

## ORIGINAL ARTICLE

# Short Term Clinical Outcome in Patients with Mitral Valve Replacement with or without Preservation of Subvalvular Apparatus

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### Abstract:

**Background:** Preservation of subvalvular apparatus (SAP) during mitral valve replacement (MVR) was introduced about forty years back, but the outcome of this procedure is not well studied yet. Our study aimed to measure the in-hospital outcome of this procedure in rheumatic patients.

**Method:** 44 patients of rheumatic heart disease undergoing for MVR in the department of cardiac surgery, BSMMU were enrolled for the study. The technique of SAP was according to choice of surgeon. Patients were divided into two groups- I) with preservation: complete preservation, where entire chordo-papillary apparatus was preserved & partial preservation, where posterior leaflet was preserved, II) no preservation: where subvalvular apparatus was completely excised. Surgical technique was different according to patient's requirement and one of either technique was adopted by Fuster et al or Miki et al. Patients' demographic profile and mitral valve status were recorded. Outcome was recorded in terms of hemodynamic outcome and in hospital death. Data was analyzed by Chi squared test.

**Result:** Mean±SD of age of patients was 32±8 years, 29±7 years in group-I, 36±9 years in group-II. There was no significant difference in age distribution between two groups. Both groups were female predominant, 82% in group-I and 73% in group-II. Low cardiac output syndrome was observed in 4.5% of group-I and 32% in group-II (P-value was <0.001). Left ventricular failure was observed as 0% & 32% respectively (p value was <0.001). Inotropic agent was needed 45% & 75% respectively (p value was <0.01). In hospital death occurred in 4.5% & 13.5% in two groups respectively with no significant difference.

**Conclusion:** Hemodynamic outcome and in hospital mortality was better when subvalvular apparatus was preserved during mitral valve replacement in rheumatic population.

**Key words:** Mitral valve replacement, subvalvular apparatus preservation, short term clinical outcome.

### Introduction:

In the early days of mitral valve replacement (MVR), there was an increased rate of mortality associated with low cardiac output syndrome (LCOS). Excision of the sub valvular apparatus (SVA) was one of the reasons for LCOS, as MVR at that time included complete excision of mitral leaflets and SVA that is, chordae tendinae and papillary muscles. Left ventricular function and geometry depend on dynamic interaction between left ventricular wall and mitral annulus which is bridged by SVA. Papillary muscle and chordae moderates wall tension during systole and optimize

left ventricular distension during diastole. Interruption of ventricular-papillary-annular complex by excision of SVA during MVR thus causes impairment of normal ventricular stress-strain pattern and thus eventually leads to impaired left ventricular function and low cardiac output. In the early sixties Lillehei and his colleagues capitalized on the fact and suggested that the high mortality rate associated with MVR could be reduced by preserving the papillary muscles and chorda tendinae. He preserved the posterior leaflet during MVR and noted a decreased incidence of post operative low output syndrome<sup>1</sup>.

In the late seventies and early eighties there was renewed interest as surgeons realized the importance of SVA preservation and innovated different newer technique of total and partial preservation<sup>2-4</sup>. Consequently number of studies showed improvement in operative survival by subvalvular apparatus preservation (SAP) and in subsequent years studies supported the improved outcome of SAP in patients undergoing MVR in terms of short term and long term survival, functional capacity and evidence of improved echocardiographic ventricular function and dimensions. These results are now translated into world wide practice of SAP in patients undergoing MVR<sup>5-11</sup>. Some studies also explained the complex mechanism involved in improvement in outcome with SAP during MVR through interaction between changed left ventricular volumes and wall stress as evident from their various echocardiographic measures<sup>7,9</sup>.

There is high prevalence of rheumatic valvular disease in Bangladesh and other developing countries<sup>14</sup>. So, it will be useful and relevant to have such a study on rheumatic subsets. In patients with rheumatic heart disease, SVA may be difficult to preserve as subvalvular apparatus may not be readily amenable because of marked calcification and adhesion. Despite this drawback, Fuster and his colleague have shown success in complete chordal preservation and better results in patients with rheumatic heart disease<sup>13</sup>. Similar results of improved survival and left ventricular function in rheumatic heart disease were reported by others<sup>15-17</sup>.

In contrast to the western world where mitral valve disease takes many years to develop, in developing countries mitral valve disease progresses more rapidly and even the interval between the appearance of rheumatic symptoms and mitral stenosis can be as short as one year<sup>18</sup>.

Although few studies in developing countries showed promising results in chordal preservation group, there are still scarcity of studies and till today there is no long term study<sup>19,20</sup>. In this study, we aimed at observing the short term clinical outcome in patient with rheumatic mitral valve disease in terms of no preservation and preservation of subvalvular apparatus during MVR.

#### **Aim of the Study:**

To assess the short term clinical outcome in patients undergoing MVR with or without SAP.

#### **Material and Methods:**

##### **Study Population:**

This cohort study was performed on the 50 consecutive subjects who presented to department of cardiac surgery

and cardiology of BSMMU with rheumatic heart disease undergoing MVR from Jan 2013 to June 2014.

