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RESEARCH ARTICLE

PAPILLARY MUSCLE RE-SUSPENSION WITH NEO-CHORDAE FORMATION - A NOVEL METHOD TO PRESERVE POSTOPERATIVE LEFT VENTRICULAR FUNCTION AND DIMENSIONS IN MITRAL VALVE REPLACEMENT IN RHEUMATIC HEART DISEASE

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ABSTRACT

Mitral apparatus plays an important part in maintaining the geometry and LV function (LVEF).In India, Rheumatic valvular heart disease (RHD) is the predominant disease which affects all the components of mitral apparatus with heavy calcification, subvalvular crowding, and chordal fusion. Hence valve repair becomes near impossible. So, we have considered the use of Neo-Chordae with re-suspension of papillary muscles as a simple, easily reproducible method to maintain annulo-papillary continuity and hence post-operative LV dimensions, geometry and LV function. 100 patients underwent Mitral Valve Replacement with chordal re-suspension and were compared with that of non-preserved replacements. Improvement in LV dimension was seen in 80% of patients who had maintained annulo-papillary continuity in the form of papillary muscle re-suspension. 10% rise in LVEF was seen in our study. 24% cases had LV dysfunction in other group with increased LV dimensions almost 20%, post-operatively in this group B.

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INTRODUCTION

Mitral valve apparatus consists of;

- Leaflets
- Annulus
- Chordae
- Papillary muscles
- LV wall

Mitral apparatus plays an important role in maintaining the geometry of Left Ventricle and hence maintaining the LV function and Ejection Fraction (LVEF).This is mainly achieved by tethering of LV wall to mitral annulus through the mitral apparatus- the annulo-papillary continuity. This is the main reason why LV function is preserved and is better in the long run in mitral valve repair cases. In India, Rheumatic valvular heart disease is the predominant disease especially affecting mitral valve. It affects all the components of mitral apparatus with heavy calcification, subvalvular crowding, and chordal fusion. In this scenario valve repair becomes near impossible. Preservation is very difficult and most of the time both leaflets and chordate have to be excised. Hence, we have considered the use of neo-chordae with re-suspension of papillary muscles as a simple and easily reproducible method to maintainannulo-papillary continuity. And hence post operative LV dimensions, geometry and LV function. A retrospective study was conducted in KEM CVTS department to evaluate the benefits of papillary muscle re-suspension in rheumatic mitral valve disease and the results were compared with cases with no preservation.

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Aims and objectives

To assess the efficacy of papillary muscle re-suspension in rheumatic mitral valve disease in preserving the LV geometry, dimensions and functions in postoperative period.

MATERIALS AND METHODS

A retrospective study of 100 patients who underwent MVR from Jan 2011 to Aug 2015 at KEM was included. Subjects were divided in 2 groups

- Group A - MVR with papillary muscle re-suspension and with Posterior Mitral Leaflet preservation either partially of completely. (50 cases)
- Group B - MVR without any preservation. (50 cases)

Investigation tools

ECG
2D Echo

Parameters studied

1. LV geometry and Dimensions.
2. LVEF
3. Diastolic Dysfunction, if any.
4. Efficacy of use of Poly propylene.

Surgical technique of papillary muscle re-suspension

Mitral leaflets and chordate were completely excised including all of the calcium.

Papillary muscles are kept intact.

4-0 double ended Poly propylene with Pericardial Pledgets was used.

This suture was passed through papillary muscle with each limb of the suture passing through the muscle three times. Both limbs of the suture were brought through the annulus at the site of commisure which is nearest to papillary muscle.

Length of the suture should be such that papillary muscle should be straight and suture taut in LV of arrested heart. There should be no in-drawing of LV wall. The suture should not form a lax loop in the LV. The sutures were tied on the LA side of the annulus to secure it.

Average length of the suture was 1.5 to 2 cm.

MVR was done after re-suspension of papillary muscles with 2-0 ethibond, pledgeted, horizontal mattress interrupted sutures with pledget's kept on LA side.

Patients were evaluated with following criteria using 2D Echo:

1. Left ventricular internal diameter is systole [LVID(s)]
2. Left ventricular internal diameter in diastole [LVID(d)]
3. Left ventricular ejection fraction (LVEF).
4. Diastolic dysfunction.
5. All parameters compared with preoperative findings.

RESULTS

Out of 100 patients with 50 cases in each group all the parameters were compared. 27 cases of the group with neo chordae and re-suspension were female and 23 were male with the mean age of 41.5 years. Where as in group B, 26 were female and 24 were male with the mean age group being 40 years.

