

IMPACT OF BALLOON MITRAL VALVOTOMY ON MITRAL ANNULAR SYSTOLIC VELOCITY AND LEFT ATRIAL APPENDAGE LATE EMPTYING VELOCITY IN ISOLATED RHEUMATIC MITRAL STENOSIS

Cardiology

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ABSTRACT

BACKGROUND: Mitral annular systolic velocity assessed by TDI is a validated parameter for indicating LV systolic function. Left atrial appendage late emptying velocity measured by Pulsed wave Doppler is a parameter for left atrial function. Reduced MASV and LAALEV is mostly related to fibrosis in the context of rheumatic mitral stenosis. In case of mitral stenosis MASV can also be used as a measure of left atrial appendage function. Our study is aimed at observing the effect of balloon mitral valvotomy on MASV and LAALEV in patients with isolated severe mitral stenosis

METHODS: A total of 113 patients with mitral stenosis was screened and 30 patients according to inclusion criteria in all age groups with isolated rheumatic mitral stenosis in whom BMV was suitable were enrolled in the study. MASV was measured by TDI in TTE obtained at the LV septal, lateral, anterior, and posterior borders of the mitral ring in the apical 2-chamber and 4-chamber views, and an average MASV value was calculated. LAALEV were obtained by using Pulsed wave (PW) Doppler from a site approximately 1 cm below the LAA outlet cavity from the middle third of LAA in TEE. All the parameters were assessed before BMV and 2 weeks after procedure.

RESULTS: Pre BMV, MASV and LAALEV was lower in both patients with and without subvalvular disease. More reduced in the subvalvular group. Post BMV both MASV and LAALEV increased in both the groups and was statistically significant.

CONCLUSION: MASV which is used in detecting LV longitudinal dysfunction along with LAALEV can be used for assessing LAA function and both parameters have increased after a successful BMV.

KEYWORDS

INTRODUCTION

Chronic pressure and volume overload imposed by MS causes left atrial (LA) and Left Atrial Appendage (LAA) dysfunction leading to reduced blood flow velocities thereby producing stasis of blood, reduced LA and LAA ejection fraction and atrial fibrillation (AF)¹. These factors predispose to formation of LA and LAA thrombi in MS and result in thromboembolic episodes². Risk of cerebrovascular accident (CVA) is increased approximately five-fold in non-rheumatic AF and 17-fold in patients with MS with AF³. Even patients of MS in sinus rhythm with depressed LA and LAA function are at increased risk of CVA. Assessment of LAA function is helpful in predicting the risk of thromboembolism.

Haemodynamically significant mitral stenosis increases the resistance to both active and passive LAA emptying resulting in an overall lowering of LAA flow velocities, regardless of the specific rhythm. Direct LA and LAA involvement in the rheumatic inflammatory process and an atrial myopathy resulting from chronic LA pressure elevation are additional possibilities.

Mitral annular systolic velocity obtained by tissue Doppler imaging (TDI) are also reduced in MS^{4,6}. The LAA has a close anatomic and functional relation with lateral annulus and thus annular velocities obtained by TDI may reflect the LAA functions⁷. We sought to study MASV and LAALEV as a marker of LAA function in rheumatic mitral stenosis and effect of BMV on this parameter.

MATERIALS AND METHODS

The study was done in a Rajiv Gandhi government general hospital Chennai from March 2019 to January 2020. A total of 113 patients with mitral stenosis were screened and 30 patients according to inclusion criteria in all age groups with isolated rheumatic mitral stenosis in whom BMV was suitable were enrolled in the study. All studies were obtained using Philips ultra sonographic machine equipped with 3.5 MHz transducer. All echo-cardiographic measurements were taken as mean of 3 consecutive cycles. Modified Simpson's method was used to assess ejection fraction (after measuring end diastolic and end systolic volumes). Mitral valve area was calculated by planimetry (measurement obtained by direct tracing of the mitral orifice at the leaflet tip, on a parasternal short-axis MASV was measured by TDI in TTE obtained at the LV septal, lateral, anterior, and posterior borders of the mitral ring in the apical 2-chamber and 4-chamber views, and an average MASV value was calculated. LAALEV was measured by