Patients with RHD properly selected for MVR with St. Judes mechanical bileaflet valve. Valve lesions were judged as rheumatic in origin on the basis of echocardiographic findings: reduced or absent coaptation with leaflet retraction or deformity for mitral regurgitation and commissural fusion with leaflets deformity for mitral stenosis<sup>15</sup>.

Consecutive patient was taken and mode of surgery was determined by morphology of subvalvular apparatus which dictated the extent of the preservation.

**Exclusion criteria:** Non Rheumatic mitral valve disease, Acute rheumatic carditis

Severe LV systolic dysfunction, Re do surgery, Previous stroke, Emergency surgery, Renal failure, Pre operative hepatic dysfunction, Concomitant procedure like AVR, CABG.

#### **Study Procedure:**

Initial evaluation of the patients was done by history, demographic data (age, sex, occupation), clinical examination and relevant investigations and were recorded.

**Surgical procedure-** The mitral valve was carefully inspected. The potential for repair was thoroughly assessed, as it was always first option. If the repair is ruled out, after carefully ascertaining the indication for MVR, notes as regard technique, types and size of prosthesis and the cardiopulmonary bypass protocol was recorded.

The technique of SAP was according to the choice of surgeons. The patient was divided into two groups-

- 1) With preservation.
  - a. Complete- where entire chordo-papillary apparatus was preserved.
  - b. Partial - posterior leaflet was preserved.
- 2) No preservation- where SVA was completely excised.

Surgical technique was different according to patient's surgical requirement and one of the either technique as adopted by Fuster et al.<sup>22</sup> or by Miki et al<sup>21</sup>

#### **Post-Operative Outcome:**

Per-operative and post-operative outcome was noted as following: Post and per operative mortality,

Need for inotropic agents, LCOS, Cardiogenic shock

Also, note was taken on size of prosthesis, total ischaemic time, bypass time, NYHA class, AF, renal failure. Follow up

data to measure the outcome was analyzed before discharge (6<sup>th</sup> to 14<sup>th</sup> postoperative day).

### Statistical Analysis:

Data was entered and analyzed with SPSS. Descriptive data was calculated for continuous and categorical variables. The chi square test and Fisher's exact test were done to determine the association among the groups for categorical variables. Comparison of continuous variable between the groups was analyzed by unpaired t test. A paired t test was done to compare pre and post operative measures. A p value of less than 0.05 was considered as significant.

### Observation & Results

The study was conducted in the department of Cardiac surgery, BSMMU from January, 2013 to June 2014.

The mean age of the patients were 32±8 years. In group I, patients age was 29±7 years and in group II 36±9 years. There was no significant difference of age distribution between the groups.

There was significant differences between the groups in terms of post hemodynamic changes and death.

Table I : Showing the difference of major hemodynamic consequence after MVR in the groups (comparison of low cardiac output syndrome, heart failure and need for inotropic support between the groups).

**Table-I**

*Comparison of major post operative hemodynamic sequence.*

Variable	Group I n=22		Group II n=22		P value
	n	%	n	%	
Low cardiac output	1	4.5%	7	32%	<.001
Left ventricular failure	0	0%	7	32%	<.001
Need for inotropic support	10	45%	17	75%	<.01

Data were analyzed using  $\chi^2$ -test and Fisher's exact test P value was not significant (>0.05),

Group I: Sub valvular apparatus preserved, Group II: Sub valvular apparatus non preserved

n= Number of subjects, NS= Not significant

**Table-II**

*Showing the difference of death between the groups following mitral valve replacement.*

Variable	Group I n = 22	Group II n = 22	Pvalue
Post operative	1(4.5%)	3 (13.5%)	NS

Data were analyzed using Fisher's exact test, P value was not significant (>0.05), Group I: Sub valvular apparatus preserved, Group II: Sub valvular apparatus non preserved, n= Number of subjects, NS= Not significant

### Discussion:

After four decades of introduction of the technique of preservation of subvalvular apparatus during mitral valve replacement and its established unequivocal benefit, there remains some areas of interest related to mechanism, outcome, and effects. There still remains some points to be seen if the similar outcome exist in different patient population. Our study addressed the issues encompassing observation of the outcome of the technique in a population which includes patients with rheumatic origin of our developing country and also looked at the mechanism involved in the outcome difference in age of the candidates requiring valve replacement again reflects the fact that, the rheumatic process in developing countries is more aggressive from those of the developed countries. This justifies the purpose of our study which has reflected a newer population.

Our patient population comprised predominantly female patients and similar pattern has also been found among many other studies where more than seventy percent of the patient population were female. (13,15, 17,20)

Our patients functional capacity was also similar to the patients in studies done on other rheumatic population. (13,19,20, 23,25). After follow up period the functional capacity improved in the preservation group significantly in our study which is similar to the studies done by Chowdhury UK et al and Zakai SB et al (19,20).

