

BEATING HEART MITRAL VALVE REPLACEMENT. EXPERIENCE AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To study the early outcomes of mitral valve surgery performed with a beating heart and cardiopulmonary bypass.

Study Design: Prospective descriptive study.

Place and Duration of Study: Cardiac Surgery department, Rawalpindi Institute of Cardiology, Rawalpindi, from Aug 2017 to Aug 2019.

Methodology: Consecutive patients requiring mitral valve surgery were included in the study. Those requiring multiple procedures, redo procedures and emergency procedures were excluded from the study. Data was collected on preformed proformas and perioperative variables were recorded. Patients were followed till discharge or 30 days after the surgery. Statistical Package for Social Sciences version 23.0 was used to analyse the data.

Results: A total of 27 patients were included in the study, 21 (77.78%) female and 6 (22.2%) male patients. The mean age of the patients was 30.89 ± 10.8 years. Of the cohort, 4 (14.8%) had mitral stenosis, 16 (59.3%) had mitral regurgitation and mixed disease (both mitral stenosis and mitral regurgitation) was present in 7 (25.9%). The median pulmonary artery pressure (mPAP) was 34 mmHg. All the patients received mechanical mitral valve prosthesis, 27 (100%). A modified Devaga's procedure for tricuspid valve repair was done in 4 (14.8%) patients. Most of the patients required only mild inotropic support, 22 (81.4%). Median intensive care unit stay was 24 hours with a mean of 33 ± 16 hours. All the patients were alive at the end of the early follow up.

Conclusion: Beating heart mitral valve surgery on cardiopulmonary bypass is a feasible technique. It has acceptable early outcome in terms of mortality and major morbidity indicators.

Keywords: Beating heart, Early outcomes, Mitral valve replacement.

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INTRODUCTION

Surgery for different pathologies of the mitral valve is an established treatment option. Before the era of cardiopulmonary bypass machine, only limited intervention was possible for the mitral valve like closed commissurotomy. But with the advent of cardiopulmonary bypass (CPB) machine cardiac surgery was revolutionised and it allowed cardiac surgeons to perform more extensive procedures on the mitral valve like repair and replacement. These surgeries bore excellent short and long term results¹.

The conventional mitral valve surgery with CPB also involves the use of cardioplegic arrest of the heart. This leads to myocardial stunning and

sometimes necrosis that results not only increased morbidity but also mortality². Strategies that avoids the use of CPB altogether like transcatheter valve implantation at the mitral position is not widespread and cannot be used in all the patients. Certain modifications of the open mitral intervention like the use of miniature CPB circuit has been in use for some time. Beating heart mitral valve surgery mitigates the effects of CPB by avoiding cardioplegic arrest of the heart. In this technique, mitral valve surgery is performed while the heart is on CPB and still beating. The technique, by avoiding cardioplegic arrest of the heart, promises to decrease morbidity and mortality.

Minimally invasive techniques like transcatheter valve implantation and mini port access valve surgery is yet to gain popularity in

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Pakistan. Therefore, techniques like beating heart mitral valve surgery provides alternative methods of benefiting the patients form a comparatively less extensive procedure. Our study demonstrates our experience with this technique in a tertiary care hospital.

METHODOLOGY

This prospective descriptive study was conducted at the department of cardiac surgery, Rawalpindi Institute of Cardiology from August 2017 to August 2019. All those patients requiring mitral valve surgery for various pathologies were included in the study. Patients undergoing emergency surgeries, redo procedures, ischemic mitral valve procedures and multiple procedures were excluded from the study. All the surgeries were performed by a single surgeon (MS). The study was approved by the ethical review board and individual consent from the patients was waived.

