



SINGLE VERSUS BI-LEAFLET PRESERVATION DURING MVR IN CHRONIC RHEUMATIC MITRAL REGURGITATION: A SINGLE CENTRE RETROSPECTIVE STUDY

Cardiology

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ABSTRACT

Background: Several clinical studies had established the significance of sub-valvular apparatus preservation over conventional mitral valve replacement regarding left ventricular geometry and performance. A few have also compared posterior leaflet preservation to bi-leaflet preservation. In this retrospective study, we will compare the early and long-term effects of single (posterior) leaflet versus bi-leaflet (total) and chordal preservation on left ventricular function.

Method and results: In this retrospective study of total 40 patients, they were divided into 2 groups: p-MVR (n=20) and t-MVR (n=20). Preoperative and 1 year follow-up echocardiographic findings were evaluated and compared. Preoperative echocardiographic parameters between p-MVR and t-MVR groups were without any statistically significant difference regarding LVEDD, LVESD, LVEDV, LVESV, LVFS, LVEF with p value of >0.05. The early postoperative comparison among 2 groups didn't showed any statistically significant difference regarding mechanical ventilation duration, ICU stay and hospital stay. Both p-MVR and t-MVR groups were free from early mortality. At 1 year follow-up, both LVEDD and LVEDV were decreased in both group as compared to preoperative (LVEDD: 63.9 5.34 to 58.5 5.43 in p-MVR and 62.2 5.21 to 56.6 4.34 in t-MVR and LVEDV: 143.8 51.70 to 113.3 24.51 in p-MVR and 133.7 52.2 to 105 25.21 in t-MVR group) but there was no significant difference on group comparison (p Value >0.05). In the t-MVR group, LV end systolic dimensions were reduced to greater extent (p Value <0.01) as compared to p-MVR group. Similarly, a significant reduction was found in end systolic volume (p Value <0.05). In the t-MVR group, LVFS and LVEF were better preserved and improved (p Value <0.01) as compared to p-MVR at 1 year echocardiography. Patients with excised anterior leaflet had a significant decrement in LVEF as compared to preoperative (Mean SD: 50.7 1.85 vs 49 2.85 preoperative vs postoperative respectively).

Conclusion: Compared with posterior chordal preservation only, bi-leaflet preservation of the sub-valvular apparatus resulted in improved ejection performance and smaller end cycle volumes.

KEYWORDS

mitral valve replacement, sub-valvular apparatus, posterior leaflet preservation, bi-leaflet/total chordal preservation.

INTRODUCTION

Conventional mitral valve replacement (MVR) in chronic rheumatic mitral regurgitation (MR) leads to postoperative left ventricular (LV) dysfunction due to loss of annulo-ventricular integrity. Superiority of valve sparing techniques (preserving one or both leaflets) over the valve excising MVR (the removal of both leaflets by cutting the chordae tendineae and the tip of the papillary muscle) is clinically proven in several studies[1]. With these existing evidences, most cardiac surgeons are performing leaflets preserving MVR (either posterior only or bi-leaflets) currently. Preservation of anterior leaflet and chordae significantly reduce the LV chamber size and systolic afterload and minimize the early postoperative decline in LV long axis fractional shortening and ejection fraction (LVEF). Still, bi-leaflets preservation is preferred less among many surgeons because of technical challenges in preserving anterior leaflet, prolonged surgical time, likelihood of LV outflow tract (LVOT) obstruction, a possible post-operative mechanical interference of prosthetic disc by parts of preserved sub-valvular chordal tissues and leaflets and chances of implanting a smaller prosthesis while bi-leaflet preservation. In this study, we will retrospectively compare the results of posterior leaflet vs bi-leaflets preservation during MVR regarding LV functions and both early and long-term follow-up.

MATERIAL AND METHODS

This is a single centre, retrospective study conducted at Laxmi Pat Singhania Institute of Cardiology, Kanpur, UP, India. Between the period of January 2018 to March 2020, a total of 40 patients of isolated chronic mitral regurgitation who had undergone leaflet preserving MVR were selected for the study. Patients were divided into 2 groups: p-MVR (n=20), patients with only posterior leaflet preservation and t-MVR (n=20), patients with total/bi-leaflets preservation. Patients with concomitant surgery for other lesions i.e. coronary bypass surgery with MVR, aortic valve or root procedure or other valve surgery with MVR, surgery for congenital defects/lesions with MVR, re-do operations,

minimal invasive or MVR through thoracotomy approach were excluded from the study.

Pre-operative and postoperative, demographic and echocardiographic details were collected retrospectively from institution patient's records and from follow up visits of the patients.

Patient's demographic and clinical profile were as follows: table 1.

