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Original Research Article

Observation of Post-Operative Support among LAVI and AF after MVR in Patients with Mitral Valve Disease

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Abstract: ***Introduction:*** Mitral valve disease is a common heart condition that may require mitral valve replacement (MVR) surgery. One of the potential complications after MVR is the development of atrial fibrillation (AF). Left atrial volume index (LAVI) is a measure of left atrial size that has been linked to the development of AF in patients with mitral valve disease. The present study aimed to observe the post-operative support needed by patients after MVR surgery, particularly those with elevated LAVI and the incidence of post-operative AF. ***Methods:*** This prospective observational study was conducted at the Department of Cardiac Surgery, National institute of cardiovascular diseases (NICVD), Sher-e-Bangla Nagar, Dhaka, Bangladesh. The study duration was 1 year, from Mar, 2018 to Feb, 2019. During this period, a total of 60 patients who underwent Mitral Valve Replacement (MVR) for mitral valve diseases at the study hospital were included in the study following the inclusion and exclusion criteria through a purposive sampling method. The 60 patients were divided in two equal groups, Group A, consisting of 30 Patients who had Left Atrial Volume Index of ≥ 39 ml/m2 after operation, while group B had been comprised of 30 patients who had Left Atrial Volume Index of < 39 ml/m2 after operation. ***Result:*** Around 23.33% of participants in both groups were aged 21-30, while 40% of Group A and 36.66% of Group B were aged 31-40. In terms of BMI, 53.33% of Group A and 46.66% of Group B had a normal BMI, while 40% and 43.33% were overweight, and 6.66% and 10% were obese, respectively. Specifically, 23.33% of participants in Group A developed post-operative AF, while only 6.66% of participants in Group B developed it. The p-value for this comparison was 0.015. The results demonstrate that Group B had significantly smaller LA diameter, LA volume, LAVI, LVIDS, and LV ejection fraction compared to Group A at all three measurements post-operation ($p<0.05$). However, there was no significant difference between the groups in LVIDD and LV ejection fraction pre-operation ($p>0.05$). According to the table, there was no significant difference between Group A and Group B in terms of the need for prolonged ICU stay (>48 hrs.) and prolonged hospital stay (>14 days.) as indicated by the p-value of 0.061 and 0.090 respectively. However, there was a significant difference between the two groups in terms of the need for prolonged mechanical ventilation time (>24 hours) and prolonged inotrope support (>48 hrs.) as indicated by the p- values of 0.016 and 0.0006 respectively. ***Conclusion:*** Our study highlights the importance of post-operative support for mitral valve replacement patients, especially those requiring prolonged mechanical ventilation time and inotrope support. Demographic variables and NYHA functional class did not differ significantly between the groups, but Group B had a higher incidence of prolonged mechanical ventilation time and inotrope support, suggesting they may need more intensive monitoring and management. Future research is necessary to identify factors contributing to prolonged postoperative care needs and develop strategies to improve outcomes.

Keywords: Mitral Valve, Atrial Fibrilation, LAVI, MVR.

INTRODUCTION

Mitral valve disease is a common condition that affects the flow of blood between the left atrium and ventricle of the heart [1]. The condition can be caused by a variety of factors, including congenital abnormalities, rheumatic fever, and degenerative changes in the valve. Mitral valve is most commonly affected in rheumatic heart diseases followed by aortic valve in a percentage of 56.7% and 6% respectively in Bangladesh [2]. In cases where conservative treatment options are not effective, mitral valve replacement (MVR) is a common surgical intervention that is highly

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effective in treating the condition [3-5]. The incidence rate of mitral valve disease varies depending on the underlying cause. Rheumatic heart disease is the most common cause of mitral valve disease globally, with an estimated incidence of 15.6 million cases worldwide. In developed countries, the incidence of mitral valve disease is lower, with degenerative changes in the valve being the most common cause [6-8]. The incidence of mitral valve disease is also influenced by age, with the condition being more common in older adults [9, 10]. While MVR is a successful treatment for mitral valve disease, it can also lead to post-operative complications, including the development of atrial fibrillation (AF) [11-13]. AF is a common arrhythmia that can cause significant morbidity and mortality in patients after MVR. The incidence of AF after MVR varies depending on a variety of factors, including patient age, comorbidities, and the type of valve used [14, 15]. Some studies have reported an incidence of AF after MVR of up to 50%. Several studies have shown that an increase in left atrial size is associated with an increased risk of AF in patients with mitral valve disease [16, 17]. Left atrial volume index (LAVI) is a non-invasive measure of left atrial size that has been shown to be a predictor of AF [18]. LAVI is calculated by dividing the left atrial volume by the body surface area and is commonly used in the assessment of patients with mitral valve disease. In addition to AF, other complications can occur after MVR, including bleeding, infection, stroke, and heart failure. The risk of these complications is influenced by a variety of factors, including patient age, comorbidities, and the type of valve used. The management of patients with mitral valve disease undergoing MVR is complex and requires a multidisciplinary approach. Risk factors for post-operative complications, including AF, should be identified and managed appropriately. In addition to pharmacological management, lifestyle modifications, such as smoking cessation and weight loss, can also help reduce the risk of complications after MVR. The observation of post-operative support and the relationship between LAVI and AF after MVR in patients with mitral valve disease is an important area of research. The findings of this research could help improve the management of patients undergoing MVR and reduce the risk of post-operative complications. By identifying patients at increased risk of developing AF after MVR, targeted interventions could be used to prevent the development of AF and improve patient outcomes.

