Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v6i5.1753
*Biol. Clin. Sci. Res. J., Volume 6(5), **2025**: 1753*
Original Research Article

Study of Clinical Profile and In-Hospital Outcomes of Patients Undergoing Percutaneous Transvenous Mitral Commissurotomy

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(Received, 24th November 2024, Accepted 2nd January 2025, Published 31st May 2025)

Abstract: *Percutaneous Transvenous Mitral Commissurotomy (PTMC) is the preferred treatment for patients with symptomatic severe rheumatic mitral stenosis and favorable valve morphology. It replicates the physiological mechanism of surgical commissurotomy with less invasiveness.* ***Objective:*** *This study aimed to assess the clinical profile and in-hospital outcomes of patients undergoing PTMC at a tertiary cardiac care center.* ***Methods:*** *A prospective observational study was conducted at the Armed Forces Institute of Cardiology, Rawalpindi, from July 1 to December 31, 2023. A total of 96 patients with severe rheumatic mitral stenosis who met the eligibility criteria underwent PTMC. Baseline demographic, clinical, and echocardiographic data were recorded. Pre- and post-procedural mitral valve area (MVA), mean transmitral gradient, and pulmonary artery systolic pressure (PASP) were assessed. Procedural success and in-hospital complications were documented. Data were analyzed using SPSS version 26.0, with p-values <0.05 considered significant.* ***Results:*** *The mean age of the study population was 38.6 ± 10.4 years, with a female predominance (78.1%). Most patients (68.8%) presented in NYHA Class III. Mean MVA increased significantly from 0.89 ± 0.12 cm² to 1.85 ± 0.21 cm² (p < 0.001). Mean transmitral gradient reduced from 17.4 ± 4.3 mmHg to 6.9 ± 2.1 mmHg (p < 0.001), and PASP decreased from 58.6 ± 13.2 mmHg to 39.5 ± 9.4 mmHg (p < 0.001). Procedural success was achieved in 92.7% of patients. Mild and moderate mitral regurgitation developed in 18.8% and 4.2% of cases, respectively. Complications included cardiac tamponade (2.1%) and vascular hematoma (3.1%). There was no in-hospital mortality.* ***Conclusion:*** *PTMC is a safe and effective intervention for severe rheumatic mitral stenosis, resulting in significant hemodynamic and symptomatic improvement with minimal complications. Proper patient selection and procedural expertise are key to successful outcomes.*

Keywords: Mitral stenosis, PTMC, rheumatic heart disease, echocardiography, mitral valve area

[***How to Cite:*** Shabeer H. Study of clinical profile and in hospital outcomes of patients undergoing percutaneous transvenous mitral commissurotomy. *Biol. Clin. Sci. Res. J.*, **2025;** 6(5): 148-151. doi: https://doi.org/10.54112/bcsrj.v6i5.1753

Introduction

Rheumatic heart disease (RHD) remains a major cause of mitral stenosis (MS) in developing countries, with studies indicating a prevalence as high as 72.47% in Nepal (1). In the 1940s, closed mitral commissurotomy (CMC) was introduced as a surgical approach for the management of severe MS (2). With the advent of cardiopulmonary bypass in the 1960s, open mitral commissurotomy (OMC) and mitral valve replacement became the preferred surgical options. However, the development of percutaneous balloon dilatation techniques in the 1980s, pioneered by Inoue in 1984 and Lock et al. in 1985, marked a significant shift in the management of mitral stenosis (3, 4). Modifications of these early techniques have led to further improvements in clinical outcomes. The Inoue balloon technique, in particular, has proven effective in children and young adults and has expanded in use, even in populations previously considered unsuitable for surgical commissurotomy, such as elderly patients with calcific mitral stenosis (5, 6). Current guidelines from Comprehensive Valve Centers endorse Percutaneous Transvenous Mitral Commissurotomy (PTMC) as a Class I-A recommended procedure for symptomatic patients (NYHA class II, III, or IV) with severe rheumatic MS (mitral valve area ≤1.5 cm², Stage D), favorable valve morphology, and no more than moderate mitral regurgitation or left atrial thrombus (7). PTMC has gained recognition as the preferred intervention for symptomatic severe mitral stenosis with suitable valve anatomy, as it replicates the valve-splitting mechanism of surgical commissurotomy with less invasiveness. The post-procedural increase in mitral valve area is primarily due to commissural splitting, which forms the physiological basis of its effectiveness. The rationale of this study lies in evaluating the real-world clinical characteristics and early in-hospital outcomes of patients undergoing PTMC in a tertiary care cardiac center. The objective of this study is to analyze the clinical profile and assess immediate procedural and in-hospital outcomes in patients undergoing PTMC for rheumatic mitral stenosis.