The parameters were compared in each group, as shown in the table:

Groups	Pre operative (mean)			Post operative (mean)		
	LVEF (%)	LVIDs (mm)	LVIDd (mm)	LVEF (%)	LVIDs (mm)	LVIDd (mm)
Group A	58.5	30.84	43.64	54.7	31.06	43.86
Group B	56.8	33.64	41.78	51.7	39.6	49.36

The average post-operative LVEF in group was 54.7% which in fact was less than the preoperative due the pump effect, but as compared to the group B the LVEF was more by almost 10% and average being 3%. 80% patients of papillary muscle re-suspension group showed significant improvement in LVEF.LV dysfunction was found in 10-12% cases. LVID dimensions showed almost about 10 mm reduction in some cases in both systolic and diastolic dimensions in group A. The mean pre operative systolic dimensions for group A was 30.84 mm and mean post operative dimensions were 31.06 mm, thus the dimensions were almost the same as compared to the preoperative. The diastolic dimensions also remained the same as that of preoperatively. (Chart 1) In fact the dimensions came down in 40% cases postoperatively

Group B

The mean preoperative LVEF was 56.8% and post operative LVEF was 51.7% with almost 5% drop as compared to group A. Only 24% patients had an improved LVEF in this group.

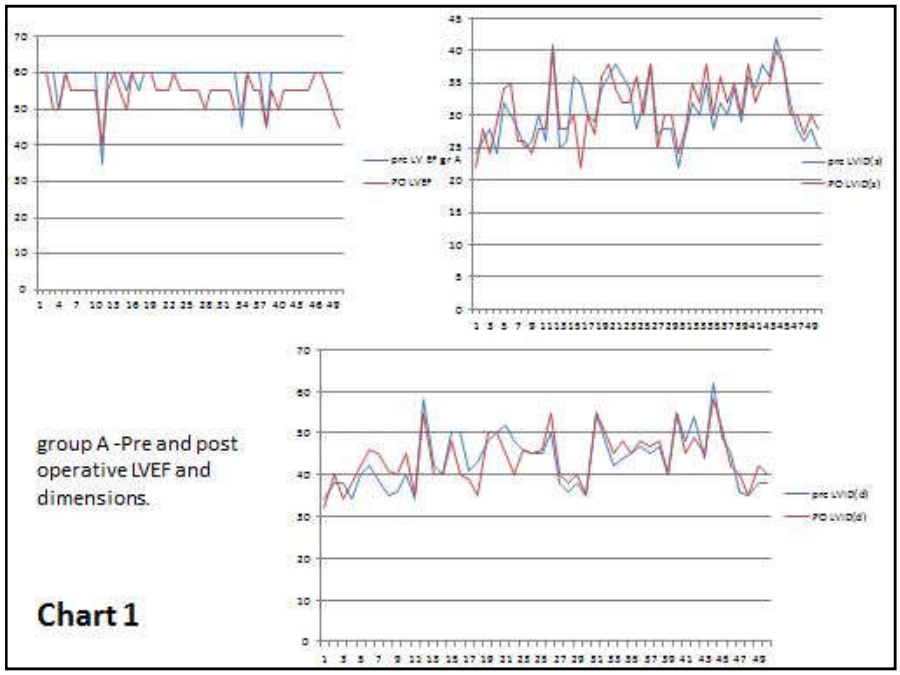
The mean preoperative and post operative systolic dimensions were 33.6 mm and 39.6 mm respectively, with an increase in mean dimension by 6 mm. The mean Diastolic dimensions were 41.78 and 49.36 pre and post operatively with an increase in 8 mm. Thus the mean systolic dimensions that raised post operatively was almost 18% and the diastolic dimensions was 20%.

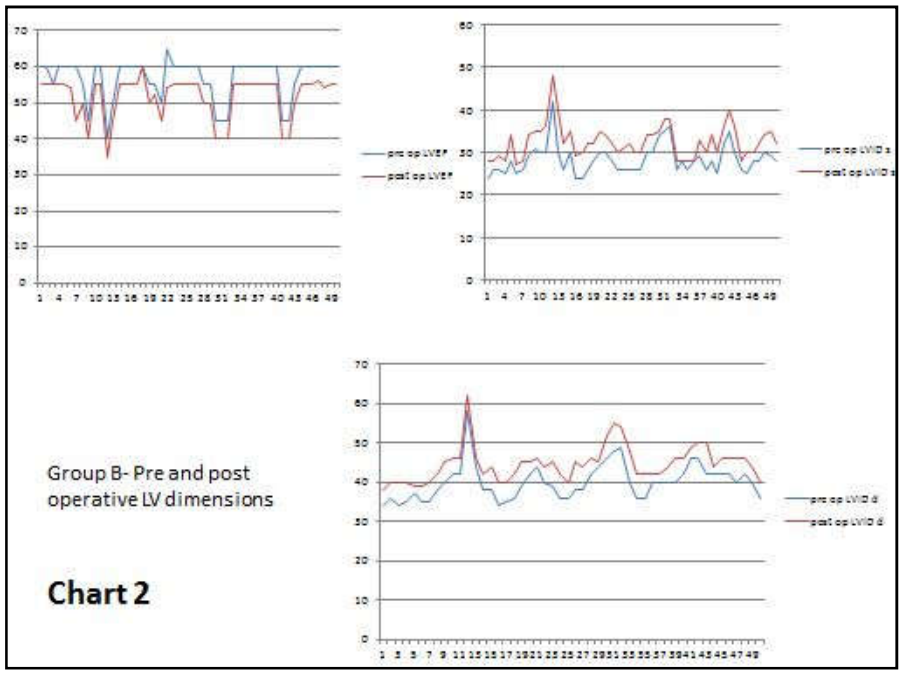
Comparison of the groups:

