgery registries in cardiac surgery data base were reviewed to identify patients who fulfilled the study inclusion criteria. Data collection tool was developed for demographic, preoperative clinical characteristics, per operative assessment and post operative outcomes. Patients were followed up for 6 months to one year to assess the surgical outcomes and changes in sPAP.

For the purpose of this study, mild pulmonary hypertension was defined as a systolic pulmonary arterial pressure of 25–39 mmHg, moderate pulmonary hypertension as a systolic pulmonary arterial pressure of 40–59 mmHg and severe pulmonary hypertension as a systolic pulmonary arterial pressure of 60 mm hg or more.

All preoperative and post-operative echocardiographic assessments were carried out by two-dimensional transthoracic echocardiography.

Operative Technique

All patients were operated on through a median sternotomy. CPB was established after aortic cannulation and bicaval cannulation. Moderate general hypothermia (28–30°C) was used during the procedure. The mitral valve was approached through the left atrium (LA) in 33 (73%) patients, through the superior septum in one patient (2.2%), and trans-septally in eleven patients (24.2%). All these patients underwent MVR. The valves used were mechanical prosthesis in 38 patients (84%) of patients and a bioprosthesis in 7 patients (16%) of patients.

Statistical Analysis

SPSS 19 version was used for descriptive statistics and was expressed as mean, median, standard deviation or frequency and percentage. The preoperative and post-operative echocardiographic parameters were compared by parametric tests (Paired sample t-Test) for within the group differences

Table-1: Pre-Operative characteristics of patients with mitral valve disease, and moderate and severe pulmonary hypertension who underwent mitral valve surgery.

Pre op characteristics	Moderate to severe pulmonary htn n=45
Age (mean, SD)	Mean=34 SD±10.3
Gender n (%)	Male=17(37.8%) Female=28(62.2%)
BMI (mean, SD)	Mean=21.5 SD±4.4
NYHA Class n (%) • I • II • III	 I=19(42.2%) II=15(33.3%) III=11(24.4%)
Mitral valve area n (%) • 2.5 – 1.6 cm^2 (Mild) • 1.5 – 1.1cm^2 (Moderate) • Less than 1 cm^2 (Severe)	 Total=16(36%) 3(6.6%) 5(11.1%) 8(17.8%)
Patients with mix mitral valve disease n (%)	14(31.1%)
Patients with MR n (%)	Total=15(33.3%) Grade I=2(4.4%) Grade II=4(8.9%) Grade III=9(20%)
Atrial fibrillation n (%)	15(33.3%)
Tricuspid Regurgitation n (%)	Mild= 6(13.3%) Moderate=8(17.8%) Severe=11(24.4%) None=20(44.5%)

RESULTS

A total number of 45 patients according to inclusion criteria were included in this study, having mitral valve disease requiring surgery and moderate to severe pulmonary hypertension. The study population comprised of 17(37.8%) males and 28(62.2%) females with a mean age of 34 years (SD ±10.3).

The pre operative clinical characteristics of the patients were as follows: 19(42%) of the patients had dyspnea NYHA class I, 15(33%) NYHA II and 11 (24.4%) NYHA class III. Amongst all the patients studied, 15(33%) had mitral regurgitation and 16 (36%) had mitral stenosis, whereas 14(31%) had mixed mitral valve disease and 25(55%) had tricuspid regurgitation. Atrial fibrillation was reported from only 15(33.3%) of the patients (Table-1).

The per-operative characteristics of the patients is shown in table-2. The mean CPB was 117.8 min (SD+47.6) and the mean aortic cross-clamp time was 79 min (SD+35.2) in patients with moderate to severe pulmonary hypertension. De Vega tricuspid annuloplasty was performed in 1 (2%) patients with severe tricuspid regurgitation. Mechanical valve replacement was done in more than two thirds of the patient population 38(84%).

Postoperatively, the patients had a mean ventilation time of 8.82 hours ±6.1 hours, 1(2.2%) patient required reopening for cardiac tamponade and 9(20%) of the patients had significant pleural effusions requiring pleural drains. The mean ICU stay was 58 ± 57.3 hours. The average time to discharge after surgery was 20±12.5 days (table-2). Total mortality for 45 patients with mitral valve replacement was 5(11.1%).

A comparison of preoperative and postoperative echocardiographic variables is presented in Table-3. Postoperatively, there was no statistically significant reduction in LA but there was a noteworthy reduction in systolic pulmonary arterial pressure sPAP ($p < 0.05$).

Table-2: Per-operative characteristics and outcomes

Per operative characteristics/out-comes	Moderate to severe pulmonary htn n=45
CPB (min)	Mean=117.4 Median= 109.0 SD±47.6
Aortic cross- clamp (min)	Mean=79.02 Median=69.0 SD±35.2
De Vega tricuspid annuloplasty n (%)	1(2%)
Valve replacement • Mechanical • Biological	 38(84%) 7(16%)
Prosthetic valve size in (mm) n(%)	25=4(8.9%) 27=18(40%) 29=19(42%) 31=3(7%) 33=1(2%)
Use of Sildenafil n (%)	12(27%)
Cardiac Tamponade n (%)	1(2.2%)
Pleural effusion n (%)	9(20%)
Lonotropic requirement n (%)	Mild=37(82.1%) Moderate=3(6.6%) Heavy=5(11.2%)
Arrhythmia n (%)	2(4%)
Ventilation (in hrs)	Mean= 8.82 Median=6.0 SD±6.1
ICU stay (in hrs)	Mean=58 Median=42 SD±57.3
Hospital stay(in days)	Mean=20 Median=16 SD±12.5
Mortality <30 days n (%)	5(11.1%)

