

## Original Research Article

# An analysis of percutaneous balloon mitral valvotomy: a tertiary care centre study

Prem Kumar Thota<sup>1</sup>, Rajesh Dake<sup>2\*</sup>

<sup>1</sup>Department of Cardiology, <sup>2</sup>Department of Emergency Medicine, Apollo Hospitals Kakinada, Andhra Pradesh, India

**Received:** 29 March 2020

**Accepted:** 20 April 2020

### \*Correspondence:

Dr. Rajesh Dake,

E-mail: [drrajesh\\_d@apollohospitals.com](mailto:drrajesh_d@apollohospitals.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** The prevalence of rheumatic heart disease (RHD) has markedly decreased in several countries but is still present in underdeveloped and developing countries, 33 million people around the world affected by RHD. Percutaneous balloon mitral valvotomy (PBMV) or valvotomy via femoral cut down using a balloon dilating catheter used in a small number of patients` as an alternative to surgical mitral commissurotomy.

**Methods:** A retrospective, observational study included 37 patients who were diagnosed to have severe mitral stenosis between October 2017 and October 2019 were included in the study. Primary endpoint was considered as in-hospital mortality and secondary endpoint was considered as 6 months clinical outcomes. All patients were evaluated clinically by the same investigator who performed PBMV.

**Results:** The mean age of the study population was  $36.6 \pm 11.37$  years. There was a female predominance 27 (72.97%) patients. Out of total patients; an optimal result was achieved in 33 (89.19%) patients, 1 patient developed pericardial effusion and for 3 (8.1%) patients wire cannot be crossed. Although the mitral valve area calculated by cardiac catheterization increased significantly from immediately before  $1.003 \pm 0.12 \text{ cm}^2$  to immediately after PBMV  $1.73 \pm 0.23 \text{ cm}^2$  there was a no significant decrease in the mitral valve area at 6 months follow-up  $1.66 \pm 0.22 \text{ cm}^2$  by Echocardiography.

**Conclusions:** PBMV is an effective treatment for acquired mitral stenosis, as demonstrated by the immediate hemodynamic results in 37 consecutive procedures. PBMV is effective therapy with good midterm results for selected patients with mitral stenosis.

**Keywords:** Echocardiography, Mitral valve area, Mitral stenosis, Percutaneous balloon mitral valvotomy, Rheumatic heart disease, Transseptal cardiac catheterization

## INTRODUCTION

Rheumatic fever (RF)/rheumatic heart disease (RHD) is the result of autoimmune response triggered by group A Beta-haemolytic streptococcal pharyngitis leading to immune-inflammatory injury to cardiac valves. The inflammatory injury of the pericardium and myocardium is transient and self-limiting, without leaving any sequel. The valvular injury is the main cause of acute and long-term morbidity and mortality in patients with acute RF and RHD, respectively.<sup>1,2</sup> The risk of RF/RHD is

primarily determined by the host, agent, and environmental factors.<sup>3</sup> RF/RHD is considered to be a physical manifestation of poverty. The distribution of the burden of RF/RHD mirrors the distribution of human development index in given geographical region, state, and nation, as well as globally. The socioeconomic state, access, and quality of health-care services are important determinants of the burden of RF/RHD. The incidence of RF/RHD has practically disappeared in developed countries.<sup>4</sup> However, RF/RHD continues to be a major cause of disease burden among children, adolescents, and

young adults in low-income countries and even in high-income countries with socioeconomic inequalities. The burden of RF/RHD is likely to be variable among countries, within the country, within states depending upon the socioeconomic status and state of health systems.<sup>5-8</sup> The major determinant of the persistent burden of RF/RHD in developing countries are because of poor standards of living conditions, over-crowding, and lack of strong population-based surveillance system for pharyngitis, RF, and RHD for effective implementation of primary and secondary preventive interventions.<sup>9,10</sup> The Indian Council of Medical Research initiated community control and prevention of RF/RHD through hospital-based passive surveillance and implementation of secondary prophylaxis under Jai Vigyan Mission Mode Project from 2000 to 2010.<sup>10</sup> There is no structured programme at a national level for prevention and control of RF/RHD. However, changing socioeconomic state, improved living conditions, and improving connectivity and access to health-care centres after adopting a policy of economic liberalization and globalization since 2000 is expected to have translated into a decline in the burden of RF/RHD in India.

