

## Changes in left Ventricular Function after Double valve Replacement for Combined Aortic and Mitral valve Diseases

Divya Mallikarjun<sup>1</sup>, Giridhar Kamalapurkar<sup>2</sup>, Anand Kuriyan Mathew<sup>3</sup>

### Authors Affiliation:

<sup>1,3</sup>Assistant Professor <sup>2</sup>Professor,  
Department of Cardiothoracic and  
Vascular Surgery, Sri Jayadeva  
Institute of Cardiovascular Sciences  
and Research, Bangalore, Karnataka  
560069, India.

### Corresponding Author:

**Divya Mallikarjun,**  
Assistant Professor, Department  
of Cardiothoracic and Vascular  
Surgery, Sri Jayadeva Institute of  
Cardiovascular Sciences and Research,  
Bangalore, Karnataka 560069, India.

**Email:** divmallik@gmail.com

**Received on** 20.07.2018

**Accepted on** 09.08.2018

### Abstract

*Context:* Rheumatic disease is the most common cause in our country. Few data are available on post operative left ventricular function in patients with mixed stenotic and regurgitant lesions. In this study, we sought to analyze short term changes in LV function after DVR in combined rheumatic and mitral diseases. *Aim:* To analyze the short term changes in LV function after DVR in combined rheumatic aortic and mitral diseases. *Settings and Design:* Prospective analysis of all cases of DVR in combined rheumatic aortic and mitral diseases done from 1/8/2012 to 31/12/2013 in 2 surgical units at Sri Jayadeva Institute of Cardiovascular Sciences and Research and their serial clinical and 2-D Trans Thoracic Echocardiographic evaluations, post-operatively, for 1 year. *Methods and Material:* Serial clinical and echocardiographic evaluations were performed prospectively in patients who underwent double valve replacement for combined aortic and mitral valve diseases, immediate post-operatively, at 3 months and at 1 year. For purposes of comparison, 2 groups were made based on types of lesions, i.e. purely regurgitant lesions and combined stenotic and regurgitant lesions. *Statistical analysis used:* Data are presented as mean  $\pm$ SD. Group comparisons made by the use of Paired t test. Significance assumed at a two-tailed value of  $p < 0.05$ . *Results:* Left ventricular diastolic and systolic dimensions and volumes reduced significantly at 3 months in regurgitant group but not in the mixed lesions group. *Conclusions:* In patients with NYHA class upto III with severely dilated left ventricle and low ejection fraction, double valve replacement surgery can be done safely.

**Keywords:** LV Function; DVR; Mixed Lesions.

### Introduction

Aortic and mitral diseases frequently occur in combination. Although myxomatous degeneration with leaflet prolapsed of both valves accounts for some cases, rheumatic disease is the most common cause. The hemodynamics and loading conditions for isolated mitral or aortic regurgitation have been well documented, and their effect on post-operative left ventricular function has been established. Although previous studies have looked at the clinical outcome of patients undergoing double valve replacement for combined severe mitral and aortic regurgitation, few data are available on post-operative left ventricular function after double valve replacement (DVR) in combined rheumatic aortic and mitral diseases. In this study, we sought

to analyze short term changes in left ventricular (LV) function after DVR in combined rheumatic aortic and mitral diseases.

### Materials and Methods

This is a prospective non-randomized study to analyze the changes in LV function after DVR in combined aortic and mitral valve lesions. This study was conducted from August 2012 to December 2014. During this period, 51 consecutive patients who underwent DVR in two surgical units at our institute were followed up for a period of one year with two Dimensional Trans Thoracic Echocardiography. Lesion severity was established with physical examination and Doppler color flow mapping. The origin of the valve lesions was

considered to be rheumatic in all cases on the basis of clinical and echocardiographic criteria and as confirmed by surgical evaluation. None of the patients had concomitant coronary bypass surgery or repair of associated congenital heart anomalies. Patients who were lost to follow-up were excluded from the study.