Table 1: Demographic and clinical parameters:

Parameter		p-MVR	t-MVR	p value
Age	Mean SD	34.9 14.3	36.1 12.87	>0.05
	Range	15 – 66	18 – 60	
Female	n (%)	12 (60%)	10 (50%)	>0.05
CHF	n (%)	8 (40%)	9 (45%)	>0.05
AF	n (%)	14 (70%)	16 (80%)	>0.05
NYHA 3	n (%)	8 (40%)	10 (50%)	>0.05
NYHA 4	n (%)	12 (60%)	10 (50%)	>0.05

Operative details:

Hemodynamic monitoring, pre-induction preparation and anesthetic induction was according to the standard protocol followed in cardiac patients. All the patients were operated by single surgeon. All operations were done by midline sternotomy. All surgeries were done on aorto-caval (uni-caval /bi-caval) CPB with moderate hypothermia and antegrade hyperkalemic cardioplegia. Bi-leaflet (SJM mechanical heart valve) prosthesis and interrupted suture technique was used in each patient. All replacements were done using standard surgical and CPB techniques for mitral valve replacement.

Echocardiographic evaluation:

Preoperative and 1 year follow-up echocardiographic findings were evaluated and compared. Parameters used were- LV end-diastolic diameter (LVEDD), LV end-systolic diameter (LVESD), LV end-

diastolic volume (LVEDV), LV end-systolic volume (LVESV), LV fractional shortening (LVFS) and LV ejection fraction (LVEF). Data were expressed as mean SD and compared for p value. A p value of less than 0.05 was considered to be statistically significant and less than 0.01 was considered as highly significant.

RESULTS

Table 2: Pre-operative echocardiographic data comparison between the groups:

Parameter		p-MVR	t-MVR	p value
LVEDD	Mean SD	63.9 5.34	62.2 5.21	>0.05
	Range	54 – 72	56 – 76	
LVESD	Mean SD	45.7 4.58	45.7 3.97	>0.05
	Range	41 – 51	40 – 53	
LVEDV	Mean SD	143.8 51.70	133.7 52.2	>0.05
	Range	80 – 254	80 – 248	
LVESV	Mean SD	70.6 24.2	65.6 24.8	>0.05
	Range	40 – 112	40 – 129	
LVFS (%)	Mean SD	29.1 4.23	26.8 4.3	>0.05
	Range	20.4 – 38.2	20 – 35.4	
LVEF (%)	Mean SD	50.7 1.85	50.6 3.75	>0.05
	Range	47.7 – 55.9	45.1 – 59.9	

Preoperative echocardiographic parameters between p-MVR and t-MVR groups were without any statistically significant difference regarding LVEDD, LVESD, LVEDV, LVESV, LVFS, LVEF with p value of >0.05 (Table 1).

Table 3: Post-operative details and early outcome:

Parameter		p-MVR	t-MVR	p Value
Atrial fibrillation		5	6	
Other arrhythmias		Nil	Nil	
Low cardiac output		Nil	Nil	
Liver dysfunction		1	Nil	
Renal dysfunction		1	Nil	
Cerebro-vascular accident		Nil	Nil	
Bleeding		Nil	Nil	
Mechanical ventilation	Mean±SD	6.5±1.06	6.3±0.95	>0.05
	Range	5 – 8.25	5 – 8	
ICU stay	Mean±SD	2.35±0.49	2.35±0.49	>0.05
	Range	2 – 3	2 – 3	
Wound infection		Nil	Nil	
Hospital stay	Mean±SD	7.4±0.75	7.55±0.76	>0.05
	Range	6 – 9	6 – 9	
Mortality		Nil	Nil	

The early postoperative comparison didn't showed any statistically significant difference regarding mechanical ventilation duration (6.5 1.06 vs 6.3 0.95, p value - >0.05), ICU stay (2.35 0.49 vs 2.35 0.49, p value >0.05) and hospital stay (7.4 0.75 vs 7.55 0.76, p value >0.05) in p-MVR and t-MVR group respectively. Transient hepatic and renal dysfunction occurred in 1 patient in p-MVR group. There was no incidence of low cardiac output, cerebro-vascular accident in either group. There were no other major morbidities like surgical bleeding, arrhythmias except atrial fibrillation, prosthetic valve dysfunction or LVOT obstruction. Both p-MVR and t-MVR groups were free from early mortality.

Long-term and Follow up outcome:

Table 4: Echocardiographic details at 1 year and their comparison:

Parameter		p-MVR	t-MVR	p Value
LVEDD	Mean SD	58.5 5.43	56.6 4.34	>0.05
	Range	50 – 68	51 – 68	
LVESD	Mean SD	41.5 2.65	38.1 1.67	<0.01
	Range	38 – 48	35 – 40	
LVEDV	Mean SD	113.3 24.51	105 25.21	>0.05
	Range	75 – 150	70 – 161	
LVESV	Mean SD	57.8 13.32	49.7 10.43	<0.05
	Range	38 – 82	37 – 70	

LVFS (%)	Mean SD	28.6 4.95	33.8 4.59	<0.01
	Range	18.9 – 38.2	25.9 – 43.6	
LVEF (%)	Mean SD	49 2.85	52.33 3.76	<0.01
	Range	44.5 – 56	47.1 – 61.	

