e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(8); 308-313

Original Research Article

Outcome of Percutaneous Balloon Mitral Valvotomy in Patient with Rheumatic Mitral Stenosis: A Single Centre Experience

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Received: 10-05-2023 Revised: 20-06-2023 / Accepted: 12-07-2023
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Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to evaluate MR severity and its changes after BMV in patient with rheumatic mitral stenosis.

Material & Methods: We prospectively evaluated consecutive patients with severe rheumatic MS undergoing BMV using the Inoue balloon technique between) in between the duration of 2 years, functional class and echocardiographic and catheterization data, including MVA, mitral valve mean and peak gradient (MVPG and MVMG), left atrial (LA) pressure, pulmonary artery systolic pressure (PAPs), and MR severity before and after BMV, were evaluated.

Results: Complete pre-and post-BMV evaluation was performed in 150 patients (100 females) at a mean age of 45.80 ± 14.36 (range = 20 to 76) years. There were 96% females and 79% females in increased MR severity and MR severity without change respectively. The patients with an increased MR degree after BMV had a significantly higher calcification score and a lower MVA before BMV. The patients with an increased MR degree after BMV had a significantly higher calcification score and a lower MVA before BMV. MR increased in tandem with an increase in the calcification score. Most cases with increased MR post BMV had commissural MR in the anterior commissure and were more likely to have commissural rupture. After BMV, MVA significantly increased, whereas PAPs, LA pressure, MVPG and MVMG were significantly reduced.

Conclusion: In our study, BMV had excellent immediate hemodynamic and clinical results inasmuch as MR severity increased only in some patients and, interestingly, decreased in a few. Our results, underscore BMV efficacy in severe MS. The echocardiographic calcification score was useful for identifying patients likely to have MR development or MR increase after BMV.

Keywords: Balloon valvuloplasty, Mitral valve insufficiency, Echocardiography.

Introduction

Rheumatic heart disease is a widely prevalent problem in developing countries, accounting for 25-40% of all cardiac disease. [1] Rheumatic mitral stenosis is common and may occur in young patients. [2] Mitral stenosis is more often caused by rheumatic heart disease. Other causes of mitral stenosis include severe calcification of the mitral annulus and congenital defects of the mitral valve. [3,4,5] Until the early1980s, surgery was the only possible treatment for severe mitral stenosis; then, a new alternative appeared, percutaneous mitral balloon valvuloplasty (PMV). Since its introduction in 1982 by Inoue et al. [6], PMV has been used successfully as an alternative to open or closed surgical mitral commissurotomy for the treatment of patients with symptomatic rheumatic mitral stenosis [7]

First described in 1984 by Inoue, percutaneous balloon mitral valvotomy (PMV) has now become a recognized and common therapeutic approach [8] and is used as an alternative to surgical mitral commissurotomy in patients with symptomatic severe mitral stenosis (MS) and suitable valve anatomy. [9] BMV produces significant changes in mitral valve morphology and improvement in leaflet mobility. [10] With an increase in the use of BMV, the effectiveness of this procedure has become widely accepted despite its risks. [11,12] BMV has considerably high success rates and low complication rates in short-term and long-term followups. [13] This complication is usually mild and well tolerated but MR degree may increase in 25%-83% of cases after BMV. [14]

Hence the aim of the study was to evaluate BMV outcome with an emphasis on MR changes.

Material & Methods

A prospective study including 150 consecutive patients with rheumatic severe MS who were eligible for BMV using the Inoue balloon technique in between the duration of 2 years were included. The study was approved by the institutional Review Board, and all the patients gave their informed consent for the procedure.

Inclusion criteria

Symptomatic severe MS with New York Heart Association (NYHA) functional class (FC) II or more, mitral valve area (MVA) ≤ 1.5 cm^2, and mitral valve echocardiographic score ≤ 11, according to the scoring system described by Wilkins et al. [15,16]

The presence of each of the following factors was considered an exclusion criterion: left atrial (LA) thrombus; MR severity higher than moderate; unfavorable mitral valve morphology; and need for cardiac surgery because of severe aortic, tricuspid, or coronary disease. The results of our previous study [17] showed that a high echocardiographic score is not a contraindication for BMV in rheumatic MS. The patients who met the exclusion criteria were referred for surgical treatment. The decision regarding BMV was mainly based on echocardiographic assessment, which was employed to measure MVA, valvular and subvalvular apparatus calcifications, and MR degree. The Wilkins score was used to determine the anatomic characteristics of the valve and subvalvular regions. [16] All the patients underwent BMV using the transvenous trans-septal antegrade technique from the right femoral vein. [8] The initial balloon size was chosen according to the patient's height. The balloon size was chosen to obtain an effective balloon dilation area/ body surface area of approximately 4cm^2 /m^2. The balloon size was stepwise increased by 0.5 mm consecutive dilations until an MVA > 1.5cm^2 was reached or MR significantly increased.

