

ISSN Print: 1813-176x
ISSN Online: 1994-4624

International Journal of Molecular Medicine and Advance Sciences
https://ijmmas.com/

Research Article

Cardiac Rhythm and Early Outcomes After Percutaneous Mitral Commissurotomy: Procedural Success, Functional Improvement and Complications.

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Received: 21-10-2026
Revised: 02-11-2026
Accepted: 16-11-2026
Published: 20-11-2026

DOI: 10.61336/ijmmas.22-04-34

Abstract: ***Background: Objective:*** To compare procedural success, functional improvement, left atrial pressure and periprocedural ischemic stroke among patients with atrial fibrillation (AF) and sinus rhythm (SR) undergoing percutaneous transvenous mitral commissurotomy (PTMC). ***Study Design:*** Prospective cohort study. ***Place and Duration of Study:*** Department of Cardiology, CPE Institute of Cardiology, Multan, Pakistan, from 26 January to 27 July 2021. ***Methodology:*** Eighty adults with mitral stenosis suitable for PTMC were enrolled consecutively and classified by preprocedural electrocardiogram into AF (n=40) and SR (n=40). Procedural success was defined as mitral valve area >1.5 cm^2 at one month. Post-PTMC left atrial pressure was recorded during catheterisation. New York Heart Association (NYHA) class was reassessed at one month. Periprocedural ischemic stroke was assessed before discharge. Comparisons used chi-square and independent-samples t-tests. ***Results:*** Mean age was 41.95 ± 14.05 years and 48 (60.0%) participants were female. Overall PTMC success occurred in 67 (83.75%) patients. Success was lower in AF than SR (29/40, 72.5% vs. 38/40, 95.0%; p=0.006). NYHA improvement was recorded in 5 (12.5%) patients with AF and 10 (25.0%) with SR (p=0.152). Post-PTMC left atrial pressure was similar (16.90 ± 2.59 vs. 16.98 ± 2.86 mmHg; p=0.902). Four (5.0%) periprocedural ischemic strokes were reported overall; group-specific counts were unavailable. ***Conclusion:*** In this cohort, PTMC achieved a higher one-month anatomical success rate in SR than AF. Functional improvement and postprocedural left atrial pressure did not differ significantly. Stroke safety comparisons by rhythm require group-level data.

Keywords: Mitral valve stenosis; Balloon valvuloplasty; Atrial fibrillation; Sinus rhythm; Treatment outcome; Stroke.

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INTRODUCTION

Rheumatic mitral stenosis remains a major cause of preventable cardiac morbidity in low- and middle-income settings. Pakistan continues to face gaps in early recognition and access to specialised valve services. The condition is characterised by commissural fusion and progressive restriction of mitral inflow. Left atrial hypertension produces exertional dyspnoea and pulmonary congestion. Atrial remodelling may promote atrial fibrillation (AF) and thromboembolism. These features make both valve anatomy and rhythm relevant when planning an intervention [1].

Percutaneous transvenous mitral commissurotomy (PTMC), also termed balloon mitral valvotomy, is a recommended treatment for selected patients with clinically significant rheumatic mitral stenosis and suitable valve morphology. Contemporary guidelines emphasise patient selection based on symptoms, valve area, commissural anatomy, mitral regurgitation, left atrial thrombus and associated clinical risk [2,3]. AF may mark a more advanced stage of disease and could modify the clinical course after apparently adequate valve opening. However, rhythm alone is not a contraindication to PTMC [2].

Published evidence on rhythm and outcomes is mixed. A meta-analysis comparing AF with sinus rhythm (SR) reported less favourable mitral valve area gains and higher embolic risk in the AF group. Separate investigations indicate that relief of obstruction may produce different patterns of left atrial remodelling according to rhythm [4,5]. More recent prediction models incorporate AF alongside anatomy, age and haemodynamic measures rather than treating rhythm as an isolated determinant [6]. Local prospective comparisons remain clinically useful because rheumatic disease, referral timing and procedural experience vary across populations.

This study compared early anatomical and clinical outcomes of PTMC in adults with AF and SR at a tertiary cardiac centre in Multan. The prespecified focus was procedural success, left atrial pressure and functional class. The available procedural safety endpoint was periprocedural ischemic stroke. The objective was to describe the observed associations without implying that the preprocedural rhythm itself caused treatment failure.

METHODOLOGY

Study design and setting. This prospective cohort study was conducted in the Department of Cardiology, CPE Institute of Cardiology, Multan, Pakistan, between 26 January and 27 July 2021. Eighty patients scheduled for PTMC were recruited using non-probability consecutive sampling. The study included 40 patients with AF and 40 with SR. The sample size described in the approved study used expected success proportions of 67.7% in AF and 94.7% in SR with 80% power and a 5% significance level. The article follows the source study protocol and reports its stated outcomes; any information not present in the dissertation was not reconstructed [7].

