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Original Article

Effectiveness of Posterior Mitral Leaflet Preservation in Mitral Valve Replacement Surgery: A Prospective Study

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Abstract

Introduction: Mitral valve replacement with chordal preservation requires technical skill, long cross clamp time and prolonged ischemic time of myocardium.

Materials and Methods: All patients undergoing mitral valve replacement in the Department of Cardiothoracic Surgery, Government Rajaji Hospital during December 2009 to December 2011 were included in the study.

Results: All the observations are depicted in tabular form.

Conclusion: In this study, the partial preservation of chordae was compared with classical mitral valve replacement. Since the partial chordal preservation (posterior mitral leaflet preservation) is simpler it can be performed in all centers with effective advantages of implanting an ideal valve without compromising the size and function of the prosthetic valve.

Key words: Mitral valve, PML preservation, Post-operative left ventricular function

INTRODUCTION

Mitral valve replacement with chordal preservation requires technical skill, long cross clamp time and prolonged ischemic time of myocardium. At the same time, chordal preservation improves the post-operative left ventricular function and exercise induced ejection fraction of the patient. However, in the mitral stenosis, it can lead to implantation of smaller valve.[1-5]

To study the effectiveness of posterior mitral leaflet (PML) preservation during mitral valve replacement on post-operative left ventricular functional improvement compared to the classical mitral valve replacement.

The parameters analyzed were left ventricular ejection fraction, left ventricular end systolic and diastolic dimension, left ventricular mass pre and postoperatively, immediate hemodynamic stability and long-term left ventricular function during exercise. These parameters were analyzed preoperatively and at the end of 6 months postoperatively.

The PML preservation in mitral valve replacement was compared with classical mitral valve replacement both techniques have their own advantage and disadvantages.

In classical mitral valve replacement, all the papillary muscular chordae were removed to facilitate bigger size valve implantation, shorter cross clamp time, technical simplicity, and less ischemic time for myocardium.

In our study, we comparing this two techniques by pre- and post-operative analysis of left ventricular function with the help of echocardiogram (ECHO) and NYHA class symptom of the patients preoperatively and 6 months post-surgery.

The study was conducted as a nonrandomized control trail. The procedures were decided preoperatively after examining the mitral valve anatomy.

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MATERIALS AND METHODS

All patients undergoing mitral valve replacement in the Department of Cardiothoracic Surgery, Government Rajaji Hospital during December 2009 to December 2011 were included in the study.

Patients having rheumatic mitral stenosis, rheumatic mitral valve replacement. All the patients were implanted TTK chitra valve varying from size 23 to 27 mm.

The pre- and post-operative ECHO evaluation was done in the Cardiology Department in Government Rajaji Hospital.

The post-operative follow-up ECHO was done at 10th post-operative day was done followed by ECHO evaluation at the end of 6th month. During ECHO evaluation left ventricular ejection fraction (LVEF), left ventricular diameter in diastole, left ventricular diameter in systole, left ventricular end systolic volume, left ventricular end diastolic volume, left ventricular mass index and exercised ejection fraction at 6th month were evaluated and analyzed.

A total of 40 patients underwent valve replacement from 2009 to 2011. Out of 40 patients, 25 patients had mitral valve replacement with PML preservation. 15 patients underwent mitral valve replacement with anterior mitral leaflet and PML resection.

Pre- and post-operative function NYHA class and ECHO evaluation were compared and analyzed.

RESULTS

Most of the cases were in 35-46 age group, very few patients were older than 45 years (7.5%) (Table 1 and Figure 1).

In Table 2, PML preserved group there were 11 males and 14 females, in the PML resected group, there were 8 males and 7 females.

In PML preserved group, 50% of patients had TTK valve implanted with size 25 or less. In the PML resected group, 60% of patient had bigger size valve implanted. This shows that PML resected group has a possibility of bigger size prosthetic valve implantation (Table 3 and Figure 2).

Ventilatory support for both group of patients extended from a minimum of 18 h to maximum of 48 h there was no significant advantage of PML preservation on the duration of ventilation (Table 4).

Tables 5 and 6 show that post-operative NYHA class of PML preserved group shows marked improvement. At that same time, PML resected groups were in higher NYHA class.

