CLINICAL PROFILE OF PATIENTS UNDERGOING PERCUTANEOUS BALLOON MITRAL VALVOTOMY AND BODY SURFACE AREA BASED MITRAL VALVE AREA ASSESSMENT

Cardiology

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ABSTRACT

Introduction: PBMV has become the procedure of choice for mitral stenosis with suitable valve apparatus. Mitral valve apparatus is related to body surface area and it varies with racial origin. We studied the clinical profile and BSA indexed MVA of patients undergoing PBMV in our institute.

Materials & Methods: This was a retrospective study consisting of 103 patients who underwent PBMV in our institute from January 2019 to December 2019. All the patients who fulfilled ACC/AHA [2014] Class I & II-a indications were included and had a detailed clinical and echocardiographic evaluation. BSA was calculated for all the patients using Du Bois formula [$BSA = 0.007184 * Height^{0.725} * Weight^{0.425}$] and body surface area indexed MVA was then calculated. Correlation of MVA and BSA indexed MVA with various parameters was done.

Results: The study population comprised of 81 females [79%] and 22 males [21%]. Age group of 21-30 had the maximum number of cases undergoing PBMV, comprising 35 cases [34%]. Baseline clinical characteristics were noted. Mean-MVG prior procedure was 15.18 ± 5.58 mm Hg. Mean-MVA pre-PBMV was 0.84 ± 0.12 cm² and when indexed to body surface area it was 0.58 ± 0.09 cm²/m². Post-PBMV mean-MVA and MVA indexed to BSA was 1.65 ± 0.19 cm² and 1.15 ± 0.18 cm²/m² respectively. Both MVA and MVA indexed to BSA showed only weak correlation with dyspnoea grade, LA size, mean-MVG and mean-LAP, with none reaching statistical significance.

Conclusion: When compared to studies in other parts of the country and world, MVA varied across different regions. We propose that MVA per BSA might standardize the cut off values across different ethnic population and provide more comparable data for PBMV and other procedures of mitral valve apparatus.

KEYWORDS

Percutaneous Balloon Mitral Valvotomy, Body surface Area and Mitral valve area.

INTRODUCTION:

Since its introduction by Inoue et al^[1] in 1984 as an alternative to surgical mitral commissurotomy for treatment of rheumatic MS, PBMV has been successfully and safely performed in large series of patients at numerous centers. The technique is as effective as open valvotomy and more effective than closed valvotomy, with reduced morbidity in most patients, except for those with unfavourable anatomy.^[2-5] Mitral valve apparatus is related to body surface area of an individual and it varies among people of different racial origin.^[6,7]

We studied the clinical profile and MVA indexed to BSA in patients who underwent PBMV in our tertiary care cardiac institute.

MATERIALS & METHODS:

This was a retrospective study consisting of 103 patients who underwent PBMV in our institute from January 2019 to December 2019.

The patients who fulfilled ACC/AHA-2014^[8] Class I and II-a indications for PBMV were included in the study. They are cases with symptomatic severe MS [MVA < 1.5cm², Stage D] with favourable valve morphology and asymptomatic patients with very severe MS [MVA < 1.0 cm², stage C].

Patients with more than mild mitral regurgitation, left atrial thrombus, other significant valve lesions requiring surgical treatment, severe or bi-commissural calcification and CAD requiring surgery were excluded from the study.

Successful PBMV was defined as mean left pressure decrease by >50% as compared to the baseline, MVA increase by > 50% as compared to the baseline and final valve area of > 1.5 cm² in the absence of more than moderate mitral regurgitation.

All patients had a detailed clinical and echocardiographic [2D-ECHO, Doppler and colour flow imaging] evaluation to assess the severity of MS, valve morphology and mitral regurgitation prior PBMV and within 24 hours after procedure. Transoesophageal ECHO was done one day before the PBMV to rule out the presence of left atrial clot.

BSA was calculated for all the patients using Du Bois formula [$BSA =$

$0.007184 * Height^{0.725} * Weight^{0.425}$]. MVA was obtained using 2D-Planimetry in parasternal short axis view early in diastole. MVA indexed to body surface area was then calculated. Left atrial size was measured in Parasternal long axis view in 2D ECHO in end systole just prior mitral valve opening. Mitral regurgitation was assessed by colour doppler in apical 4 chamber view and according to the extent of distribution of regurgitant jet within left atrium, it was graded 1+ to 4+ considering left atrium divided into 4 quarters. Pulmonary hypertension assessed using echocardiography, was classified as mild [mPAP 25 - 40 mm Hg], moderate [mPAP 41 - 55 mm Hg] and severe [mPAP > 55 mm Hg].