Participants and clinical assessment. Eligible patients were 18–65 years of age, had mitral valve area below 1.5 cm² with pliable leaflets and were considered suitable for PTMC by the attending cardiologist. The protocol also specified a mitral stenosis duration of up to three months. Patients with concomitant mitral regurgitation or a history of myocardial infarction were excluded. Preprocedural 12-lead electrocardiography classified rhythm as AF or SR. Age, sex, diabetes mellitus and hypertension were recorded. Diabetes and hypertension were defined in the study by use of the respective medication for at least one year. Baseline NYHA functional class was assessed by a consultant cardiologist.

Procedure and outcomes. PTMC was performed by a consultant interventional cardiologist according to the institutional protocol. Left atrial pressure was measured in the catheterisation laboratory immediately before and after intervention; the available comparative results concern the postprocedural measurement. Success was defined prospectively as a mitral valve area greater than 1.5 cm² on echocardiography at one-month review. Functional response was assessed as improvement in NYHA class from baseline to one month. A consultant not involved in the study and unaware of baseline rhythm reviewed follow-up mitral valve area and NYHA class. Periprocedural ischemic stroke was defined as a new neurological deficit related to embolic vessel occlusion during PTMC with confirmatory cerebral computed tomography. Participants were assessed for this endpoint before hospital discharge.

Statistical analysis. The original analysis used SPSS version 25.0. Quantitative variables were described using mean and standard deviation. Categorical variables were expressed as frequency and percentage. The original investigators used chi-square tests for the association of rhythm with success and improvement in NYHA class, and independent-samples t-tests to compare left atrial pressure. Age, sex, diabetes and hypertension were explored by stratification, followed by chi-square or t-tests as applicable. An unadjusted p-value of 0.05 or less was regarded as significant. The original reported p-values are retained; no additional multivariable modelling or patient-level reanalysis is claimed. Given sparse subgroup cells, the exploratory p-values should not be interpreted as adjusted interaction tests.

Ethics. The source dissertation documents approval from the CPSP Research Evaluation Unit and informed consent from participants before recruitment. An institutional ethics approval number was not available in the supplied record and must be confirmed from the original approval letter before submission.

RESULTS

Participant characteristics. The mean age was 41.95 ± 14.05 years (range: 18–65 years). There were 48 women (60.0%) and 32 men (40.0%). Diabetes mellitus was recorded in 18 (22.5%) participants and hypertension in 15 (18.75%). The recorded baseline NYHA classes were I in 16 (20.0%), II in 40 (50.0%), III in 13 (16.25%) and IV in 11 (13.75%). At one month, the distribution was class I in 21 (26.25%), II in 48 (60.0%), III in nine (11.25%) and IV in two (2.5%). The overall group characteristics are presented in Table I. The source file did not provide a complete group-specific baseline NYHA distribution.

Primary outcome: procedural success. At one month, 67 of 80 patients (83.75%) met the protocol definition of procedural success and 13 (16.25%) did not. Success occurred in 29 of 40 patients with AF (72.5%) compared with 38 of 40 with SR (95.0%). This 22.5-percentage-point absolute difference was statistically significant on the originally reported chi-square comparison (p=0.006; Table II). The greater success rate with SR was evident in the crude data, but the study did not provide adjusted estimates for differences in valve morphology or baseline severity.

Functional and haemodynamic outcomes. Improvement in NYHA functional class was documented in 15 patients (18.75%) overall: five of 40 with AF (12.5%) and ten of 40 with SR (25.0%). The difference did not reach the prespecified significance threshold (p=0.152). The mean reported post-PTMC left atrial pressure was 16.94 ± 2.71 mmHg overall (range: 10–23 mmHg). It was 16.90

± 2.59 mmHg in AF and 16.98 ± 2.86 mmHg in SR (p=0.902). Because group-level preprocedural pressure summaries were not supplied, the amount of within-patient pressure reduction could not be estimated from the available aggregate tables.

Periprocedural complications. Four cases of ischemic stroke were reported among the 80 treated patients (5.0%). The dissertation did not provide the AF-versus-SR distribution of these events or their exact onset times. Consequently, the risk of stroke by rhythm could not be compared and a rhythm-specific p-value was not calculated. The original results did not provide rates for other potential complications such as severe postprocedural regurgitation, tamponade, urgent surgery or death; an absence of these complications cannot be inferred.