Table 7 shows the post-operative LVEF of PML preserved groups had improved values. PML resected group showed no improvement in LVEF (ECHO evaluation done by Simpson method).

Table 8 shows post-operative left ventricular diastolic diameter of PML preserved group shows reduction in size compared to PML resected group. *P* value is

Table 1: Age distribution

Age in years	Male	Female	Total
16-25	3	4	7
26-35	5	7	12
36-45	9	9	18
>45	2	1	3
Total	19	21	40

Table 2: Sex distribution

Sex	PML preserved	PML resected	Number of cases (%)
Male	11	8	19 (47.5)
Female	14	7	21 (52.5)
Total	25	15	40 (100)

PML: Posterior mitral leaflet

Table 3: Size of valve

Size of valve in mm	PML preserved	PML resected	Total
TTK 23	3	3	6
TTK 25	12	3	15
TTK 27	9	5	14
TTK 29	1	4	5
Total	25	15	40

Chi-square *P*=0.679 not significant. PML: Posterior mitral leaflet

Table 4: Ventilation time

Ventilation time (in h)	PML preserved	PML resected	Total
18	10	0	10
24	11	12	23
36	1	1	2
48	3	5	5
Total	25	15	40

Chi-square *P*=0.886 not significant. PML: Posterior mitral leaflet

Table 5: PML preserved

NYHA class	Number of patients			
	I	II	III	IV
Pre-operative	0	0	25	0
Post-operative	23	2	0	0

Chi-square *P*=0.019 (significant). PML: Posterior mitral leaflet

significant (ECHO evaluation done by Simpson method) (Figure 3).

Table 9 shows post-operative left ventricular systolic diameter of PML preserved group shows reduced in size comparatively to PML resected group. *P* valve is significant (ECHO evaluation done by Simpson method).

In Table 10, post-operative left ventricular systolic volume of PML preserved group shows reduction in volume compared to PML resected group. *P* value is significant (ECHO evaluation done by Simpson method).

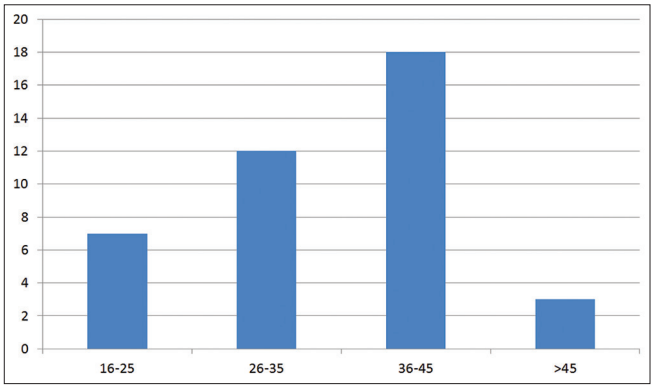

Figure 1: Post-operative ejection fraction

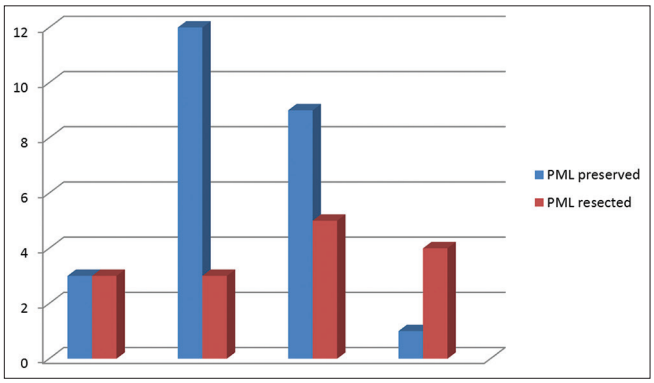

Figure 2: Post-operative left ventricular diameter in diastole

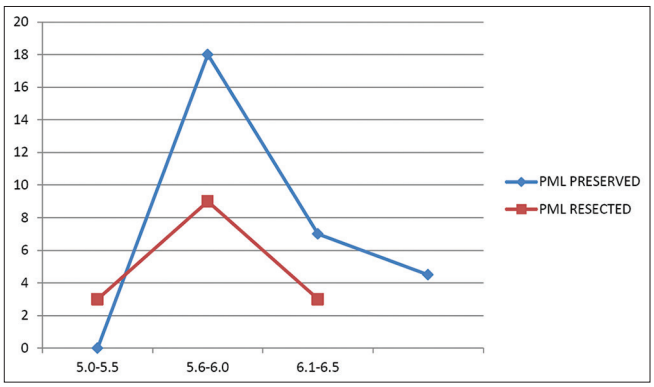

Figure 3: Post-operative left ventricular diameter in systole

In Table 11, post-operative left ventricular diastolic volume of PML preserved group shows reduction in volume compared to PML resected group. *P* value is significant (ECHO evaluation done by Simpson method).