Statistical analysis included mean and standard deviation calculation for continuous variables. Correlation matrix was done to assess the relation of various parameters with MVA and BSA indexed MVA. Pearson correlation was done for numerical data and Spearman correlation was done for parametric data. Correlation coefficient graded from +1 to -1 with +1 considered strong positive correlation and -1 considered strong negative correlation. A 2 tailed P-value of less than 0.05 was considered statistically significant. Analysis was performed with Graph pad prism-8 software.

RESULTS:

The study population comprised of 81 females [79%] and 22 males [21%], depicted in **Figure-1**.

Table-1 shows age group distribution of cases. Mean age was 35.52 ± 9.96 . Age group of 21-30 had the maximum number of cases undergoing PBMV, comprising 35 cases [34%]. Baseline characteristics are described in **Table-2**.

Figure-1: Gender Distribution

■ Females-79% ■ Males-21%

Table-1: Age Group Distribution

AGE GROUPS	NUMBER / [%]
11-20	6 / [5.8%]
21-30	35 / [34%]
31-40	33 / [32.1%]
41-50	20 / [19.4%]
51-60	9 / [8.7%]

Table-2: Baseline Characteristics

BASILINE CHARACTERISTICS	NUMBER / [%] Or [Mean +/- S.D]
Dyspnoea [NYHA- Class] - I, II, III & IV	1 / [0.9%], 67 / [65.1%], 31 / [30.1%] & 4 / [3.9%]
Antenatal Cases	9 / [8.7%]
Prior-Closed mitral commissurotomy	3 / [2.9%]
Prior-PBMV	12 / [11.6%]
Sinus Rhythm [Includes 2 cases of paroxysmal atrial fibrillation]	88 / [85.4%]
Atrial Fibrillation	15 / [14.6%]
Left atrial appendage clot	4 / [3.8%] {2 of 4 / [50%] in AF}
Prior CVA	4 / [3.8%] {1 of 4 / [25%] in AF}
Associated Valvular Lesions:	16 / [15.5%]
Mild aortic regurgitation	2 / [1.9%]
Moderate aortic regurgitation	2 / [1.9%]
Mild aortic stenosis & mild aortic regurgitation	1 / [0.9%]
Moderate aortic stenosis & moderate aortic regurgitation	1 / [0.9%]
Organic mild tricuspid regurgitation	1 / [0.9%]
Moderate pulmonary regurgitation [Quadracuspid Valve]	1 / [0.9%]
Moderate aortic regurgitation, mild aortic stenosis & moderate tricuspid stenosis	1 / [0.9%]
Left atrial size [2D-PLAX] in [mm]:	43.60 +/- 6.30
Sinus Rhythm	47.53 +/- 8.01
Atrial Fibrillation	
LV function:	4 / [3.8%]
<55%	99 / [96.1%]
>55%	
Right Ventricular Dysfunction [Tricuspid Annular Plane Systolic Excursion] TAPSE < 17	11 / [10.6%]
Pulmonary Hypertension:	12 / [11.7%]
Nil	31 / [30.1%]
Mild	43 / [41.7%]
Moderate	17 / [16.5%]
Severe	

Table-3 and Figure-2 show correlation of MVA and BSA indexed MVA with various parameters. Both MVA and BSA indexed MVA showed weak negative correlation with dyspnoea and pre-PBMV mean-LAP. LA size showed weak positive correlation with MVA and weak negative correlation with BSA indexed MVA. Mean-MVG showed weak negative correlation with MVA and weak positive correlation with BSA indexed MVA. None of the parameters reached statistical significance in our study.

Table-3: Correlation of Dyspnoea, LA size, mean-MVG, mean-LAP with MVA and BSA indexed MVA

	MVA Pre-PBMV [n=103]	BSA indexed MVA Pre-PBMV [n=103]
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Table-4: Comparison of Various Parameters with Other Studies

	Our Study	Kothari et al ^[12] 1998	Arora et al ^[13] 2002	John et al ^[14] 1983	Lung et al ^[15] 2004	Palacios et al ^[16] 2002	Tomai et al ^[17] 2014
Country	India	India	India	India	France	USA	Italy
Females	79%	N.A	71%	46%	80%	82%	83.3%
Mean Age	35.52 +/- 9.96	11+/-1.2	27.2+/-11.2	27.3+/-9.3	47+/-15	55+/-15	55.3+/-11.6
Dyspnoea	65.1%	29%	N.A	N.A	28%	24.1%	73.2%[more than II]
NYHA Class	30.1%	64%	87.5% [III & IV]	57.5%	67%	61.2%	
II	3.9%	6%		41.5%	3.5%	13.3%	
III							
IV							