Right and left heart pressures, including simultaneous LA and left ventricular (LV) end diastolic pressure (trans-mitral gradient), were measured before and after BMV. The BMV procedure was terminated once the gradient was ≤ 4 mmHg, there was no diastolic rumble, or in case MR occurred or increased.

Standard transthoracic echocardiography (TTE) was performed almost one week before and 24 hours after BMV with a GE Vivid 7 scanner, equipped with an M3S multi-frequency phased array transducer and tissue Doppler imaging facility. Data were acquired with the subjects at rest, lying in the lateral supine position. Grey-scale images were obtained using second-harmonic imaging (1.7/3.4 MHz). Two-dimensional (2D) electrocardiography (ECG) was superimposed on the images, and end-diastole was considered at the peak R-wave of the ECG. Left ventricular ejection fraction (LVEF) was determined using the Simpson biplane method by measuring the end-diastolic and end systolic volumes in 2D images. All the measurements, including MVA, mitral valve peak gradient (MVPG), mitral valve mean gradient (MVMG), MR severity, LA pressure, and pulmonary artery systolic pressure (PAPs), were obtained in accordance with the American Society of Echocardiography (ASE) recommendations.

Transesophageal echocardiography (TEE) was performed on the same day or on the day before intervention for the exclusion of LA thrombi, better evaluation of mitral valve structure, Wilkins score, and MR severity (grades 1-4), interatrial septal thickening measurement, and reassessment of TTE data. [18-20] The MV score was judged according to the Wilkins score system, obtained by adding the score of each of these individual morphological features: leaflet mobility; thickness; calcification; and subvalvular thickening. [15] A score of 0-4 was assigned to each component in accordance with the Wilkins echocardiographic scoring system. Adding the individual scores generally resulted in a total echocardiographic score, which varied from 0 to 16 for the MV, with higher values representing increased morphological abnormality.[15] In this study, the final total echocardiographic scores ranged from 5 to 12.

After BMV, color Doppler echocardiography was used to screen left-to-right atrial shunts. LV gram was performed in all the patients before and after BMV to assess MR severity.

Statstical Analysis

The data are presented as mean ± standard deviation (SD). The variables were compared before and after the procedure using the paired samples t-test (continuous variables) or the chi-squared test (categorical variables). The continuous variables were compared between the patients with and without an increase in MR severity and between the patients with and without a decrease in MR severity using the independent samples t-test. A p value was considered significant when it was ≤ 0.05. Data were collected and analyzed using SPSS statistical package version 16.0 (SPSS Inc. Chicago, IL, USA).

Results

Table 1: Comparison of baseline and echocardiographic characteristics in patients with and without increased MR after BMV

	Increased MR Severity (n=50)	MR Severity without Change (n=100)	P value
Age (y)	45.55±12.48	45.25±14.56	0.093
Gender (female)	48 (96)	78 (78)	0.118
Ejection fraction (%)	54.46±3.87	51.69±4.66	0.136
Mean Wilkins echocardiographic score	8.00±0.92	8.52±1.38	0.064
Favorable valve anatomy (Wilkins Score ≤ 8)	16 (32)	48 (48)	0.188
Unfavorable valve anatomy (Wilkins Score > 8)	34 (68)	54 (54)	0.314
Wilkins score components			
Mobility	2.14±0.49	2.06±0.44	0.564
Calcification	2.02±0.52	1.52±0.48	< 0.001
Thickness	2.07±0.43	2.08±0.52	0.885
Subvalvular	2.29±0.42	2.48±0.56	0.220
Mitral valve area (cm^2)	0.82±0.25	0.91±0.19	0.017
Pulmonary artery peak systolic pressure (mmHg)	45.00±8.82	48.02±10.20	0.224
Left atrial pressure (mmHg)	26.44±4.86	26.24±4.36	0.729
MV peak gradient (mmHg)	21.49±4.26	21.29±4.86	0.824
MV mean gradient (mmHg)	12.48±3.57	12.58±3.77	0.822

Complete pre-and post-BMV evaluation was performed in 150 patients (100 females) at a mean age of 45.80 ± 14.36 (range = 20 to 76) years. There were 96% females and 79% females in increased MR severity and MR severity without change respectively. The patients with an increased MR degree after BMV had a significantly higher calcification score and a lower MVA before BMV.