Table 12 shows there was no significant advantage in heavy mass index reduction in the PML preserved compared to PML resected group (ECHO evaluation done by Simpson method).

Table 13 shows that at 6 months post-operative period, exercise ejection fraction was improved in PML resected

Table 6: PML resected

NYHA class	Number of patients			
	I	II	III	IV
Pre-operative	0	0	15	0
Post-operative	2	13	0	0

Chi-square *P*=0.003 (significant). PML: Posterior mitral leaflet

Table 7: LVEF

LVEF %	PML preserved		PML resected	
	Pre	Post	Pre	Post
45-50	8	2	14	15
51-55	12	12	1	0
56-60	3	10	0	0
61-65	2	1	0	0
Total	25	25	15	15

Chi-square *P*=0.048 significant. LVEF: Left ventricular ejection fraction, PML: Posterior mitral leaflet

Table 8: LVIDd

LVIDd in cm	PML preserved		PML resected	
	Pre	Post	Pre	Post
5.0-5.5	0	15	3	2
5.6-6.0	18	10	9	10
6.1-6.5	7	0	3	1
Total	25	25	15	13 (death-2)
Mean		6.008		5.556
SD		0.220		0.227
P	<0.001 significant			

LVIDd: Left ventricular dimension in diastole, SD: Standard deviation, PML: Posterior mitral leaflet

Table 9: LVIDs

LVIDs in cm	PML preserved		PML resected	
	Pre	Post	Pre	Post
2.8-3.4	0	4	3	2
3.5-3.8	17	21	8	5
>3.9	8	0	4	6
Total	25	25	15	13 (death-2)
Mean		3.852		3.484
SD		0.161		0.155
P value	<0.001 significant			

LVIDs: Left ventricular dimension in systole, SD: Standard deviation, PML: Posterior mitral leaflet

Table 10: LVESV

LVESV in ml	PML preserved		PML resected	
	Pre	Post	Pre	Post
25-35	0	10	4	2
36-45	4	15	3	10
46-55	17	0	8	1
56-65	4	0	0	0
Total	25	25	15	13 (death-2)
Mean		51.4		38.28
SD		5.66		3.95
P value	<0.001 significant			

LESV: Left ventricular end systolic volume, SD: Standard deviation, PML: Posterior mitral leaflet

Table 11: LVEDV

LVEDV in ml	PML Preserved		PML resected	
	Pre	Post	Pre	Post
<130	0	25	4	6
130-140	11	0	10	5
141-150	11	0	1	2
151-160	3	0	0	0
Total	25	25	15	13 (death-2)
Mean		144.28		113.4
SD		7.87		4.58
P value	<0.001 significant			

LVEDV: Left ventricular end diastolic volume, PML: Posterior mitral leaflet

group. *P* value is significant (ECHO evaluation by Simpson method by 6 min walk test) (Figure 4).

DISCUSSION

Mitral valve replacement surgery is the most common open heart surgery performed in the Department of Cardiothoracic, Government Rajaji Hospital, Madurai. Rheumatic mitral valvular disease is more common than degenerative mitral valve disease. Mitral valve repair is not possible in large number of patients because of rheumatic cicatrized subvalvular mitral valve disease. The prosthetic mitral valve replacement is commonly performed in our center. Because of economical reasons bioprosthetic valve were not implanted.