Mitral stenosis (MS) is a disabling and eventually lethal disease. Untreated progressive disease can lead to significant symptoms (eg, dyspnoea and fatigue) and serious complications (eg, pulmonary oedema, systemic embolism, and pulmonary hypertension). The great majority of cases in adults are due to rheumatic heart disease, with symptoms usually appearing 16 to 40 years after the episode of acute rheumatic fever. Although medical therapy can relieve symptoms, it does not affect the obstruction to flow. As a result, surgical commissurotomy and open valvuloplasty were, for many years, the only methods by which MS could be corrected.

However, the development of percutaneous mitral balloon valvotomy (PMBV) by Inoue in 1984 and Lock in 1985 for the treatment of selected patients with MS has revolutionized the treatment of this disorder. Possible risks associated with valvuloplasty include, but are not limited to, the following: bleeding at the catheter insertion site, blood clot or damage to the blood vessel at the insertion site, infection at the catheter insertion site, cardiac dysarrhythmias/arrhythmias (abnormal heart rhythms), stroke, rupture of the valve, requiring open-heart surgery, the amount of radiation used during a valvuloplasty procedure is considered minimal; therefore, the risk for radiation exposure is very low.

## METHODS

A retrospective, observational study included 37 patients who were diagnosed to have severe mitral stenosis between October 2017 and October 2019 was included in the study. Primary endpoint was considered as in-hospital mortality and secondary endpoint was considered as One year clinical outcomes.

Systematic sampling method was followed

## Inclusion criteria

Patients who are symptomatic and having severe mitral stenosis ( $MVA \leq 1.5 \text{ cm}^2$ )

## Exclusion criteria

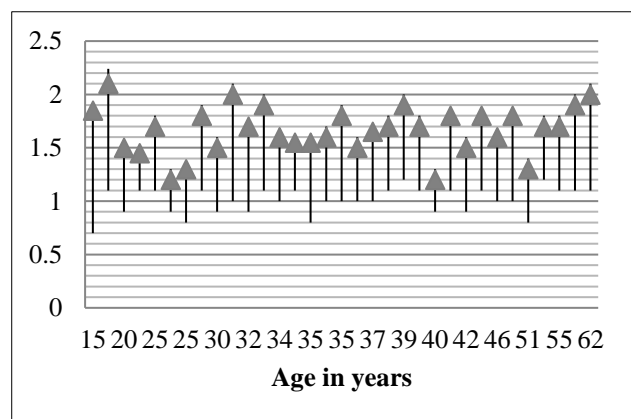
Patients who are asymptomatic and mild to moderate stenosis ( $MVA \geq 1.5 \text{ cm}^2$ ).

## Statistical analysis

The data was analysed by One-Way ANOVA for before and after PMBV LA pressures which shows that the f-ratio value is 118.10717. The p-value is  $<0.00001$ . The result is significant at  $p < 0.05$ . And for before and after PMBV Mitral valve area shows that the f-ratio value is 247.26518. The p-value is  $<0.00001$ . The result is significant at  $p < 0.05$ .

## RESULTS

Data collected was analyzed. A total of 37 patients were included in the study. The mean age of the study population was  $36.6 \pm 11.37$  years. There was a female predominance 27 (72.97%) patients. Out of total patients; an optimal result was achieved in 33 (89.19%) patients (Figure 1), one patient (2.7%) developed pericardial effusion and for 3 (8.1%) patients wire cannot be crossed. Various Balloon size combinations were selected as shown in table 1. Mean Hemodynamic results before and after PMBV are as shown in table 2.



**Figure 1: Depicts MVA (in mm) before PMBV and post operative and 6 months follow-up.**

**Table 1: Balloon size combination.**

Balloon size diameter (In mm)	Patients
22-24	2
23-26	28
25-28	3

**Table 2: Hemodynamic results.**

Mean left atrial pressure		Mitral valve area		
Before	After	Before	After PBMV	After 6 months
27.25±6.91	12.5±5.53	1.003±0.12	1.73±0.23	1.66±0.22

All patients were alive and had marked symptomatic improvement, 25 patients were having class I, 6 patients were having class II, and 2 patients were having class III dyspnoea. Although the mitral valve area calculated by cardiac catheterization increased significantly from before to immediately after PBMV there was a decrease in the calculated mitral valve area at 6 months follow-up. Echocardiographic analysis show an increase in mitral area, immediately after PBMV, and no significant decrease in mitral valve area at 6 months (before PBMV planimetry 1.003±0.12 cm<sup>2</sup>; immediately after 1.73±0.23; 6 months follow-up 1.66±0.22).