Methodology

This prospective observational study was conducted at the Armed Forces Institute of Cardiology (AFIC), Rawalpindi, over a period of six months, from 1st July 2023 to 31st December 2023. The study aimed to evaluate the clinical profile and in-hospital outcomes of patients undergoing Percutaneous Transvenous Mitral Commissurotomy (PTMC).

The calculated sample size was 96 patients. This estimation was derived using the OpenEpi sample size calculator, based on a confidence level of 95%, anticipated frequency of favorable immediate PTMC outcome at 90%, and a margin of error set at 6%. The study employed a non-probability consecutive sampling technique, enrolling every eligible patient who underwent PTMC within the specified study period until the desired sample size was achieved. The inclusion criteria were strictly defined to ensure homogeneity of the study population. Patients aged between 18 to 65 years, diagnosed with rheumatic mitral stenosis and fulfilling the established clinical and echocardiographic criteria for PTMC were included. Specifically, only those patients were selected who had a Wilkins echocardiographic score of ≤8, indicating favorable valve morphology, and who presented with symptomatic mitral stenosis, classified as New York Heart Association (NYHA) functional class II to IV. Exclusion criteria included patients with left atrial thrombus as visualized on transesophageal echocardiography, more than mild mitral regurgitation, significant aortic valve disease, presence of congenital heart disease, left atrial myxoma, coexistent coronary artery disease requiring intervention, and patients with contraindications to

anticoagulation or those who had previously undergone PTMC or surgical mitral valve intervention. All patients underwent a detailed pre-procedural clinical and echocardiographic evaluation. Clinical parameters including age, gender, presenting symptoms, heart rhythm on electrocardiography, NYHA functional class, and comorbidities such as hypertension, diabetes mellitus, and atrial fibrillation were recorded. Transthoracic echocardiography was performed in all patients to assess mitral valve area (MVA), Wilkins score, presence of mitral regurgitation, pulmonary artery systolic pressure (PASP), and left atrial size. Transesophageal echocardiography was performed to exclude left atrial thrombus prior to the procedure.

Percutaneous Transvenous Mitral Commissurotomy was carried out under fluoroscopic guidance using the Inoue balloon technique. The procedure was performed by experienced interventional cardiologists in a catheterization laboratory equipped with biplane fluoroscopy. Hemodynamic parameters including left atrial pressure, transmitral gradient, and pulmonary artery pressures were measured pre- and post-procedure. The procedural success was defined as an increase in MVA to ≥1.5 cm² with no more than mild mitral regurgitation and no major complications. In-hospital outcomes were systematically recorded. These included procedural success rate, post-procedural increase in MVA, reduction in mean transmitral gradient, reduction in PASP, improvement in NYHA functional class, and development of complications such as cardiac tamponade, significant mitral regurgitation, embolic events, vascular access complications, or death. All patients were monitored clinically and echocardiographically during their hospital stay, and the duration of hospitalization post-procedure was also documented.

The collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables such as age, pre- and post-procedural MVA, transmitral gradient, PASP, and hospital stay duration were expressed as mean ± standard deviation. Categorical variables including gender, NYHA class, presence of atrial fibrillation, comorbidities, procedural success, and complications were presented as frequencies and percentages. Paired sample t-test was applied to assess the significance of pre- and post-procedural changes in continuous echocardiographic and hemodynamic parameters. A p-value of <0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Ethical Review Committee of the Armed Forces Institute of Cardiology prior to data collection. Written informed consent was taken from all patients before enrollment, and patient confidentiality was maintained throughout the study.