DISCUSSION

Pulmonary arterial hypertension develops in patients with mitral valve disease due to transmission of the elevated LA pressures into the pulmonary circulation. In patients with mild to moderate mitral valve disease, pulmonary vascular resistance is not increased and pulmonary arterial pressure may be normal at rest only rising transiently during exercise. In later stages the pulmonary vascular resistance

also increases12. In severe chronic mitral valve disease with elevated pulmonary vascular resistance the pulmonary artery pressure is raised at rest and can approach systemic pressures with exercise, untreated the pulmonary hypertension progressively worsens leading to right sided heart failure, tricuspid insufficiency and occasionally pulmonic valve insufficiency[13,14].

Table-3: Comparison of preoperative- and postoperative echocardiographic variables in 45 patients with moderate and severe pulmonary hypertension after mitral valve replacement.

Echocardiographic Variables	Pre operative	Post operative	*p*-value
Rhythm	SR =30(66.6%) AF= 15(33.3%)	SR =32(71.1%) AF= 13(28.8%)	1.000
LVDD	Mean=52.7 SD± 9.6	Mean=56.7 SD±8.2	0.096
LVSD	Mean= 35.3 SD±7.07	Mean=47.1 SD±7.8	0.000
LV Function	Fair=10(22.2%) Moderate=10(22.2%) Good=25(55.5%)	Fair=16(35.5%) Moderate=24(53.3%) Good=6(13.3%)	0.029
MV MPG	Mean= 9.7 SD ±7.4	Mean= 6.61 SD ±3.8	0.083
MV PPG	Mean= 16.7 SD ±11.0	Mean= 13.3 SD ±5.07	0.180
EF	Mean=55 SD±7.69	Mean=47 SD±5.1	0.000
PAP	Mean=46 SD± 14.0	Mean=25.5 SD±8.1	0.000
LA	Mean=53.5 SD±9.99	Mean=56.4 SD±9.8	0.325
TR	Mild=10(22.2%)	16(35.5%)	0.453

The development of PAH is associated with a poor prognosis in mitral valve disease. In our part of the world, patients with advanced disease frequently present in our outpatients with severe pulmonary hypertension even with systemic and supra systemic PAPs. These patients are at higher operative risk, however they usually improve postoperatively with reduction in pulmonary vascular pressures[17]. Surgical intervention significantly improves functional capacity and long term survival of patients with significant mitral valve disease[15,16].

LA size can be larger in patients in long standing mitral regurgitation than in MS, however atrial fibrillation, thrombus formation and thromboembolism occur less frequently with MR. In our study we did not observe any significant reduction in LA size (*p*-value 0.325) in our patients studied 6-12 months after the valve replacement procedure[18,14].

Successful mitral replacement for mitral stenosis usually is associated with clinical improvement, augmented forward stroke volumes and smaller LV end diastolic volumes[19,16,20]. Our study shows a significant decline in the postoperative LV ejection fraction (EF 55±7.69 to 47±5.1 *p*-value 0.000) and an increase in LVESD from 35.3±7.07 to 47.1±7.8 *p* value 0.000 on follow up echocardiograms done after one year. Furthermore of our patient population 67% of the patients had mitral

regurgitation with an additional 31% having mixed MV disease. About 25-50% of patients with severe mitral stenosis have LV systolic dysfunction due to associated problems like mitral regurgitation; aortic valve disease, ischemic heart disease, rheumatic myocarditis or pancarditis[21,22]. In these patients the LV end systolic and diastolic volumes may be larger than normal, improvement in LV function after surgery may not occur[23].

The decline in ejection fraction after mitral valve replacement for chronic mitral regurgitation historically is thought to result from increase in LV after load as a result of closure of the low resistance early systolic pop off into the left atrium and the surgical excision of the subvalvular apparatus.

Some surgeons operate on patients with supra-systemic pulmonary artery pressure with the knowledge that with intensive post-operative respiratory and diuretic therapy is necessary to achieve dry lungs and reduce the incidence of severe right ventricular failure. It has been known for more than forty years that after mitral valve surgery for MS the pulmonary artery pressures decrease within hours in most patients and decrease more gradually in weeks and months in others.24In our study we observed a significant reduction in PAP 46±14 mm Hg to25.5±8.1 mmHg *p*-value 0.000 on follow up echocardiograms after 12 months of valve replacement surgery. These findings are in agreement with other investigators who have reported hemodynamic changes in patients with rheumatic mitral valve disease at different intervals after MVR.

Operative mortality is linked to myocardial pump failure, multisystem organ failure, bleeding, respiratory failure, infection, stroke and rarely technical problems[25]. The current risk of primary mitral valve replacement is 5-9% in most studies (3.3-13.1%)[26]. In our study the 30 day mortality after MVR for MVD was 11.1%.

The present study has a limited sample size of 45 patients having mitral stenosis, regurgitation and mixed mitral valve disease. Studying and comparing identical disease groups would have made are results more reliable.

CONCLUSION

Mitral valve replacement is safe and effective in patients with moderate to severe pulmonary hypertension and results in significant improvement of pulmonary hypertension, despite relatively higher mortality.

Conflict of Interest

This study has no conflict of interest to declare by any author.

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