Pulsed wave doppler from a site approximately 1cm below the LAA outlet cavity from the middle third of LAA in TEE. Transmittal gradients were measured using Bernoulli principle from continuous wave Doppler recordings through mitral inflow. Suitability for BMV was assessed using Wilkins score and commissural calcium score. Systolic pulmonary artery pressures were derived from Tricuspid regurgitant jet velocity. Right atrial pressure is calculated by estimating the inferior vena caval size and its variation with respiration. An experienced team performed BMV monitoring of conventional hemodynamic parameters. Balloon size was chosen according to height. Percutaneous BMV was regarded as successful if the mitral valve area post-percutaneous BMV was >1.5 cm² or the gain was >50% of baseline with no significant mitral regurgitation. All the parameters were assessed before BMV and 2 week after procedure.

INCLUSION CRITERIA	EXCLUSION CRITERIA
All age group	Diabetes
Both male & female	Hypertension
Rheumatic severe and very severe Mitral stenosis suitable for BMV	Chronic kidney disease
Normal LV function	Previous mitral valve procedures
	Non-rheumatic mitral valve disease
	Atrial Fibrillation
	More than mild MR
	Associated other valve lesions
	LV dysfunction
	RV Dysfunction

STATISTICAL ANALYSIS

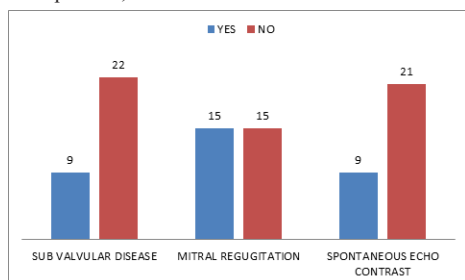
Statistical analysis was performed with Graph Pad Prism version 5.0. Data was presented as mean $\pm$ SD for continuous variables. Qualitative variables, expressed as numbers and percentages were compared by the Chi-square test. Quantitative variables among study group and control group were compared by T test. A p value less than 0.05 was considered as significant

RESULTS

Out of the 30 patients, 27 were females and 3 were males. Mean age was 34.7 years. Mean height was 154 $\pm$ 8.4cm. BMV done via femoral approach using appropriately sized Accura balloon. Mean MVOA 0.87 $\pm$ 0.16. A total of 22 patients had tight mitral stenosis with MVOA less than 1cm².

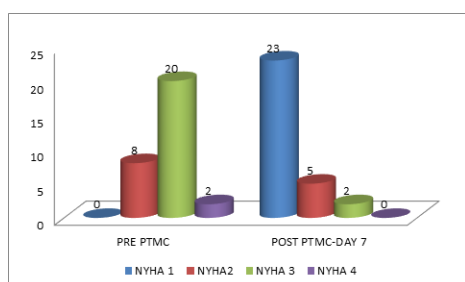
SEX DISTRIBUTION AMONG PATIENTS

Out of the 30 patients, 27 were females and 3 were males



GRAPH 1 CO FACTORS DISTRIBUTION

Out of 30, 9 patients had spontaneous echo contrast in LA. Subvalvular disease was present in 9 patients. 9 patients had trivial MR and 6 had mild MR



GRAPH 2 FUNCTIONAL CLASS COMPARISON BETWEEN PREBMV AND POST BMV

Most of the patients were in NYHA Functional class III preoperatively and improved to functional class I at the end of 2 week post BMV

TABLE 2 COMPARISON OF RELEVANT PARAMETERS PRE AND POST BMV

PARAMETER	PRE BMV	POST BMV DAY 7	P VALUE
AGE(years)	34.7±1.7	34.7±1.7	-
HEIGHT(cm)	154.2±8.40	154.2±8.40	-
MVOA(cm ²)	0.87±0.16	1.7±0.18	<0.00001
MPG(mmHg)	16.67±3.23	7.50±1.38	<0.00001
PASP(mmHg)	47.67±15.25	43.13±11.39	0.00010
TAPSE(mm)	18.30±1.30	19.03±1.06	0.003
MASV(cm/sec)	15.8 ± 3.8	19.2±2.6	0.0002
LAALFV(cm/sec)	21.60±8.4	27.7±5.6	0.0016

Post BMV there was statistically significant improvement in MASV and LAALFV.