#### A) Patient demographics

The age of the patients ranged from 18 to 69 years. 8 patients had poor ejection fraction (i.e. <45%, lowest being 40%) and dilated LV (End Diastolic Volume >250ml), highest being 266ml. Patient demographics are given in Table 1. Types of lesions are shown in Figure 1.

**Table 1:** Patient demographics

Study period	From Aug 2012 to Dec 2013
Mean follow up	15±2 months
Total patients	51
Mean age (in years)	38.51±20.49
Sex	24 Female and 27 Male
Etiology	
Rheumatic fever	48
Degenerative	3
Symptoms	
NYHA Class II	14
NYHA Class III	37
Rhythm	
Sinus	36
AF	15

**Table 2:** CPB & Procedure related

Aortic Cross Clamp Time (in minutes)	122.9±18.29
CPB Time (in minutes)	144.5±21.71
Chordal Preservation	31(62%)
Tricuspid Annuloplasty	14(28%)
Aortic Valve Size	20±2
Mitral Valve Size	27±2

**Table 4:** Echocardiographic findings

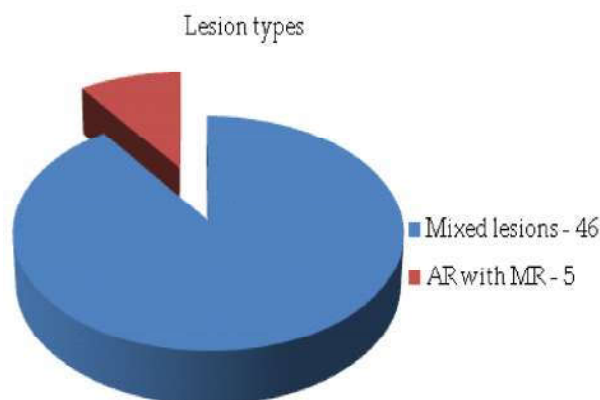
Echocardiography Parameters	Pre-op	3 months Post-op	P value	1 year follow up	P value
End Diastolic Volume (EDV) in ml	177.3±132.1	132.5±79.81	0.02	124.5±73.12	0.01
End Systolic Volume (ESV) in ml	81.14±74.22	71.95±61.61	0.28	68.52±57.53	0.16
Ejection Fraction (EF) in %	56.42±6.48	50.33±9.60	0.002	53.19±10.81	0.12
Left Ventricular Internal Diameter end diastole in mm (LVIDd)	58.86±15.71	52.52±10.96	0.0003	50.03±10.42	0.0001
Left Ventricular Internal Diameter end systole in mm (LVIDs)	41.95±14.72	39.24±13.08	0.04	37.48±12.24	0.003

#### B) Surgery

Operations were performed with the standard techniques of cardiopulmonary bypass (CPB), including hemodilution using a hemofilter to remove excess fluid and moderate systemic hypothermia and myocardial protection with cold sanguineous antegrade cardioplegia. All patients underwent conventional CPB. See Table 2. Post-operatively, inotropic supports in the form of dopamine, adrenaline and noradrenaline were used as required. Serum Potassium (K<sup>+</sup> levels were strictly maintained at 4mEq/L post operatively. Chordae to the posterior mitral leaflet were preserved in a majority of the patients. The various implanted valve prosthesis are given in Table 3.

**Table 3:** Prosthesis used

Valve Prosthesis Used	No. of patients
St Jude Mechanical	32
St Jude Biocor	4
Medtronic Hancock	2
Perimount	4
ATS	4
TTK Chitra	5