NYHA Dyspnoea Class	Spearman Correlation	-0.039	-0.016
	P-value	0.692	0.873
LA-Size	Pearson Correlation	0.076	-0.052
	P-value	0.444	0.603
Mean MVG Pre-PBMV	Pearson Correlation	-0.066	0.094
	P-value	0.508	0.344
Mean LAP Pre-PBMV	Pearson Correlation	-0.166	-0.191
	P-value	0.093	0.054

Figure-2: Comparison of correlation coefficient of MVA and BSA indexed MVA with various parameters

The main parameters prior and after PBMV are shown in **Table-4**. Mean-MVG prior procedure was 15.18 +/- 5.58 mm Hg. Mean-MVA pre-PBMV was 0.84 +/- 0.12 cm² and when indexed to body surface area it was 0.58 +/- 0.09 cm²/m². Post-PBMV mean MVA and BSA indexed MVA was 1.65 +/- 0.19 cm² and 1.15 +/- 0.18 cm²/m² respectively. The mean left atrial pressure prior and after the procedure was 26.97 +/- 9.04 mm Hg and 13.02 +/- 6.22 mm Hg respectively. Mitral regurgitation prior PBMV was nil or trivial in 73 cases [70.9%] and 1+ in 30 cases [29.1%]. Post-PBMV it was nil or trivial 46 cases [44.6%], 1+ in 51 cases [49.6%] and 2+ in 6 cases [5.8%]. None of them had grade 3 & 4 mitral regurgitation.

DISCUSSION:

The various clinical, echocardiographic and hemodynamic parameters of our study are compared with other studies in **Table-4**. In our study, the most common age group of patients was 21-30 [34%] which is comparable to natural history and previous Indian epidemiological studies.^[9] Females constituted 79% of cases which is similar to world statistics of two-thirds of patients of rheumatic mitral stenosis being female patients.^[10]

The mitral valve area post-PBMV in our study increased by 96.4%, which is in accordance to guidelines.^[11] and mean LAP reduced by 51.7%.

The mitral valve area has strong correlation with body surface area and people of different ethnic origin will have varying body surface area and mitral valve area.^[6] This shows a single cut-off value of mitral valve area across various geographic distribution is not sound. Our study showed only weak correlation of both MVA and BSA indexed MVA with dyspnoea, LA size, mean-MVG and mean-LAP with none showing statistical significance. We propose that MVA per BSA would be a better scale to assess and a study with large sample and comparison across all subsets of MS severity would give better understanding.

Limitations of our study are complications weren't included and no long term follow up was done.

Previous Commissuro-tomy	14.6%	0%	13.6%	N.A	15.6%	24%	7.2%
AF	14.6%	0%	14.5%	12.5%	31%	49.3%	45.2%
Prior CVA/ Embolism	3.8%	N.A	N.A	14.4%	9.5%	N.A	N.A
LAA clot	3.8%	N.A	N.A	N.A	N.A	N.A	N.A
Mean MVA [cm²] Pre - Post -	0.84+/-0.12 1.65+/-0.19	0.64+/-0.14 1.63+/-0.45	0.7+/-0.2 1.9+/-0.3	0.5 N.A	1.03+/-0.23 N.A	0.9+/-0.3 1.9+/-0.7	0.99+/-0.2 1.9+/-0.4
Mean MVG [mm Hg] Pre - Post-	15.18+/-5.58 N.A	24.3+/-7.7	29.5+/-7	N.A	10.3+/-4.6	14+/-6 6+/-3	17+/-6.6 6.6+/-4.1
MR Grade-2 Pre- Post-	None 5.8%	N.A	18.9%	12.8%	2.6%	6.5%	11% 21.6%[2or more]
Aortic Valve involvement	21.3%	13.3%	12.7%	15.5%	N.A	N.A	N.A

*N.A-Data Not Available

CONCLUSION:

When compared to studies in other parts of the country and world, MVA varied across different regions. We propose that MVA per BSA might standardize the cut off values across different ethnic population and provide more comparable data for PBMV and other procedures of mitral valve apparatus.

ABBREVIATIONS USED:

MS - Mitral stenosis. PBMV - Percutaneous Balloon Mitral Valvotomy. MVA - Mitral Valve Area. BSA - Body Surface Area. MVG - Mitral Valve Gradient. LA – Left atrium. LAP - Left Atrial Pressure. ACC/AHA-American College of Cardiology/American Heart Association. CAD - Coronary Artery Disease. CVA - Cerebro-Vascular Accident. mPAP - Mean Pulmonary Artery Pressure.

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