Stratified findings. For participants aged 18–40 years, success was achieved in 13/18 with AF and 18/18 with SR (reported p=0.016); among those aged 41–65 years, 16/22 and 20/22 achieved success (p=0.118). Success was recorded in 10/15 men with AF versus 16/17 with SR (p=0.047) and in 19/25 women with AF versus 22/23 with SR (p=0.054). The source tables also reported differences within selected diabetes and hypertension strata (Table III). These estimates came from small, unadjusted subgroups and should be regarded as descriptive rather than evidence of effect modification. Age-stratified postprocedural left atrial pressure comparisons were not significant (18–40 years: p=0.393; 41–65 years: p=0.660). The original tables contained inconsistencies in selected diabetes-related NYHA counts and hypertension-related pressure entries; these were not reproduced as valid findings.

TABLES

Table I. Demographic profile and functional class distribution of the cohort (n=80).

Variable	Value
Age, years, mean ± SD	41.95 ± 14.05
Female sex	48 (60.0%)
Male sex	32 (40.0%)
Diabetes mellitus	18 (22.5%)
Hypertension	15 (18.75%)
Baseline NYHA class I	16 (20.0%)
Baseline NYHA class II	40 (50.0%)
Baseline NYHA class III	13 (16.25%)
Baseline NYHA class IV	11 (13.75%)
One-month NYHA class I	21 (26.25%)
One-month NYHA class II	48 (60.0%)
One-month NYHA class III	9 (11.25%)
One-month NYHA class IV	2 (2.5%)

Data shown as number (percentage) unless otherwise stated. NYHA = New York Heart Association; SD = standard deviation.

Table II. Early outcomes according to preprocedural cardiac rhythm.

Outcome	AF (n=40)	SR (n=40)	p-value
Success at one month	29 (72.5%)	38 (95.0%)	0.006
Unsuccessful procedure	11 (27.5%)	2 (5.0%)	—
Improvement in NYHA class	5 (12.5%)	10 (25.0%)	0.152
No recorded NYHA improvement	35 (87.5%)	30 (75.0%)	—
Post-PTMC LA pressure, mmHg	16.90 ± 2.59	16.98 ± 2.86	0.902

AF = atrial fibrillation; SR = sinus rhythm; NYHA = New York Heart Association; LA = left atrial. p-values are those reported in the original dissertation. Success was mitral valve area >1.5 cm² at one month. Four periprocedural ischemic strokes (5.0%) were reported overall; a rhythm-specific breakdown was not supplied.

Table III. Exploratory stratified procedural success comparisons.

Stratification	AF: success/total	SR: success/total	p-value
Age 18–40 years	13/18	18/18	0.016
Age 41–65 years	16/22	20/22	0.118
Male	10/15	16/17	0.047
Female	19/25	22/23	0.054
Diabetes: yes	3/6	12/12	0.007
Diabetes: no	26/34	26/28	0.081
Hypertension: yes	7/8	5/7	0.438
Hypertension: no	22/32	33/33	<0.001

AF = atrial fibrillation; SR = sinus rhythm. Original unadjusted p-values; small or zero cells limit inference. Inconsistent NYHA and pressure subgroup entries were excluded.

DISCUSSION

The principal observation was a lower one-month PTMC success rate in patients with AF than in those with SR. The difference was substantial in absolute terms and the original unadjusted comparison was statistically significant. By contrast, the between-group differences in NYHA class improvement and postprocedural left atrial pressure were not statistically significant. This distinction is clinically important: anatomical success assessed by valve area and early symptomatic recovery are related but not interchangeable outcomes. A patient may achieve an adequate mitral valve area yet continue to experience symptoms from residual atrial or pulmonary vascular disease.

The overall procedural success rate was 83.75%. The AF association agrees in direction with the meta-analysis by Liu and colleagues [4]. However, the observed association cannot establish a causal effect of AF. AF may coexist with longer-standing stenosis, atrial enlargement, less favourable valve anatomy or greater pulmonary hypertension. Recent multicentre data also show that procedural success rates change when the definition incorporates postprocedural mitral regurgitation and complications, rather than valve area alone [8]. The present study applied the narrower protocol definition of mitral valve area >1.5 cm^2 at one month. Its success percentage must therefore not be directly equated with results using composite definitions.