**Fig. 1:** Lesion types

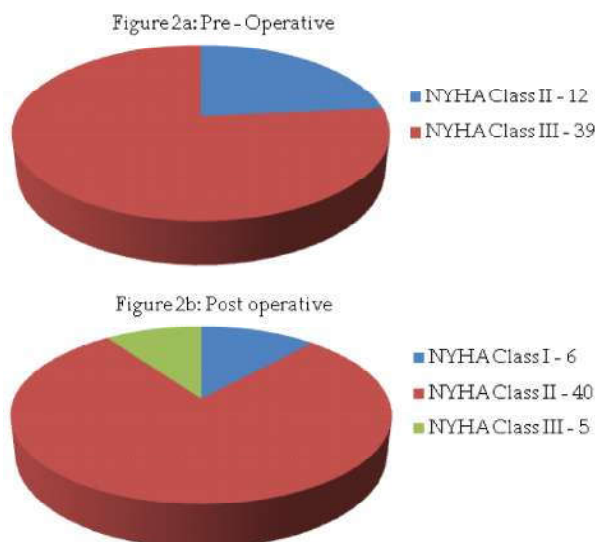


Fig. 2: Comparison of symptoms

### C) Follow up and Echocardiography

All patients were followed up at our hospital at a dedicated outpatient follow-up clinic. Patients were seen at two weeks and at one, two, and three months after surgery and thereafter every three months or more frequently if clinically indicated. At each visit, a clinical examination plus anticoagulation level determination was performed [Tablet (Tab) Acitrom, to maintain a therapeutic International Normalized Ratio (INR) of 2.5-3.5]. Angiotensin-converting enzyme (ACE) inhibitors were started at discharge; Injection (Inj) Penidure prophylaxis (every 21 days) was continued. Any patient developing atrial fibrillation received amiodarone, which was continued upto six weeks post operatively.

Doppler two-dimensional echocardiography with color flow mapping was performed in every patient before surgery. Serial follow up studies were performed by use of the same equipment, by the same observer. Echocardiographic studies were performed at 3 and 12 months or at more frequent intervals whenever feasible or when a complication was suspected.

Pre-operatively, all patients received optimal medical management in the form of furosemide, digoxin, ACE inhibitors, beta-blockers (in selected patients), and regular Penidure prophylaxis (every three weeks). All had good nutrition, with dietary iron supplements and maintained a hemoglobin of at least 10gm% and albumin of >3gm%.

### D) Statistical analysis

Data are presented as mean±SD. Group

comparisons were made by use of the Paired t test. Significance was assumed at a two-tailed value of  $p < 0.05$ .

## Results

All pre-operative as well as subsequent follow-up 2D echocardiographies were done by a single echocardiography technician, to avoid inter observer variations, at our institute. The observations have been tabulated in Table 4.

The comparison of the patients' symptoms [as per New York Heart Association (NYHA)] pre and post operatively are shown in Figures 2a and 2b.

Two patients, who were in atrial fibrillation preoperatively, reverted to sinus rhythm postoperatively. All prosthetic valves were functioning normally postoperatively as determined by echo. There was no mortality at the end of one year follow up. One patient succumbed to septicemia on Post operative day 22.

Further analysis was done by splitting the lesions into two groups. Those that were purely regurgitant lesions in one; and mixed stenotic plus regurgitant lesions in another (as they could not be classified into either a stenotic or a regurgitant group).

Left ventricular diastolic dimension (LVIDd) reduced significantly at three months in regurgitant group ( $p = 0.0007$ ) but not in the mixed group ( $p = 0.06$ ) and continued to decrease at one year ( $p = 0.001$  for regurgitant versus  $p = 0.004$  for mixed group).

Left ventricular systolic dimension (LVIDs) reduced significantly at three months in regurgitant group ( $p = 0.0004$ ) but not in the mixed group ( $p = 0.12$ ) and continued to decrease at one year ( $p = 0.0008$  for regurgitant versus  $p = 0.03$  for mixed group).

There was a significant reduction in end diastolic and systolic volumes (EDV and ESV) in the regurgitant subsets at three months (EDV:  $p = 0.01$ , ESV:  $p = 0.004$ ) as well as one year follow-up (EDV:  $p = 0.01$ , ESV:  $p = 0.006$ ), but they were not significantly altered in the mixed lesion subset.

Due to reduction in both the EDV as well as ESV in the regurgitant group, there was no significant change noted in the left ventricular ejection fraction at three months ( $p = 0.25$ ) and at one year ( $p = 0.31$ ) of follow up. The mixed lesion subset showed a significant reduction in the left ventricular ejection fraction at three months.