OBJECTIVE

- To observe the necessity of post-operative support based on LAVI after mitral valve replacement.

METHODS

This prospective observational study was conducted at the Department of Cardiac Surgery, National institute of cardiovascular diseases (NICVD), Sher-e-Bangla Nagar, Dhaka, Bangladesh. The study duration was 1 year, from Mar, 2018 to Feb, 2019. During this period, a total of 60 patients who underwent Mitral Valve Replacement (MVR) for mitral valve diseases at the study hospital were included in the study following the inclusion and exclusion criteria through a purposive sampling method. The 60 patients were divided in two equal groups, Group A, consisting of 30 Patients who had Left Atrial Volume Index of ≥ 39 ml/m^2 after operation, while group B had been comprised of 30 patients who had Left Atrial Volume Index of < 39 ml/m^2 after operation. Any patients who had undergone MVR for their mitral valve disease without Atrial Fibrillation (AF) had been included in the study. However, patients with pre- existing AF, patients undergoing concomitant cardiovascular procedures comprising valve surgery (AVR, TVR, PVR) and procedure for congenital heart diseases, patients with electrolyte imbalance and patients with comorbid conditions were excluded. All relevant data were collected from each respondent by use of interview schedule, measured parameters and investigations in a predesigned format. LA volume was measured by planimetry in the four chamber view and two chamber view with the area length method. Informed consent was obtained from the participants prior to their enrollment in the study, and ethical approval for the study was obtained from the ethical review committee of the study hospital. All data were recorded systematically in preformed data collection form (questionnaire). Statistical analyses were performed by using windows based computer software devised with Statistical Packages for Social Sciences (SPSS-25). Quantitative data was expressed as mean and standard deviation and qualitative data as frequency distribution and percentage. Continuous variables were compared by using the two independent samples t-test.

RESULTS

Table 1: Distribution of participants by baseline characteristics

Variables	Group A (n=30) No. (%)	Group B (n=30) No. (%)	p-value
Age			
10-20	1 (3.33%)	2 (6.66%)	
21-30	7 (23.33%)	8 (26.66%)	
31-40	12(40%)	11(36.66%)	
41-50	8(26.66%)	6 (20%)	0.699 ns

Variables	Group A (n=30) No. (%)	Group B (n=30) No. (%)	p-value
51-60	2 (6.66%)	3 (10%)	
Mean ± SD	39.88 ± 13.51	39.32 ± 11.16	
Gender			
Male	18 (60%)	17 (56.66%)	0.382ns
Female	12 (40%)	13(43.33%)	
BMI			
Normal (18.5-24.9)	16(53.33%)	14(46.66%)	
Overweight (25.0-29.9)	12(40.0%)	13(43.33%)	0.329ns
Obese (>30.0)	2(6.66%)	3(10.0%)	
Mean ±SD	24.85±2.61	25.73±4.18	
NYHA Classification			
I	2 (6.66%)	4 (13.33%)	
II	12 (40%)	13 (43.33%)	0.077 ns
III	15 (50%)	11 (36.66%)	
IV	1 (3.33%)	2 (6.66%)	

Approximately 23.33% of participants in both groups were aged 21-30, while 40% of Group A and 36.66% of Group B were aged 31-40. The majority of participants in both groups were male, with 60% in Group A and 56.66% in Group B, while 40% and 43.33% were female, respectively. In terms of BMI, 53.33% of Group A and 46.66% of Group B had a normal BMI, while 40% and 43.33% were overweight, and 6.66% and 10% were obese, respectively. The mean BMI was slightly higher in Group B than in Group A. The NYHA classification of heart failure severity was also assessed, and while no significant difference was found between the two groups, the distribution of participants in each class was slightly different. Specifically, 50% of Group A and 36.66% of Group B were in NYHA Class III, while 40% of Group A and 43.33% of Group B were in Class II. Only one participant in Group A was in Class IV, while two participants in Group B were in this class.