Median sternotomy was followed by standard aortic and bicaval cannulation. Cardiopulmonary bypass was established after confirming Activated Coagulation Time (ACT) of more than 450 seconds. Continuous normothermic coronary blood flow was maintained at a rate of 245 ml/kg/min to perfuse the heart after cross clamping. After left atriotomy, the left atrium (LA) and left ventricle (LV) were decompressed using pump suckers. Mitral valve was assessed and trans thoracic echo (TEE) findings were confirmed. Valve was assessed for repairability. Special attention was given to remove any clots in the left atrium or LA appendage. The posterior mitral apparatus was preserved in every case. The valve was replaced with mechanical valve using interrupted technique in all cases. Standard methods of deairing using Valsalva's manoeuvre, filling the heart etc were followed. After removal of cross clamp continuous blood flow to the coronaries was stopped and deairing continued using aortic root vent. Venting was done through right superior pulmonary vein as well as the aortic root vent.

Tricuspid insufficiency of greater than grade II and annulus more than 40 mm was repaired

using either modified DeVaga's technique on beating un-clamped heart having right atrium as the access route.

Intra operative TEE was done in every case to assess the valve, paravalvular leak, gradients across the valve, regional wall motion abnormality especially in area of left circumflex artery, tricuspid evaluation and especially for aortic insufficiency as it can be worsened if existed in the first place. The vent was removed once the TEE confirmed the absence of any air bubbles in the chambers. The termination of cardiopulmonary bypass was done in the conventional manner and all cannulation sites secured.

The whole procedure was carried out without cooling. Nasal temperature was maintained around 37 degree Celsius to prevent fibrillation. EKG was continuously monitored especially lead II because sometimes excessive retraction caused by mitral retractor can jeopardize flow to the right coronary artery resulting in dysrhythmias or ST sag in inferior leads. This usually responds by decreasing the retraction. Pharmacological support can be added if required.

Perioperative variables were recorded and analysed using Statistical Package for Social Sciences version 23.0 (SPSS Inc, Chicago, IL, USA). Frequencies were calculated for categorical variables and mean, median and standard deviations were calculated for continuous variables.

RESULTS

Most of the subjects included were female 21 (77.78%). The mean age of the patients was 30.89 ± 10.8 years, (table-I). Patients presented with different pathologies like MS 4 (14.8%), MR 16 (59.3%) and mixed disease (both MS and MR) was present in 7 (25.9%). The median pulmonary artery pressure (mPAP) was 34 mmHg which meant that most patients had moderate pulmonary hypertension. Because of the younger age of the patients, all of them received mechanical mitral valve prosthesis, 27 (100%). A modified Devaga's procedure for tricuspid valve repair was done in 4 (14.8%) patients. Most of the patients required only mild inotropic support, 22

(81.4%). Median ICU stay was 24 hours with a mean of 33 ± 16 hours (table-II). Which meant that most of the patients were shifted to step down unit within one day. There was no mortality observed.

Table-I: Baseline characteristics of the patients.

Variable		Patient n=27
Gender	Male	6 (22.2%)
	Female	21 (77.7%)
Age (years)		30.89 ± 10.8
Lesion	MS	4 (14.8%)
	MR	16 (59.3%)
	MS ± MR	7 (25.9%)
Ejection Fraction (%)		$48.52 \pm 6.76\%$
Rhythm	AF	14 (51.9%)
	NSR	11 (40.7%)
	RBBB	2 (7.4%)
Left Atrial size (mm)		51.96 ± 13.2
LVIDD (mm)		55.6 ± 8.7
LVIDS (mm)		43.19 ± 8.2
mPAP (mmHg)		37.85 ± 17.87
Median mPAP		34.0 mmHg

Table-II: Important intraoperative and postoperative variables.

Use of prosthetic valves	Mechanical	27 (100%)
		Bioprosthetic
Tricuspid Valve Repair		4 (14.8%)
Bypass Time (minutes)		89.4 ± 31.9
Cross Clamp Time (minutes)		68.7 ± 29.9
Postoperative Inotropic Requirements	Mild	22 (81.4%)
	Moderate	5 (18.5%)
Postoperative Cardiac Enzymes On First Postoperative Day (CK-MB) (IU/L)		47.56 ± 22.44
MeanICU Stay (Hours)		33 ± 16
Re-exploration for Bleeding		2 (7%)
Postoperative Neurological Complications		-
Mortality		-