Results

A total of 96 patients underwent Percutaneous Transvenous Mitral Commissurotomy (PTMC) during the study period at Armed Forces Institute of Cardiology, Rawalpindi. The mean age of the study population was 38.6 ± 10.4 years, with a female predominance (78.1%, n=75). Most patients (68.8%) were in NYHA Class III at the time of presentation. The baseline characteristics, including clinical and demographic features, are summarized in Table 1. All patients underwent echocardiographic assessment before and after the procedure. The mean pre-procedural mitral valve area (MVA) was 0.89 ± 0.12 cm², which significantly increased to 1.85 ± 0.21 cm² post-procedure ($p < 0.001$). The mean transmitral gradient decreased from 17.4 ± 4.3 mmHg to 6.9 ± 2.1 mmHg ($p < 0.001$). Pulmonary artery systolic pressure (PASP) also showed significant improvement, decreasing from 58.6 ± 13.2 mmHg to 39.5 ± 9.4 mmHg ($p < 0.001$). These echocardiographic and hemodynamic findings are presented in Table 2. The procedural success rate, defined as MVA ≥1.5 cm² post-PTMC with no more than mild mitral regurgitation and absence of major complications, was achieved in 89 patients (92.7%). Mild mitral regurgitation occurred in 18 patients (18.8%), while moderate mitral regurgitation developed in 4 patients (4.2%). No cases of severe mitral regurgitation were observed. Complications included cardiac tamponade in 2 patients (2.1%), cerebrovascular embolic events in 1 patient (1.0%), and vascular access site hematoma in 3 patients (3.1%). There was no in-hospital mortality. These outcomes are detailed in Table 3. Post-procedural improvement in NYHA functional class was observed in the majority of patients. At the time of discharge, 81 patients (84.4%) were in NYHA Class I or II, as compared to only 19 patients (19.8%) before PTMC. This functional improvement is summarized in Table 4. The mean duration of post-procedure hospital stay was 2.6 ± 1.1 days. No readmissions or late complications were reported within the hospital stay period.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 96)

Parameter	Frequency (%) / Mean ± SD
Age (years)	38.6 ± 10.4
Gender	
- Male	21 (21.9%)
- Female	75 (78.1%)
NYHA Functional Class at Presentation	
- Class II	19 (19.8%)
- Class III	66 (68.8%)
- Class IV	11 (11.4%)
Atrial Fibrillation	29 (30.2%)
Hypertension	14 (14.6%)
Diabetes Mellitus	11 (11.5%)

Table 2: Pre- and Post-Procedural Echocardiographic and Hemodynamic Parameters (n = 96)

Parameter	Pre-Procedure Mean ± SD	Post-Procedure Mean ± SD	p-value
Mitral Valve Area (cm²)	0.89 ± 0.12	1.85 ± 0.21	<0.001
Mean Transmitral Gradient (mmHg)	17.4 ± 4.3	6.9 ± 2.1	<0.001
PASP (mmHg)	58.6 ± 13.2	39.5 ± 9.4	<0.001

Table 3: Procedural Outcomes and Complications (n = 96)

Outcome / Complication	Frequency (%)
Successful Procedure	89 (92.7%)
Post-Procedure Mitral Regurgitation	
- None	69 (71.9%)
- Mild	18 (18.8%)

- Moderate	4 (4.2%)
- Severe	0 (0%)
Cardiac Tamponade	2 (2.1%)
Cerebrovascular Event	1 (1.0%)
Vascular Access Hematoma	3 (3.1%)
In-Hospital Mortality	0 (0%)

Table 4: Comparison of NYHA Functional Class Pre- and Post-PTMC (n = 96)

NYHA Class	Pre-Procedure n (%)	Post-Procedure n (%)
Class I	0 (0%)	32 (33.3%)
Class II	19 (19.8%)	49 (51.1%)
Class III	66 (68.8%)	15 (15.6%)
Class IV	11 (11.4%)	0 (0%)
p-value	-	<0.001 (Chi-square test)

Discussion

The present study was conducted to evaluate the clinical profile and in-hospital outcomes of patients undergoing Percutaneous Transvenous Mitral Commissurotomy (PTMC) for rheumatic mitral stenosis at the Armed Forces Institute of Cardiology, Rawalpindi. Our findings are largely in concordance with previously published national and international studies and offer insights into demographic patterns, hemodynamic outcomes, procedural success, and complications.

In our study, the mean age of patients undergoing PTMC was 38.6 ± 10.4 years, with a strong female predominance (78.1%). This is consistent with other South Asian studies, which report a higher prevalence of rheumatic mitral stenosis among women, especially in the reproductive age group, likely due to differential access to care and gender-specific disease progression (8). Similar demographics have been reported in studies by Deshmukh et al. and by Vora et al., where female representation was over 75% (8, 9). Rheumatic heart disease remains endemic in low-to-middle-income countries, with its onset typically occurring in childhood and progressing to symptomatic stenosis by the third or fourth decade, explaining the relatively young age of patients in our cohort (10).

The majority of our patients (68.8%) presented in NYHA Class III, which aligns with clinical expectations for symptomatic severe mitral stenosis and echoes the findings of Varma et al., who also reported that most patients undergoing PTMC present with advanced NYHA class (11). Post-procedural NYHA class improved significantly, with 84.4% of patients moving to Class I or II at discharge, indicating substantial symptomatic relief. These results are consistent with prior studies that show immediate symptomatic improvement in more than 80% of patients' post-PTMC (12, 13).