Mitral valve replacement is done either by preservation of all chordate to the mitral leaflet or by resection of both anterior and PMLs. There are many techniques of preserving chordate during surgery. PML and their chordates were commonly preserved in our center. The effectiveness of PML chordal preservation was analyzed and compared with classical mitral valve replacement. The study includes total of 40 patients; 25 patients were PML preservation and 15 patients had both anterior and PML resected.[5-8]

The procedure of choice was decided while doing surgery after examining the mitral valve. The study group included

Table 12: LVMI

LVMI	PML preserved		PML resected	
	Pre	Post	Pre	Post
150-160	7	11	6	4
161-170	18	14	8	8
>170	0	0	1	1
Total	25	25	15	13 (death-2)
Mean		159.56		161.28
SD		31.5		5.08
P value	0.789 not significant			

LVMI: Left ventricular mass index, PML: Posterior mitral leaflet, SD: Standard deviation

Table 13: LVEF %

Exercise LVEF %	Post-operative	
	PML preserved	PML resected
40-49	0	13
50-59	2	0
60-65	23	0
Total	25	13 (death-2)

LVEF: Left ventricular exercise ejection fraction, PML: Posterior mitral leaflet

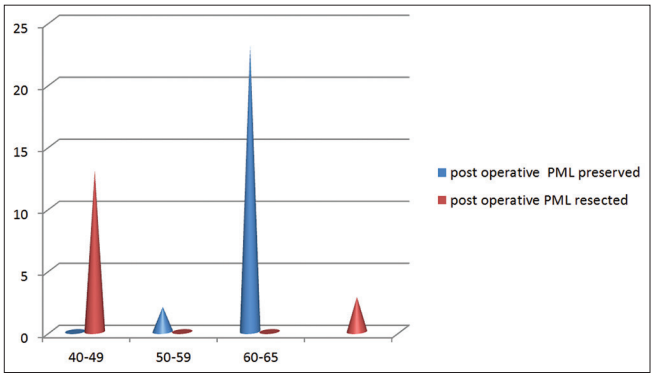

Figure 4: Post-operative ejection fraction with exercise

11 males and 14 female in PML preserved group; 8 males and 7 females in PML resected group.

In PML preserved group, the size of valve implanted was 25 and/or smaller than 25 size. At the same time, PML resection groups 60% if the cases had more than 25 size of prosthetic valve implanted. In PML resected groups had larger size valves implanted.

Out of the 40 cases, isolated mitral stenosis was 3 cases, mitral restenosis were 2 cases, and pure mitral regurgitation included 10 cases. All of them were of rheumatic etiology. The rest of the cases were of mitral stenosis with mitral regurgitation. The mitral and restenosis had mostly PML resection, because of severe subvalvular disease and for implanting the valve without hinderence of prosthetic valve movement. The statistical analysis of ventilatory support following surgery for the both groups was similar.

The complication in the PML preserved group was cerebrovascular accident in one case and heart block in 2 cases, 2 death occurred in PML resected group due to low output cardiac failure. The immediate post-operative ECHO study done on 10th day by Simpson method showed improvement in left ventricular ejection fraction in PML preserved groups, but there was no significant improvement in PML resected group.

After 6 months, patients in PML preserved group remain in NYHA Class I, but in PML resected group most of them were in NYHA Class II with significant effort in tolerance as shown by exercised left ventricular ejection fraction.

Statistical analysis of ECHO evaluation at 6 months showed marked improvement of post-operative left ventricular diastolic and systolic dimension, end diastolic and end systolic volume in PML preserved group. The *P* value is significant ($P < 0.001$). However, in the PML resected groups these parameters did not show any improvement.[9-12]

Hence, PML preservation is advantageous and a simpler procedure which can help the mitral valve replacement patients in long run when compared to PML resection.

Mitral valvular chordal preservation is done in many ways, total chordal and partial chordal preservation. In this study, partial preservation of chordate was compared with classical mitral valve replacement. Since partial chordal preservation (PML preservation) is a simpler technique, it can be performed in all centers with the effective advantage of implanting an ideal valve without compromising the size and function of the prosthetic valve. PMLs preservation contributes to post-operative improvement of patient symptoms and cardiac output index.[13,14]

CONCLUSION

In this study, the partial preservation of chordae was compared with classical mitral valve replacement. Since the partial chordal preservation (PML preservation) is simpler it can be performed in all centers with effective advantages of implanting an ideal valve without compromising the size and function of the prosthetic valve. PMLs preservation contributes to post-operative improvement of patient symptoms and cardiac output index.

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