When both the groups were compared it was found that the LVEF in group A was almost normal with an increase by 10% in some cases and with an average of 3% more than other group. The dimensions in group A were almost normal with a change of only 1-2 mm, where as in group B the dimensions were significantly increased by 6-8 mm (18-20%). Improvement in LV dimension was seen in 80% of patients who had maintained annulo-papillary continuity in the form of papillary muscle re-suspension (chart 1).The LV dysfunction was almost 24% in group B. 4% of conventional MVR patients developed choked valve in follow up period compared to none in the papillary muscle re-suspension group

DISCUSSION

Mitral valve repair is in general superior to mitral valve replacement; however, replacement is the only option in some cases as in rheumatic valvular heart diseases. Many studies showed the superiority of bileaflet preservation during MVR, over the standard MVR technique (Yun *et al*., 1999; Rozich *et al*., 1992; Moon *et al*., 1994; Sintek *et al*., 1995).


group A -Pre and post operative LVEF and dimensions.
Chart 1


Group B- Pre and post operative LV dimensions
Chart 2

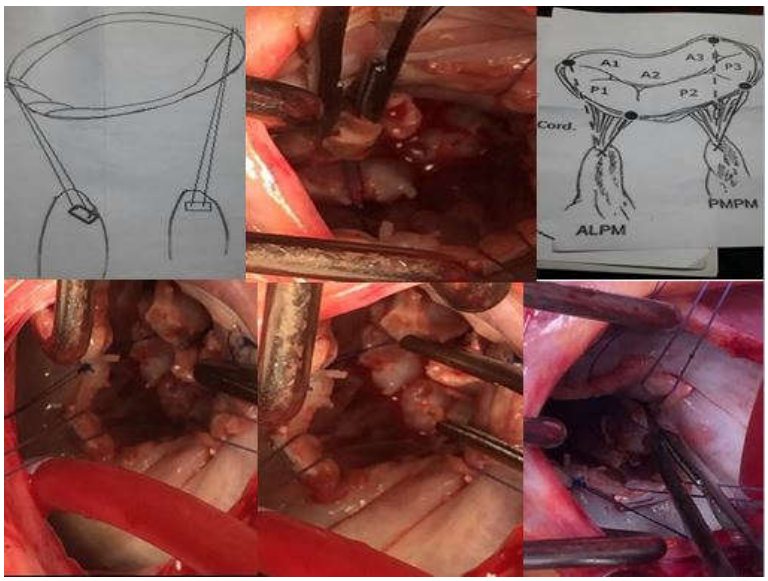

A1
A2
A3
P1
P2
P3
Cord.
ALPM
PMPM

Figure 1.

Currently, the more frequently accepted and performed technique is MVR that preserves only the posterior leaflet. Although the superiority of bileaflet preservation over conventional valve-excising MVR has been shown by many studies, there are studies that compare bileaflet preservation with posterior-leaflet-only preservation. (Muthialu *et al*., 2005; Chowdhury *et al*., 2005; Borger *et al*., 2002) The study conducted by Yun and colleagues[1] revealed no differences between the 2 techniques in terms of LV diameter and LVEF. In their study, Hennein and coworkers (Hennein *et al*., 1990) compared bileaflet preservation, posterior-leaflet-only preservation, and total resection. When they performed echocardiography during the 6th and 9th postoperative months, they found bileaflet preservation and posterior-leaflet-only preservation to be superior over total resection in terms of exercise capacity, systolic dimensions, and fractional shortening. However, they observed no significant difference between their bileaflet preservation and posterior-leaflet-only preservation groups. A meta-analysis of bileaflet preservation reviewed investigations of different preservation techniques but failed to show the superiority of bileaflet preservation over posterior-leaflet-only preservation. (Athanasiou *et al*., 2008) The results of the present study are similar to those of the studies mentioned above. However we have used the technique of papillary re-suspension and neo chordae formation whereas none of the above studies included the re-suspension and neochordae formation during the mitral valve replacement. To our knowledge there are very few studies or almost none with the novel technique of neochordae formation and the papillary re-suspension.

Conclusion

Papillary muscle re-suspension with neo-chordae formation is thus a simple reproducible and effective method for maintaining annulo-papillary continuity in rheumatic mitral valve disease. It preserves LV dimensions and function effectively with almost 10% rise in LVEF in our study and 80% cases with improvement in LV dimensions. It creates postoperative results similar to total chordal preservation. The procedure can be easily applicable in rheumatic mitral disease, as no diseased tissue is left behind. Also, the chances of pannus formation postoperatively are very less as there is no diseased tissue left behind.

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