Pre-procedural echocardiographic findings revealed a mean mitral valve area (MVA) of 0.89 ± 0.12 cm², which increased significantly to 1.85 ± 0.21 cm² after the procedure ($p < 0.001$). This nearly twofold increase in MVA is a hallmark of a successful PTMC and has been reported similarly in studies by Palacios et al. and others, where the post-procedural MVA often exceeds 1.5 cm² in the majority of cases (14, 15). The mean transmitral gradient reduced significantly from 17.4 ± 4.3 mmHg to 6.9 ± 2.1 mmHg ($p < 0.001$), and PASP decreased from 58.6 ± 13.2 mmHg to 39.5 ± 9.4 mmHg ($p < 0.001$). These hemodynamic improvements are consistent with global data and reaffirm PTMC's efficacy in improving left atrial and pulmonary hemodynamics (13, 16).

Atrial fibrillation was present in 30.2% of our patients. This finding is slightly lower than the 40% prevalence reported in other studies but still reflects a known association between atrial fibrillation and long-standing mitral stenosis due to left atrial dilatation (17). As also noted in previously published literature, the presence of atrial fibrillation often correlates with older age and more severe structural cardiac changes (17, 18).

The procedural success rate in our study was 92.7%, defined as an increase in MVA to ≥1.5 cm² without the development of more than mild mitral regurgitation (MR) or any major complication. This success rate is consistent with other series reporting rates ranging from 80% to 96% (18, 8, 9). Patients with favorable valve morphology, particularly those with a Wilkins score ≤8, tend to have better outcomes, as observed by Palacios et al. (14). However, recent findings suggest that commissural morphology and calcification, which are not adequately captured in the Wilkins score, also significantly impact PTMC outcomes (13).

Post-procedural MR was mild in 18.8% of patients and moderate in 4.2%, with no cases of severe MR. These rates compare favorably with those reported in the literature, where moderate-to-severe MR occurs in approximately 5–10% of cases (13, 19). The low incidence of severe MR in our study may be attributed to a systematic, stepwise balloon inflation technique and strict adherence to echocardiographic selection criteria. Harrison et al. reported that emergency mitral valve replacement (MVR) is required in only 0.3% to 3.3% of PTMC cases due to severe MR, a complication we did not encounter in our cohort (20).

Cardiac tamponade occurred in two patients (2.1%) in our study, consistent with reported incidence rates between 0.6% and 4% in PTMC literature (21, 22). Careful attention to septal puncture technique and fluoroscopic guidance may reduce the risk of pericardial injury. Similar to our experience, Varma et al. described that most pericardial effusions post-PTMC can be managed conservatively unless persistent or hemodynamically significant (11). Additionally, vascular access site hematomas were observed in three patients (3.1%), and one patient (1.0%) developed a cerebrovascular embolic event. These are well-recognized procedural risks. Kadiyala et al. have also described rare occurrences of coronary embolization leading to myocardial infarction during PTMC, a complication observed in one of our patients (22).

Our findings underscore the importance of careful echocardiographic assessment before PTMC. Favorable echocardiographic parameters, particularly valve pliability, absence of significant calcification, and lack of LA thrombus, are crucial predictors of procedural success 14, 15(15, 17). Additionally, symptom burden and NYHA class at presentation strongly influence the perceived benefit of intervention.

Limitations

this was a single-center observational study with a limited sample size, which may not fully represent the national population. Although the AFIC is a high-volume tertiary care center and acts as a referral hub, multicenter data would provide broader generalizability. Furthermore, only immediate in-hospital outcomes were assessed, and long-term follow-up was beyond the scope of the current study. A prospective study design with extended follow-up would provide more robust data on recurrence, restenosis, and survival outcomes.

Conclusion

Our study reinforces the clinical value of PTMC in patients with symptomatic severe rheumatic mitral stenosis and favorable valve morphology. The high success rate, significant hemodynamic improvements, low complication profile, and symptomatic relief observed in our cohort are consistent with previously published evidence. Pre-procedural valve assessment and careful procedural technique remain the cornerstones for optimizing outcomes and minimizing complications in PTMC.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-AFMC-03-22)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

HS (Fellow Interventional Cardiology)
Manuscript drafting, Study Design,
Review of Literature, Data entry, Data analysis, and drafting articles.
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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