Table 2: Hemodynamic and echocardiographic characteristics before and after BMV

	Before BMV	After BMV	P value
Mitral valve area (cm^2)	0.68±0.22	1.86±0.24	< 0.001
Pulmonary artery peak systolic pressure (mmHg)	45.05±10.12	36.84±6.34	< 0.001
Left atrial pressure (mmHg)	25.15±4.56	17.33±4.16	< 0.001
Mitral valve peak gradient (mmHg)	20.16±4.86	9.71±2.76	< 0.001
Mitral valve mean gradient (mmHg)	11.49±3.87	5.85±2.48	< 0.001
MR severity No MR	102 (68)	96 (64)	0.913
MR 1+	30 (20)	24 (16)	
MR 2+	18 (12)	28 (18.66)	
MR 3+	0	2 (1.33)	

MR increased in tandem with an increase in the calcification score. Most cases with increased MR post BMV had commissural MR in the anterior commissure and were more likely to have commissural rupture. After BMV, MVA significantly increased, whereas PAPs, LA pressure, MVPG and MVMG were significantly reduced.

Discussion

Rheumatic heart disease complicates pregnancy in a high number of women in countries like India with high endemicity of rheumatic fever. Mitral stenosis remains the commonest valvular heart disease encountered during pregnancy in India. [21] Mitral stenosis is poorly tolerated in pregnancy because of increased hemodynamic burden. There is a physiological increase in heart rate, blood volume during pregnancy which cannot be accommodated in the heart with mitral stenosis. This leads to increase in mean left atrial pressure, and pulmonary venous pressure which may precipitate heart failure and pulmonary edema especially during the third trimester and peri-partum period. [22,23] The risk of maternal death is greatest during labor and the immediate postpartum period. There is auto transfusion from the uterus during this time, which reaches the central circulation. This suddenly increases the pre-load immediately after delivery, leading to decompensation. This auto transfusion continues upto 24-72 h after delivery and thus the chance of decompensation continues until that time. A significant number of patients remain symptomatic in-spite of optimum medical therapy, necessitating mechanical relief of mitral stenosis. The immediate hemodynamic effectiveness of balloon mitral valvuloplasty in the relief of rheumatic mitral stenosis is apparent from various studies as well as the present. However, long-term results are still being evaluated. Closed mitral valvotomy with its low risk, low cost, large experience, time-tested effectiveness, and large number of cases of mitral stenosis requiring surgery, remains the favored procedure for the relief of critical mitral stenosis in India. Balloon mitral valvuloplasty, however, presents a viable alternative in patients who are unwilling to undergo surgery for personal or cosmetic reasons or in patients in whom surgery is contraindicated due to coexistent medical illness. If facilities exist, there is no doubt that open mitral valvulotomy is the best form of' repair for a mitral valve multilated by the rheumatic process. [24-27]

Complete pre-and post-BMV evaluation was performed in 150 patients (100 females) at a mean age of 45.80 ± 14.36 (range = 20 to 76) years. There were 96% females and 79% females in increased MR severity and MR severity without change respectively. The patients with an increased MR degree after BMV had a significantly higher calcification score and a lower MVA before BMV. The patients with an increased MR degree after BMV had a significantly higher calcification score and a lower MVA before BMV. MR increased in tandem with an increase in the calcification score. Most cases with increased MR post BMV had commissural MR in the anterior commissure and were more likely to have commissural rupture. After BMV, MVA significantly increased, whereas PAPs, LA pressure, MVPG and MVMG were significantly reduced. It has been previously demonstrated that an MVA $\geq$ 2 cm2 can be achieved irrespective of the technique used in most patients. [28,29] In our study, there was a significant improvement in hemodynamic variables, including MVA, PAPs, LA pressure, MVPG, and MVMG after BMV. The increase in MVA was $\leq$ 2 cm2 in most of the patients. It is believed that a higher increase in MVA can be achieved only at the expense of more frequent complications. [30] However, in our study, a higher than twofold increase in MVA with no complications shows the efficacy of BMV.

Most studies have evaluated the effect of hemodynamic and echocardiographic variables on the BMV outcome. Aslanabadi and colleagues [31] evaluated repeated BMV and mitral valve replacement in patients (even with a Wilkins score > 11) who had restenosis after primary balloon valvotomy and achieved acceptable results. Similarly, other studies have shown that a high Wilkins mitral score is not a very robust predictor of poor outcomes after BMV. [32,33] In our study, BMV was successful in all the patients. We evaluated the factors that could influence MR severity or MR development. A higher calcification score and a lower MVA before BMV predicted a rise in MR, but the total Wilkins score could not predict its occurrence. In contrast, Abascal and colleagues [34] reported that an increase in MR could not be predicted by any features of the valve or the subvalvular apparatus, clinical characteristics of the patient, or technical aspects of the procedure. Also worthy of note is that Pan et al [35] found no predictors for the development of significant MR after BMV.

Conclusion

In our study, BMV conferred excellent immediate hemodynamic and clinical results inasmuch as MR severity increased only in some patients and, interestingly, decreased in a few. What is more, there were no major complications. Our results, therefore, give emphasis to the efficacy of BMV in the treatment of patients with severe MS. The echocardiographic calcification score was useful for identifying patients likely to have MR development or MR increase following BMV.

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