At 1 year follow-up, both LVEDD and LVEDV were decreased in both group as compared to preoperative (LVEDD: 63.9 5.34 to 58.5 5.43 in p-MVR and 62.2 5.21 to 56.6 4.34 in t-MVR and LVEDV: 143.8 51.70 to 113.3 24.51 in p-MVR and 133.7 52.2 to 105 25.21 in t-MVR group) but there was no significant difference on group comparison (p Value >0.05).

In the t-MVR group, LV end systolic dimensions were reduced to greater extent (p Value <0.01) as compared to p-MVR group. Similarly, a significant reduction was found in end systolic volume (p Value <0.05). In the t-MVR group, LVFS and LVEF were better preserved and improved (p Value <0.01) as compared to p-MVR at 1 year echocardiography. Patients with excised anterior leaflet had a significant decrement in LVEF as compared to preoperative (Mean SD: 50.7 1.85 vs 49 2.85 preoperative vs postoperative respectively). No differences were found between the groups in terms of late outcome: liver and renal dysfunction, incidence of cerebro-vascular accident, congestive heart failure, prosthetic valve dysfunction and mortality (Table 5).

Table 6: Comparison of long-term follow-up between the groups.

Parameter	pMVR	tMVR
Atrial fibrillation	3	2
Other arrhythmias	Nil	Nil
Liver/renal dysfunction	Nil	Nil
Cerebro-vascular accident	Nil	Nil
Congestive heart failure	Nil	Nil
Prosthetic valve dysfunction	Nil	Nil
LVOTO	Nil	Nil
Redo MVR	Nil	Nil
Mortality	Nil	Nil

DISCUSSION

Mitral valve repair has clinically reported superiority and lower operative mortality and morbidity and improved long term survival over mitral valve replacement, and currently, MVR is considered only when repair is not feasible [1,2]. Two techniques are available for MVR including valve excising (conventional MVR) and with sub-valvular (leaflet and chordal) preservation. Conventional MVR in patients with chronic MR results in a decrease in LV functions due to disruption of the chordal apparatus with disturbance of the annulo-papillary continuity [3]. Lillehei and associates were the first to advocate the physiologic principles of valvular-ventricular integrity during MVR to reduce operative mortality rate and an improvement in post-operative left ventricular function [4].

Papillary-annular continuity is critical to maintain normal LV diastolic and systolic function by maintaining normal LV torsional deformation, normal LV stress-strain patterns, LV geometry and shortening the LV long axis during systole [5,4]. Conventional MVR is associated with significant depression of LV systolic function and more stiff LV compared to with preservation of sub-valvular apparatus either posterior or anterior [6]. Furthermore, studies had shown that preservation of anterior leaflet is associated with slightly greater positive impact on LV systolic function as compared to posterior leaflet preservation only and these were superior with an intact sub-valvular apparatus, intermediate with preservation of posterior leaflet chordae, and poorest with conventional valve excising MVR with loss of all valvular-ventricular integrity [7,8]. Despite these facts advocating significance of bi-leaflets preservation, still, it is preferred less among many surgeons because of technical challenges in preserving anterior leaflet, prolonged surgical time, likelihood of LV outflow tract (LVOT) obstruction, a possible post-operative mechanical interference of prosthetic disc by parts of preserved sub-valvular chordal tissues and leaflets and chances of implanting an undersized prosthesis while performing bi-leaflet preservation [9,10,11]. Studies comparing the left ventricular function with bi-leaflet to posterior leaflet MVR are limited but few of them had shown that the total chordal-preservation had statistically significant improvement of left ventricular diastolic and systolic dimensions over posterior and nonchordal groups and patients undergoing MVR with intact anterior leaflet and its chordae had an decrease in end systolic volume and systolic LV afterload, thereby increasing LV performance, i.e. a greater increase in LVFS and

LVEF and decrease in ESV [7,8,12].

In our study, patients with either intact or excised anterior leaflet had a significant reduction in LVEDD, LVESD, LVEDV, LVESV as compared to preoperative but patients with preserved anterior leaflet had greater reduction than excised anterior leaflet group. As compared to preoperative, patients with excised anterior leaflet showed a significant reduction in LV function at 1 year follow-up but it was well preserved and improved in total preservation group. There was no incidence of LVOTO and prosthetic valve dysfunction in either group and there was no significant difference among the groups regarding early and long-term outcome. Based on our study, we can signify the importance of sub-valvular preservation either posterior only or both anterior and posterior leaflet and chordae for better outcome. And we also highly recommend the preservation of anterior leaflet and chordae because it has greater impact on LV end-diastolic/systolic dimensions and is crucial to maintain the LV geometry and LV performance at long-term follow-up.

CONCLUSION:

Compared with posterior chordal preservation only, bi-leaflet preservation resulted in improved ejection performance and smaller end cycle volumes. To conclude, every effort should be made to preserve the annulo-ventricular integrity while performing mitral replacement preferably by preserving both anterior and posterior leaflet to maintain valvular-ventricular integrity and LV functions and for better results in early and long term follow-up.

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