DISCUSSION

The mitral annulus has an important role for LA and left ventricular (LV) functions by moving throughout LV long axis. The LV long-axis function which is a useful echocardiographic index of LV systolic function can be evaluated by measuring excursion of the mitral annulus obtained by measuring annular systolic velocity obtained by TDI. The excursion of the mitral annulus accounted for approximately 20% of the total LV filling and emptying in healthy subjects. Furthermore, mitral annular movement contributes to LA filling by creating a suction effect during systole and it contributes to LA emptying by decreasing LA volume during diastole.

In MS patients, LV, LA, and LAA functions are impaired and the excursion of mitral annulus is reduced due to scarring and inflammatory processes. It has been recently reported that annular velocities obtained by DTI are reduced in patients with MS.

In our study, there was a positive correlation between annular systolic and LAALFV and reduction in annular velocities were corresponded closely with reduction in LAA emptying velocity. Thus, the annular systolic and late diastolic velocity alterations reflected the changes in LAA function. Hoit et al showed that LV systolic function is a major determinant of the late LAA emptying velocity. MASV that reflects LV long-axis function is an independent predictor of the inactive LAA. So

this result showed that impaired LV long-axis function may be the most important factor that contributes to the LAA dysfunction in MS patients with SR.

In patients with normal left atrium and sinus rhythm, Pollick & Taylor observed at the TEE that the ejection fraction of the left atrial appendage is of approximately 55%, with average values of maximum antegrade velocity of 0.48 m/s. In the patients with mitral stenosis in this research, before the percutaneous balloon valvotomy, the transesophageal study of the left atrial appendage showed an average ejection fraction of 20%, with average antegrade maximum velocities of 0.30 m/s. Those data suggest the existence of dysfunction of the left atrial appendage in the mitral stenosis and reflect a compromising of the function ability of that structure. Similar data were described by Hwang et al characterizing a compromising of the intrinsic contractile function of the left atrial appendage in the mitral stenosis. Those authors observed more dilated left atrial appendages, with lower ejection fractions and lower velocities in patients with mitral rheumatic disease in sinus rhythm. Such dysfunction of the left atrial appendage in the mitral stenosis can be explained by the degeneration of the myocardial fibers with a consequent diffused interstitial fibrosis of this structure, which result from repeated crises of the rheumatic activity. Madden already demonstrated that the tissue of the left atrial appendage in the mitral stenosis presents degeneration of the myocardial fibers and diffused interstitial fibrosis⁸.

In our study we have evaluated the effect of BMV on both MASV and LAALFV. There was a significant increase in both MASV (P=0.0002) and LAALFV (P=0.0016) post BMV suggesting improvement in LV longitudinal function and LAA function respectively. And the improvement in MASV and LAALFV was lower in subvalvular disease due to higher myocardial fibrosis. The augmentation of LAA velocities following balloon valvotomy is related directly to the hemodynamic relief of the valvular stenosis (i.e., the decrease in transmitral pressure gradient).

The fact that there has been an improvement of the flow, without a significant increase of the ejection fraction of the left atrial appendage, suggests that the flow of that structure is more dependent of the left intra-atrial pressure than the recovery of the appendicular contractile function. Those observations are corroborated by Hoit et al.

CONCLUSION

MASV reflecting longitudinal myocardial shortening along with LAALFV is a simple and sensitive echocardiographic parameter for assessing global longitudinal LAA function and both parameters have shown a significant improvement after successful BMV.

LIMITATIONS

Our study has a small sample size. Large scale studies are required to validate our findings. We have not measured other parameters of LAA function. Even though we have carefully selected the patient group without conventional cardiovascular risk factors, we have not done coronary angiogram to rule out CAD. A longer follow up would have given a better to assess the improvement in LAA function.

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