## Discussion

Aortic and mitral regurgitation frequently occur in combination [1,2]. The first report of simultaneous mitral and aortic valve replacement was published by Cartwright and co-workers in 1963 [3].

The phenomenon of fall in end systolic dimension and recovery of systolic function in our group of patients with double valve replacement is similar to that for patients with isolated aortic regurgitation (AR) [4,5]. The elevated afterload measured preoperatively and its significant reduction postoperatively is also similar to the data reported for isolated aortic regurgitation [6]. It would appear, therefore, that the hemodynamics of combined valve regurgitation more closely approximates those of aortic regurgitation than isolated mitral regurgitation (MR). Although the post operative increase in ejection fraction is most likely due to a substantial reduction in afterload, a concomitant improvement in contractility cannot be excluded. These results would also suggest that the detrimental loading conditions created by mitral valve replacement are more than offset by the favorable hemodynamics of aortic valve replacement.

Skudicky et al [7] noted in a prospective study that, after an initial postoperative decline in EF, normalization in Left Ventricle (LV) systolic function may be expected 1 year after Double Valve Replacement (DVR) for rheumatic MR + AR. ESV and EF are the only independent predictors of postoperative LV performance.

In a study by Turina et al [8], included 170 patients, they observed that, in double valve disease, preoperative myocardial function is the main predictor of long term survival. Low operative mortality rates and good late outcome make valve replacement mandatory before deterioration of myocardial function occurs. Additional tricuspid valve disease requiring surgery significantly decreases late survival rate.

Although several studies [9,10,11,12] have shown that retaining the submitral apparatus during mitral valve replacement may enhance preservation of left ventricular function, most of these studies have not been randomized and were performed in a predominantly non-rheumatic population. In a small (n = 16), but randomized trial, Komeda et al. [13] showed a greater ejection fraction 4 to 5 years after mitral valve replacement with chordal preservation than with mitral valve replacement with chordal transection (degenerative

disease of the mitral valve in all cases). By contrast, in a large, non randomized study [14], preservation of chordae tendinae was not an independent predictor of postoperative outcome in 61 patients with rheumatic mitral regurgitation. The role of chordal preservation in rheumatic mitral insufficiency, therefore, is as yet uncertain.

### *Study limitations*

The use of echocardiography for the assessment of left ventricular ejection fraction may be a concern.

### *Conclusion*

Left ventricular end diastolic and systolic diameters decrease significantly at three months & one year after surgery in the regurgitant group without a significant change in ejection fraction.

In mixed lesions group, left ventricular end diastolic diameter decreases at three months without a significant change in end systolic dimension resulting in a decline in ejection fraction. At one year, a significant reduction in end systolic dimension was observed, the ejection fraction was normalized.

In patients with NYHA class up to III (no NYHA IV in this series) with severely dilated left ventricle and low ejection fraction, double valve replacement can be done safely.

*Conflict of interest:* The authors declare that they have no conflict of interest.

*Key Messages:* In patients with NYHA class upto III with severely dilated left ventricle and low ejection fraction, double valve replacement surgery can be done safely

## References

1. Melvin DB, Tecklenberg PL, Hollingsworth JF, Levine FH, Glancy DL, Epstein SE, Morrow AG. Computer based analysis of preoperative and postoperative prognostic factors in 100 patients with combined aortic and mitral valve replacement. *Circulation*.1973;48(suppl III):III-56-III-62.
2. Clause BJ. Rheumatic heart disease: an analysis of 796 cases. *Am Heart J*. 1940;20:454-74.
3. Cartwright RS, Giacobine JW, Ratan RS, Ford WB, Palich WE. Combined aortic and mitral valve replacement. *J Thorac Cardiovasc Surg*. 1963; 45:35-42.