## DISCUSSION

Mitral stenosis is a valvular heart disease characterized by the narrowing of the orifice of the mitral valve of the heart. It is almost always caused by rheumatic valvular heart disease. Normally, mitral valve is about 5 cm<sup>2</sup> during diastole. Any decrease in area below 2cm<sup>2</sup> causes mitral stenosis. Early diagnosis of mitral stenosis in pregnancy is very important as the heart cannot tolerate increased cardiac output demand as in the case of exercise and pregnancy. Atrial fibrillation is a common complication of resulting left atrial enlargement, which can lead to systemic thromboembolic complications like stroke.

The normal area of the mitral valve orifice is about 4 to 6 cm<sup>2</sup>. In normal cardiac physiology, the mitral valve opens during left ventricular diastole, to allow blood to flow from the left atrium to the left ventricle. A normal mitral valve will not impede the flow of blood from the left atrium to the left ventricle during (ventricular) diastole, and the pressures in the left atrium and the left ventricle during ventricular diastole will be equal. The result is that the left ventricle gets filled with blood during early ventricular diastole, with only a small portion of extra blood contributed by contraction of the left atrium (the "atrial kick") during late ventricular diastole.

When the mitral valve area goes below 2 cm<sup>2</sup>, the valve causes an impediment to the flow of blood into the left ventricle, creating a pressure gradient across the mitral valve. This gradient may be increased by increases in the heart rate or cardiac output. As the gradient across the mitral valve increases, the amount of time necessary to fill the left ventricle with blood increases. Eventually, the left ventricle requires the atrial kick to fill with blood. As the heart rate increases, the amount of time that the ventricle is in diastole and can fill up with blood (called the diastolic filling period) decreases. When the heart rate

goes above a certain point, the diastolic filling period is insufficient to fill the ventricle with blood and pressure builds up in the left atrium, leading to pulmonary congestion.

When the mitral valve area goes less than 1 cm<sup>2</sup>, there will be an increase in the left atrial pressures (required to push blood through the stenotic valve). Since the normal left ventricular diastolic pressures is about 5mmHg, a pressure gradient across the mitral valve of 20mmHg due to severe mitral stenosis will cause a left atrial pressure of about 25 mmHg. This left atrial pressure is transmitted to the pulmonary vasculature and causes pulmonary hypertension.

The constant pressure overload of the left atrium will cause the left atrium to increase in size. As the left atrium increases in size, it becomes more prone to develop atrial fibrillation (AF). When atrial fibrillation develops, the atrial kick is lost (since it is due to the normal atrial contraction).

In individuals with severe mitral stenosis, the left ventricular filling is dependent on the atrial kick. The loss of the atrial kick due to atrial fibrillation (i.e. blood cannot flow into the left ventricle thus accumulating in the left atrium) can cause a precipitous decrease in cardiac output and sudden congestive heart failure.

Patients with mitral stenosis prompt a series of hemodynamic changes that frequently cause deterioration of the patient's clinical status. A reduction in cardiac output, associated with acceleration of heart rate and shortening of the diastolic time, frequently leads to congestive heart failure. In addition, when AF sets in, systemic embolization becomes a real danger.

Mitral stenosis typically progresses slowly (over decades) from the initial signs of mitral stenosis to NYHA functional class II symptoms to the development of atrial fibrillation to the development of NYHA functional class III or IV symptoms. Once an individual develops NYHA class III or IV symptoms, the progression of the disease accelerates and the patient's condition deteriorates. Balloon valvotomy is used to increase the opening of a narrowed (stenotic) valve. It is used for Select patients who have mitral valve stenosis with symptoms or older patients who have aortic valve stenosis, but are not able to undergo surgery or some patients with pulmonic valve stenosis. This balloon valvotomy procedure can be performed on the mitral, tricuspid, aortic or pulmonary valves.

Harken and associates" noted that patients with shortened, fused, and thickened chordae obtained less satisfactory results with finger-fracture valvuloplasty than patients with commissural fusion and normal chordae. This observation has been confirmed and also shown to predict a poorer long-term result.<sup>10-12</sup> Valvular calcification has also been shown to adversely affect the outcome of both closed and open commissurotomy. PBMV is effective therapy with good midterm results for selected patients with mitral stenosis.<sup>13-17</sup>

This study does have few limitations as this is not a comparative study with other hospitals. Secondly, our work represents a retrospective study, and is therefore subject to the limitations of such analyses. Third, the data are derived from a single-centre, which limits the extension of the applicability of the results. In addition, we analyzed only the 12-months mortality. Therefore, it is not possible to extend the results beyond the acute phase and to other major cardiovascular events.