DISCUSSION

Cardiopulmonary bypass (CPB) is inevitable for mitral valve replacement because it is an intracardiac procedure. But techniques have been evolved to mitigate the effects of CPB. Valve surgery has taken strides towards a less invasive approach in the last two decades and focus has

been on reducing the invasiveness of the procedure in terms of smaller incisions or no incisions at all (Transcatheter technologies) as well as reducing the effects of CPB³. But most of these studies aim at avoiding the median sternotomy and the associated morbidity with median sternotomy. But other techniques have been explored to reduce the morbidity associated with mitral valve replacement. One such technique is on pump beating mitral valve replacement. This involves the use of cardiopulmonary bypass but without cardioplegic arrest of the heart. Our study cohort showed that it is a feasible technique and good early results can be achieved. On pump beating heart mitral valve surgery provides a real time examination of the mitral valve for feasibility for repair and post repair status.

All the patients in our cohort had rheumatic heart valvular disease. The mean age (30.89 ± 10.8 years) is typical of rheumatic involvement and contrasts with studies reported from the western world where the mean age of the patients undergoing valve surgery is much higher⁴. This shows that most of the valve surgery in the west is done for pathologies other than rheumatic valvular disease. All the patients in our study underwent valve replacement and there was no repair. This again is a testament to the fact that very few of the valves affected by rheumatic heart disease are amenable to repair⁵.

Increased cross clamp time has been shown to be an independent predictor of poor outcome in open heart surgery⁶. This can be of paramount importance in patients with impaired left ventricular function⁷. Beating heart mitral valve surgery can significantly lower the cross-clamp time. This was evident in our study where the cross-clamp time was 68.7 ± 29.9 minutes. Gersak and colleagues used the same technique and demonstrated a significantly lower cross clamp time in patients who underwent on pump beating heart surgery⁸. Moreover, the continuous antegrade perfusion allows the heart to be perfused while beating empty. This essentially reduces the workload of the heart leading to good outcomes⁹.

An important concern about the beating heart technique is distension of the cardiac chambers and visibility as the field is flooded with blood. Effective venting of the heart solves this problem and provides a clear field for the surgeon¹⁰. We used venting through right superior pulmonary vein as well as the aortic root to decompress and vent the heart after closure of the left atrium. It has also been suggested that by venting the left ventricle to the atmosphere, the air preferentially goes out through the vent because the pressure in the aorta is far above the pressure in the open cardiac chambers when performing on pump beating heart valve surgery. This not only keeps the field clean but also prevents air embolism. Thompson and colleagues observed a stroke rate of 1.6% using beating heart mitral valve surgery in their cohort of 125 patients⁴.

Beating heart does not add to the complexity of valve replacement as shown by the cross clamp and bypass time in our study which is comparable to that of other studies in the literature¹¹. In fact, the beating heart provides a more physiological environment for the assessment of the valve and decision regarding reparability can be made¹².

Beating heart mitral surgery can decrease the overall operation time. This ultimately translates to better outcomes in terms of reduce incidence of low cardiac output syndrome postoperatively and reduce ventilation and ICU stay¹³. The mean bypass time in our study was 89.4 ± 31.9 minutes and mean ICU stay was 33 ± 16 hours. This essentially means that most of our patients were out of the ICU after one day. Salhiyyah and colleagues reviewed the beating heart valvular intervention and concluded that avoidance of cardioplegia time, better assessment for reparability and post reparability assessment makes the overall procedure shorter and saves time¹⁴. Another advantage that helps to save time is the easy assessment of post replacement paravalvular leakage in physiological conditions¹⁵.

Our study is limited by a small sample size and the lack of a control group for comparison.

Moreover, this is a single centre experience and the results cannot be generalised. Assessment of some of the outcome variables like stroke would require a large cohort. But this study demonstrates the safety and efficacy of beating heart mitral valve replacement in our patient cohort. Large scale studies are needed to compare this technique with on pump mitral surgery on the arrested heart.

CONCLUSION

This study presents an experience with beating heart mitral valve surgery. This technique is safe and leads to favourable short-term outcomes and can be included in large scale trials for comparison with conventional arrested heart mitral valve surgery.

CONFLICT OF INTEREST

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

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