4. Taniguchi K, Nakano S, Kawashima Y, Sakai K, Kawamoto T, Sakaki S, Kobayashi J, Morimoto S, Matsuda H. Left ventricular ejection performance, wall stress, and contractile state in aortic regurgitation before and after aortic valve replacement. *Circulation*. 1990;82:798-807.
  5. Boucher CA, Bingham BJ, Osbakken MD, Okada RD, Strauss HW, Block PC, Levine FH, Phillips HR, Pohost GM. Early changes in left ventricular size and function after correction of left ventricular volume overload. *Am J Cardiol*. 1981;47:991-1004.
  6. Kumpuris AG, Quinones MA, Waggoner AD, Kannon DJ, Nelson JG, Miller RR. Importance of preoperative hypertrophy, wall stress and end systolic dimension as echocardiographic predictors of normalization of left ventricular dilatation after valve replacement in chronic aortic insufficiency. *Am J Cardiol*. 1982;49:1091-1100.
  7. Daniel Skudicky, Mohammed R Essop, Pinhas Sareli. Time related changes in left ventricular function after double valve replacement for combined aortic and mitral regurgitation in a young rheumatic population. *Circulation*. 1997; 95(4):899-904.
  8. Turina J, Stark T, Seifert B, Turina M. Predictors of the long term outcome after combined aortic and mitral valve surgery. *Circulation*. 1999 Nov 9; 100(19 Suppl):II48-53.
  9. Rozich JD, Carabello BA, Usher BW, Kratz JM, Adelle EB, Zile MR. Mitral valve replacement with and without chordal preservation in patients with chronic mitral regurgitation: mechanisms for differences in postoperative ejection performance. *Circulation*. 1992;86:1718-26.
  10. Okita Y, Miki S, Kusuhara K, Ueda Y, Tahata T, Yamanaka K, Higa T. Analysis of left ventricular motion after mitral valve replacement with a technique of preservation of all chordae tendinae. *J Thorac Cardiovasc Surg*. 1992;104:786-95.
  11. David TE, Burns RJ, Baccus CM, Druch MN. Mitral valve replacement for mitral regurgitation with and without preservation of chordae tendinae. *J Thorac Cardiovasc Surg*. 1984;88:718-25.
  12. Hennein HA, Swain JA, McIntosh CL, Bonow RO, Stone CD, Clark RE. Comparative assessment of chordae preservation versus chordae resection during mitral valve replacement. *J Thorac Cardiovasc Surg*. 1990;99:828-37.
  13. Komeda M, David TE, Rao V, Sun Z, Weisel RD, Burns RJ. Late hemodynamic effects of preserved papillary muscles during mitral valve replacement. *Circulation*. 1994;90(pt 2):II-190-II-194.
  14. Borrow KM, Newburger JW. Noninvasive estimation of central aortic pressure using the oscillometric method for analyzing systemic artery pulsatile blood flow: comparative study of indirect systolic, diastolic and mean brachial artery pressure with simultaneous direct ascending aortic pressure measurements. *Am Heart J*. 1982;103:879-86.
-

## Journal of Cardiovascular Medicine and Surgery

### Library Recommendation Form

If you would like to recommend this journal to your library, simply complete the form below and return it to us. Please type or print the information clearly. We will forward a sample copy to your library, along with this recommendation card.

#### Please send a sample copy to:

Name of Librarian

Name of Library

Address of Library

#### Recommended by:

Your Name/ Title

Department

Address

#### Dear Librarian,

I would like to recommend that your library subscribe to the Journal of Cardiovascular Medicine and Surgery. I believe the major future uses of the journal for your library would provide:

1. useful information for members of my specialty.
2. an excellent research aid.
3. an invaluable student resource.

**I have a personal subscription and understand and appreciate the value an institutional subscription would mean to our staff.**

Should the journal you're reading right now be a part of your University or institution's library? To have a free sample sent to your librarian, simply fill out and mail this today!

Stock Manager

Red Flower Publication Pvt. Ltd.

48/41-42, DSIDC, Pocket-II

Mayur Vihar Phase-I

Delhi - 110 091(India)

Phone: Phone: 91-11-45796900, 22754205, 22756995, Cell: +91-9821671871

E-mail: sales@rfppl.co.in