Table 2: Comparison of post-operative AF between two groups, (N=60)

Incidence of post-operative AF	Group A (n =30)	Group B (n =30)	p-value
AF present	07(23.33%)	02(6.66%)	0.015 s
AF absent	23(76.66%)	28(93.34%)	

The table shows that the incidence of post-operative AF was significantly higher in Group A than in Group B. Specifically, 23.33% of participants in Group A developed post-operative AF, while only 6.66% of participants in Group B developed it. The p-value for this comparison was 0.015, indicating that this difference was statistically significant.

Table 3: Comparison of patients between two groups by Echocardiographic findings, (N=60)

Variables	Group A (n=30)	Group B (n =30)	p-value
LA diameter (mm)			
Pre-operative	56.56 ± 4.891	47.04 ± 6.093	<0.001s
Post-operative (3rd day)	51.84 ± 5.121	43.60 ± 5.439	<0.001s
Post-operative (1month)	49.00 ± 4.690	39.16 ± 4.913	<0.001s
LA Volume(ml)			
Pre-operative	60.88 ±8.090	54.20 ±8.684	0.034s
Post-operative (3rd day)	58.20 ±8.073	51.76±8.136	0.039s
Post-operative (1month)	54.20 ±7.963	46.56 ±7.932	0.034s
LAVI(ml/m²)			
Pre-operative	48.88 ±7.190	35.21 ±6.884	0.044 s
Post-operative (3rd day)	46.20 ±6.273	33.76±5.146	0.035 s
Post-operative (1month)	42.40 ±8.664	29.56 ±8.732	0.041s
LVIDD (mm)			
Pre-operative	42.86±7.090	40.20 ±5.484	0.054 ns
Post-operative (3rd day)	38.20 ±6.073	36.76±8.166	0.059 ns

Variables	Group A (n=30)	Group B (n =30)	p-value
Post-operative (1month)	35.20±8.963	32.56 ±7.532	0.044s
LVIDS (mm)			
Pre-operative	34.96 ± 6.617	30.12±7.155	0.017 s
Post-operative (3rd day)	33.04 ±6.541	28.32±6.556	0.014 s
Post-operative (1month)	31.40 ±6.545	26.92±6.164	0.016 s
LV Ejection fraction (EF) (%)			
Pre-operative	56.00 ± 8.231	60.32 ± 7.674	0.061 ns
Post-operative ((3rd day)	57.48 ±7.241	61.36 ± 6.849	0.057 ns
Post-operative (1month)	58.76 ± 6.815	62.36 ± 6.396	0.060 ns

The Table shows various measurements of left atrial (LA) diameter, LA volume, LA volume index (LAVI), left ventricular internal dimension in diastole (LVIDD), left ventricular internal dimension in systole (LVIDS), and left ventricular ejection fraction (EF) measured pre-operatively and at the third day and first month post-operation. The results demonstrate that Group B had significantly smaller LA diameter, LA volume, LAVI, LVIDS, and LV ejection fraction compared to Group A at all three measurements post-operation ($p<0.05$). However, there was no significant difference between the groups in LVIDD and LV ejection fraction pre-operation ($p>0.05$).

Table 4: Comparison of Prolonged postoperative care among study population

Post-Operative Variables	Group A (n=30) No. (%)	Group B (n=30) No. (%)	p-value
Prolong ICU stay (>48 hrs.)			
Needed	2(6.66.0%)	5(16.66%)	0.061ns
Not needed	28(93.34.0%)	25(83.34%)	
Prolong Hospital stay (>14 days)			
Needed	6(20.0%)	3(10.0%)	0.090ns
Not needed	24(80.0%)	27(90.0%)	
Prolong mechanical ventilation time (>24 hours)			
Needed	1(3.33%)	4(13.3%)	0.016s
Not needed	29(96.66%)	26(86.7%)	
Prolong inotrope support (>48 hrs.)			
Needed	5(16.66%)	15(50.0%)	0. 0006s
Not needed	25(83.34%)	15(50.0%)	

According to the table, there was no significant difference between Group A and Group B in terms of the need for prolonged ICU stay (>48 hrs.) and prolonged hospital stay (>14 days.) as indicated by the p-value of 0.061 and 0.090 respectively. However, there was a significant difference between the two groups in terms of the need for prolonged mechanical ventilation time (>24 hours) and prolonged inotrope support (>48 hrs.) as indicated by the p-values of 0.016 and 0.0006 respectively. Group B had a higher percentage of participants who needed prolonged mechanical ventilation time and inotrope support compared to Group A.