Most of the patients in our study had mitral stenosis. The study done by Sugita T et al in Japan and by Kayacoglu I in Turkey comprised patients solely of mitral stenosis. The patient population in the study done by Fuster RG et al, Chowdhury UK et al and Zakai SB et al had patients mostly with mitral stenosis alone or along with mitral regurgitations. So, the patient population of our study as regard type of valvular lesion is similar to previous studies. (10, 17,19, 20).

Our patients with non preserved group require more days to be transferred to the general ward in compare to preserved group. This difference was due to the fact that non preserved group had more patients with low output syndrome and heart failure.

There were three early deaths in the non preserved group and one in the preserved group. In both the groups the cause of death was low output syndrome except one patient in non preserved group who died due to sepsis. In the non preserved group there were significant number of patients who had low cardiac output syndrome and left ventricular failure in the postoperative period. Majority of patients in this group required inotropic support.

In contrast, there was only one patient in preserved group with low cardiac output syndrome. He died on the 2<sup>nd</sup> postoperative day. Although half of the patients in this group required inotropic support, none had developed significant heart failure. There were three more deaths during six months follow up. One patient from each group died due to thromboembolic complication of anticoagulant therapy. The other patient in the non preserved group died due to congestive heart failure.

In a study done by Fuster NG et al, the early mortality was 8.3% in non preserved group, 8.1% in partially preserved group but the late death was 17.5% and 9.6% respectively. Nine percent patients of their nonpreserved group in compare to 3.2% in preserved group had low cardiac output syndrome.

Kapisiz NS et al among 36 of their rheumatic patients with preservation of valve apparatus found no death in early period and at 1 year follow up<sup>(15)</sup>.

Kayacioglu I et al after 8 years of follow up of their patients, found 20% death in non preserved group and 14% in preserved group.<sup>(17)</sup> Chowdhury UK et al in their rheumatic patients in India found 7% early death in the non preserved group (group-I) while the mortality were 2% in partially preserved group (group-II) and 1% in totally preserved group (group-III). The late death was 9%, 5% and 2% respectively in group-I, II and III, during 4 year follow up.<sup>(19)</sup> Zakai SB et al in a patient population of mixed origin of mitral valvular disease found early mortality of 9.9% in non preserved group, 5.6% in partially preserved group and 2.8% in completely preserved group.<sup>(20)</sup> Elwarry SE et al in Egypt reported early mortality of 10% during mitral valve replacement in patients with high pulmonary artery pressure.

The early death was little higher in our non preserved group in comparison to non preserved group of other studies. While we found similar mortality in preserved group in compare to other studies. One of our three patients in non preserved group died due to infection in early post operative period. Exclusion of this patient would give a similar rate of mortality in our non preserved group in compare to other studies. Another cause of higher mortality in our patient population may be due to the fact that these patients had high pulmonary artery pressure. There was not much differences in mortality rates between developing and developed countries.

In contrast to similarity in death rates there was marked differences of frequency of low cardiac output syndrome

between rheumatic population of developed countries to ours. Fuster MG et al reported low output syndrome in 9.0% of their patients in non preserved group and 3.2% percent in preserved group. Zakai SB et al in their study, showed 12.5% low cardiac output syndrome in non preserved group and 3.7% in preserved group. Sarker R et al and Paul S et al in separate studies in Bangladesh found low cardiac syndrome in 33% and 30% respectively in non preserved group. The frequency was 50% among our patients without preservation of subvalvular apparatus<sup>23,24</sup>.

The results indicating a marked difference of low cardiac output syndrome between rheumatic population of developed and developing countries while undergoing mitral valve replacement without subvalvular preservation. Frequency of heart failure was also higher in our rheumatic population undergoing MVR without preservation.

Congestive heart failure and needs for inotropic support were also higher in our population. Paul S reported 30% of the patients without valvular apparatus preservation suffered heart failure and all of the patients required inotropic support. Sarker R et al reported heart failure in 27% of the patients with non preserved group. There was significant difference between non preserved and preserved group in their patient population as regard low cardiac output syndrome and heart failure. Although requirement of inotropic support was all most similar in two groups.

Low cardiac output syndrome in preserved group of patients in study done by Sarker R was 10% and it was 5% in the study done by Paul S. Heart failure was present in 6% of these patients with preserved subvalvular apparatus in study done by Paul S. Requirement of inotropic support was 85% of his patient with preserved subvalvular apparatus.

The scenario regarding hemodynamic status was similar to our study in compare to other studies done in Bangladesh<sup>23,25</sup>. Our rheumatic population in this part of the world suffered more low cardiac output syndrome and heart failure in non preserved group. Isotropic support required in both the groups but in higher doses and for prolonged period in non preserved group.

Our study had following limitations. 1. The sample size was small. 2. Single center study.

Preservation of subvalvular apparatus during Mitral valve replacement increases survival and improves



clinical outcome in rheumatic population similar to other population. Outcome seems to be worse in non preserved group of rheumatic population in our study in compare to non preserved groups of other studies. Despite similar survival benefit in rheumatic population between developed and underdeveloped countries the cardiac output syndrome and need for inotropic support are much higher in our population.

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