## CONCLUSION

PBMV is an effective treatment for acquired mitral stenosis, as demonstrated by the immediate hemodynamic results in 37 consecutive procedures. Factors that adversely influence the results of PBMV include marked valvular calcification and leaflet immobility, severe sub valvular thickening, the presence of atrial fibrillation, and the use of smaller effective balloon dilating areas. Echocardiographic analysis shows an increase in mitral area, immediately after PBMV, and no significant decrease in mitral valve area after 6 months. In successful cases, BMV results in a very high survival rate and freedom from symptoms. Appropriate patient selection and a competent technique are the key factors for achieving an excellent result.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Taranta A, Markowitz M. Rheumatic Fever. Boston: Kluwer Academic publishers; 1989:1e18.
2. Kumar R, Sharma YP, Thakur JS, Patro BK, Bhatia A, Singh IP, et al. Streptococcal pharyngitis, rheumatic fever and rheumatic heart disease: eight-year prospective surveillance in Rupnagar district of Punjab, India. *Natl Med J India*. 2014 Mar 1;27(2).
3. Karthikeyan G, Guilherme L. Acute rheumatic fever. *Lancet*. 2018 Jul 14;392(10142):161e174.
4. Gordis L. The virtual disappearance of rheumatic fever in the United States: lessons in the rise and fall of disease. T. Duckett Jones memorial lecture. *Circulation*. 1985 Dec;72(6):1155-62.
5. Markowitz M, Kaplan EL. Reappearance of rheumatic fever. *Adv Pediatr*. 1989;36:39-65.
6. Kaplan EL, Hill HR. Return of rheumatic fever: consequences, implications, and needs. *J Pediatr*. 1987 Aug 1;111(2):244-6.
7. Padmavati S. Rheumatic fever and rheumatic heart disease in developing countries. *Bull World Health Organization*. 1978;56(4):543.
8. Seckeler MD, Hoke TR. The worldwide epidemiology of acute rheumatic fever and rheumatic heart disease. *Clin Epidemiol*. 2011;3:67.
9. Carapetis JR. Rheumatic heart disease in developing countries. *N Engl J Med*. 2007;357(5):439-41.
10. Vigyan J. Mission mode project on community control of RHD. *Noncommunicable diseases. Indian Council Med Res Annu Rep*. 2007e08:63e64
11. Scanneil JG, Burke JF, Saidi F, Turner JD. Five-year follow-up study of closed mitral valvulotomy. *J Thorac Cardiovasc Surg*. 1960 Dec 1;40(6):723-30.
12. Akins CW, Kirklin JK, Block PC, Buckley MJ, Austen WG. Preoperative evaluation of subvalvular fibrosis in mitral stenosis. A predictor factor in conservative vs replacement surgical therapy. *Circulation*. 1979 Aug;60(2):71-6.
13. Nathaniels EK, Moncure AC, Scannell JG. A fifteen-year follow-up study of closed mitral valvuloplasty. *Ann Thoracic Surg*. 1970 Jul 1;10(1):27-36.
14. Ellis LB, Singh JB, Morales DD, Harken DE. Fifteen-to twenty-year study of one thousand patients undergoing closed mitral valvuloplasty. *Circulation*. 1973 Aug;48(2):357-64.
15. Ellis LB, Benson H, Harken DE. The effect of age and other factors on the early and late results following closed mitral valvuloplasty. *Am Heart J*. 1968 Jun 1;75(6):743-51.
16. Grantham R, Daggett W, Cosimi A, Buckley M, Mundth E, Mcenany M, et al. Transventricular mitral valvulotomy: analysis of factors influencing operative and late results. *Circulation*. 1974;50(2).
17. Rutledge R, McIntosh CL, Morrow AG, Picken CA, Siwek LG, Zwischenberger JB, et al. Mitral valve replacement after closed mitral commissurotomy. *Circulation*. 1982 Aug;66(2 Pt 2):I162-6.

**Cite this article as:** Thota PK, Dake R. An analysis of percutaneous balloon mitral valvotomy: a tertiary care centre study. *Int J Adv Med* 2020;7:924-7.