A systematic review involving more than 3,500 patients supported the effectiveness of balloon mitral intervention while highlighting heterogeneity in haemodynamic outcomes and complications [9]. In a Thai tertiary-centre study, age, tricuspid regurgitation, postprocedure valve area and mitral regurgitation contributed to subsequent adverse event risk [10]. Other reports show that residual regurgitation can meaningfully affect the interpretation of success even when valve area improves [11]. These findings support a combined preprocedural assessment of clinical state, valve morphology and haemodynamics. Our dataset lacked patient-level Wilkins scores, valve calcification grades, left atrial size and pulmonary arterial pressure. It was therefore not possible to assess whether the observed rhythm difference persisted after adjustment for these variables.

Only 18.75% of the cohort met the source study's binary definition of improvement in NYHA class at one month. A larger fraction of patients occupied NYHA I or II after the procedure, but aggregate before-and-after distributions do not permit reconstruction of individual class shifts. The apparent difference between these summaries underscores the need to preserve the original outcome definitions. Symptom recovery may depend on atrial function, exercise capacity and the time allowed for reverse remodelling. Imaging evidence indicates that restoration of valve opening does not produce identical left atrial functional changes in AF and SR [5]. One-month follow-up is also too short to describe sustained functional recovery, restenosis or long-term event-free survival. Work on left atrial size identifies additional prognostic information not represented by the rhythm category alone [12].

Postprocedural left atrial pressure was nearly identical in the two rhythm groups. This does not contradict the lower anatomical success seen in AF, because the pressure measurement reflects one immediate haemodynamic variable whereas the success endpoint was assessed by mitral valve area after one month. Cohorts stratified by transmitral gradient demonstrate that valve anatomy, filling pressure and flow can differ even among patients labelled as having severe mitral stenosis [13]. Studies using atrial deformation and longitudinal haemodynamic parameters provide further examples of the limits of single-measure outcome assessment [14,15]. A pre-to-post pressure change could have made the haemodynamic analysis more informative, but the needed group-level summary was not available.

Four periprocedural ischemic strokes were reported, corresponding to 5.0% of the sample. This is an important safety signal, not a basis for attributing events to one rhythm group. A systematic review of procedural complications and a separate meta-analysis reported much lower pooled short-term stroke frequencies, generally below 1%, although definitions and patient mix vary [9,16]. A Pakistani PTMC series also documented low thromboembolic event frequency following balloon treatment [17]. The comparatively high observed proportion in the present small cohort merits verification against original case records, including stroke timing, imaging findings and anticoagulation status. No inference about other adverse events can be made because their incidence was not tabulated.

The crude subgroup results suggested that success differed by rhythm in some age, sex, diabetes and hypertension strata. Yet several cells were small or contained zero failures. The original analyses used chi-square tests and did not establish interaction effects using a formal model. Therefore, subgroup p-values should not be used to recommend different treatment solely on the basis of sex or comorbidity. The larger clinical context remains decisive. Recent multidisciplinary valve programmes in Pakistan emphasise individualised decisions about percutaneous, surgical or medical care [18]. Current European guidance likewise places rhythm within a broader anatomical and thromboembolic assessment [2,19].

Strengths and limitations. The study prospectively enrolled equal-sized rhythm cohorts and prespecified anatomical, functional, haemodynamic and cerebrovascular outcomes. A reviewer unaware of rhythm assessed the one-month clinical and echocardiographic endpoints. Limitations include consecutive single-centre recruitment, modest sample size, short follow-up, lack of adjusted analyses, and missing comparative baseline anatomic and haemodynamic data. Stroke events were available only as an overall count. Some original subgroup cells were internally inconsistent and the absence of individual records prevented validation. The data do not address long-term durability or establish that AF independently predicts failure. Clearer event documentation and an analysis incorporating morphology, left atrial size and baseline NYHA class would strengthen future research. Clinical management should continue to be guided by current recommendations for rheumatic mitral stenosis and AF [19,20].

CONCLUSION

Among 80 adults undergoing PTMC, the one-month procedural success rate was higher in sinus rhythm than in atrial fibrillation. The differences in documented NYHA class improvement and postprocedural left atrial pressure were not statistically significant. Four periprocedural ischemic strokes were reported overall, but rhythm-specific safety could not be evaluated. These findings support careful preprocedural assessment and cautious interpretation of the association between baseline rhythm and early procedural outcome.

DECLARATIONS

Ethical approval: Approval from the CPSP Research Evaluation Unit is recorded in the study dissertation. Institutional ethics approval details must be supplied from the original letter.

Patient consent: Informed consent was obtained as described in the study protocol.

Conflicts of interest: To be declared and signed by the submitting authors.

Funding: To be declared and verified by the submitting authors.

Authors' contributions: To be finalised using actual contributions before submission.

Data availability: Aggregate outcome tables are available in the source study; individual patient records were not supplied for this manuscript preparation.

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