DISCUSSION

The aim of this study was to determine whether post-operative support is necessary after mitral valve replacement based on Left Atrial Volume Index (LAVI). The mean age of patients in Group A and Group B was 39.88 ± 13.51 and 39.32 ± 11.16 years, respectively. In Group A, 60% were male and 40% were female, while in Group B, 56.66% were male and 43.33% were female. The highest incidence of disease was observed in the age group of 31-40 years, which was common to both groups. The mean BMI of Group A and Group B was 24.85±2.61 kg/m² and 25.73±4.18 kg/m², respectively. Of the overweight patients, 12 (40.0%) were in Group A and 14 (46.7%) were in Group B. Obese patients accounted for 2 (6.66%) and 3 (10.0%) in Group A and Group B, respectively. In our study, the differences in demographic variables (age, sex, BSA, BMI) between the two groups were not statistically significant ($p=0.699$, $p=0.382$, $p=0.649$, $p=0.329$). These findings were consistent with other similar studies [19-21]. Regarding the NYHA functional class, 40% were in NYHA class-II followed by 50% in NYHA class-III in Group A. In Group B, 43.33% were in NYHA class-II followed by 36.66% in NYHA class-III. We found no significant association between NYHA and postoperative AF in our study, which corresponds to the previous studies [19]. In the present study, the LA volume was 60.88 ± 8.090 mm in Group A and 54.20 ± 8.684 mm in Group B in the preoperative period. In the 3rd postoperative period, it was 58.20 ± 8.073 mm in Group A and 51.76 ± 8.136

mm in Group B, and during the 1st month of the post-operative period, it was 54.20 ± 7.963 mm in Group A and 46.56 ± 7.932 mm in Group B. Raine and colleagues also reported similar results, which revealed a reduction from 59.0 ± 6.0 mm to 50.1 ± 8.4 mm [20]. With regard to LAVI, in the pre-operative period, it was 48.88 ± 7.190 ml/m² in Group A and 35.21 ± 6.884 ml/m² in Group B. In the 3rd post-operative period, it was 46.20 ± 6.273 ml/m² in Group A and 33.76 ± 5.146 ml/m² in Group B. During the 1st month of the post-operative period, it was 42.40±8.664 ml/m² in Group A and 29.56 ±8.732 ml/m² in Group B. These findings were also supported by previous studies [22]. The ejection fraction (EF) in the preoperative period was 56.00 ± 8.231%, on the 3rd post-operative day it was 57.48±7.241%, and after 1 month it was 58.76 ±6.815% in Group A. In Group B, the mean EF in the preoperative period was 60.32 ±7.674%, on the 3rd post- operative day it was 61.36 ± 6.849%, and after 1 month it was 62.36 ± 6.396%. These findings were similar to the results reported by Osranek *et al*., [23]. The results show that Group B patients had a higher percentage of participants who needed prolonged mechanical ventilation time and inotrope support compared to Group A patients. However, there were no significant differences between the two groups in terms of the need for prolonged ICU stay and prolonged hospital stay. Contrary to our findings, the study by Osranek *et al*., found median length of ICU hospital stay was significantly higher in patients with post-operative AF compared with those without AF [23]. This difference might be due to some confounding variables dictating discharge from both ICU and hospital. May be due to these unavoidable factors, length of ICU and hospital stay turned out to be insignificant variable in our study. The need for prolonged mechanical ventilation time and inotrope support is an important indicator of postoperative morbidity and mortality. Prolonged mechanical ventilation time is associated with increased rates of respiratory complications, including pneumonia, atelectasis, and respiratory failure. Similarly, prolonged inotrope support is associated with increased rates of cardiovascular complications, including arrhythmias, myocardial infarction, and heart failure. Therefore, the higher percentage of participants in Group B requiring prolonged mechanical ventilation time and inotrope support indicates that these patients may be at increased risk for postoperative morbidity and mortality compared to Group A patients. So, the observations of this study highlight the importance of monitoring and managing patients who require prolonged postoperative care, particularly those who require prolonged mechanical ventilation time and inotrope support. These patients may be at increased risk for postoperative complications and may require more intensive monitoring and management to optimize outcomes. Further research is needed to better understand the factors that contribute to prolonged postoperative care needs and to identify strategies to minimize the risk of postoperative morbidity and mortality.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

In conclusion, our study observed the importance of post-operative support for patients who undergo mitral valve replacement, particularly those who require prolonged mechanical ventilation time and inotrope support. The demographic variables and NYHA functional class did not show significant differences between the two groups, but there was a higher incidence of prolonged mechanical ventilation time and inotrope support in Group B compared to Group A. This suggests that Group B patients may be at increased risk for postoperative complications and require more intensive monitoring and management. Future research is needed to better understand the factors that contribute to prolonged postoperative care needs and identify strategies to optimize outcomes.

RECOMMENDATION

First, it is recommended to consider adding additional surgical procedures to prevent atrial fibrillation and maintain sinus rhythm. Second, measuring left atrial volume index (LAVI) can be a useful tool for risk stratification and guiding surveillance and therapy. Third, longer follow-up periods are needed to fully understand the association between postoperative LAVI and the occurrence of atrial fibrillation. Finally, large-scale multicenter studies are necessary to validate these findings and further improve patient care.

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