INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

FREQUENCY OF LEFT ATRIAL THROMBUS IN PATIENT WITH MITRAL STENOSIS AND SINUS RHYTHM ON TRANSESOPHAGEAL ECHOCARDIOGRAPHY SCHEDULED FOR PERCUTANEOUS TRANS MITRAL COMMISSUROTOMY

Original Research

Jibran Ul Haq[1]*, Ehtisham Ul Haq[2], Amin Ullah[3], Muhammad Younis[3], Aisha Hussain[3], Tahir Saghir[4], Mahin Saif[5]
[1]PGR Adult Cardiology, NICVD Karachi, Pakistan.
[2]Resident Internal Medicine, Pak Emirates Military Hospital Rawalpindi, Pakistan.
[3]Clinical Fellow, NICVD Karachi, Pakistan.
[4]Professor of Cardiology, NICVD Karachi, Pakistan.
[5]Medical Student, Jinnah Medical & Dental College, Karachi, Pakistan.
Corresponding Author: Jibran Ul Haq, PGR Adult Cardiology, NICVD Karachi, Pakistan, jayaminoos@gmail.com
Acknowledgement: The authors acknowledge the support of the Department of Cardiology, NICVD, Karachi, for facilitating this research.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Mitral stenosis remains a significant complication of rheumatic heart disease, particularly in low- and middle-income countries. Left atrial thrombus is a recognized complication in these patients, traditionally linked to atrial fibrillation. However, emerging evidence suggests that thrombus formation can also occur in those maintaining sinus rhythm, posing a risk for thromboembolic complications. The reported prevalence of left atrial thrombus in patients with sinus rhythm varies widely across studies. Understanding its frequency in this subset of patients is crucial for preoperative risk assessment and management strategies.

Objective: To determine the frequency of left atrial thrombus in patients with mitral stenosis and sinus rhythm undergoing transesophageal echocardiography before percutaneous trans-mitral commissurotomy.

Methods: A cross-sectional study was conducted at the National Institute of Cardiovascular Diseases (NICVD), Karachi, over six months. A total of 185 patients diagnosed with mitral stenosis and sinus rhythm, aged 18 to 70 years, were included. Transesophageal echocardiography was performed to assess the presence of left atrial thrombus. Data were analyzed using SPSS version 26, with stratification applied to control for effect modifiers. Chi-square or Fisher's exact test was used to assess associations, with a p-value ≤ 0.05 considered statistically significant.

Results: The mean age of the participants was 45.0 ± 10.1 years, with 58.4% males and 41.6% females. The mean duration of mitral stenosis was 73.0 ± 23.7 months. Hypertension was present in 51.4%, diabetes mellitus in 28.1%, and smoking history in 28.1%. Left atrial thrombus was detected in 11.4% of patients on transesophageal echocardiography.

Conclusion: Left atrial thrombus was observed in a considerable proportion of patients with mitral stenosis despite maintaining sinus rhythm. This highlights the need for careful preoperative evaluation, as thrombus presence has significant implications for procedural safety. Transesophageal echocardiography should be an essential part of the risk stratification process before percutaneous trans-mitral commissurotomy to optimize patient outcomes.

Keywords: Echocardiography, Heart Valve Diseases, Mitral Stenosis, Percutaneous Mitral Commissurotomy, Rheumatic Heart Disease, Sinus Rhythm, Thrombus.

INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INTRODUCTION

Rheumatic heart disease (RHD) has witnessed a significant decline in prevalence, incidence, and associated mortality in high-income countries over the past few decades. This reduction can largely be attributed to improved living standards and the widespread use of benzathine penicillin G for the treatment and prevention of rheumatic fever (RF) (1). Despite a 47.8% decrease in age-standardized global mortality from RHD between 1990 and 2015 (2), the disease continues to impose a substantial burden on low- and middle-income countries (LMICs), where poor living conditions, inadequate sanitation, overcrowding, and limited healthcare infrastructure contribute to its persistence (3,4). Among the various complications of RHD, left atrial thrombus formation remains a critical concern, particularly in patients with mitral stenosis. Mitral stenosis can lead to progressive left atrial enlargement, predisposing patients to thrombus formation, which may result in embolization and subsequent complications. While atrial fibrillation is a well-established risk factor for left atrial thrombus, its occurrence has also been reported in patients with mitral stenosis who maintain sinus rhythm. Various studies have estimated the frequency of left atrial thrombi in such patients to range from 20% to 33%, with factors such as the severity of mitral stenosis and the presence of atrial fibrillation playing pivotal roles in thrombus development (5). Approximately one in five patients with mitral stenosis is found to have a left atrial thrombus, a finding with significant therapeutic and prognostic implications. Thrombi are most commonly located in the left atrial appendage but can extend into the left atrial cavity (6).

Existing literature provides variable estimates regarding the frequency of left atrial thrombus in patients with mitral stenosis and sinus rhythm. A study conducted at the National Institute of Cardiovascular Diseases (NICVD) in 2019 reported a 25% frequency of left atrial thrombus in patients with mitral valve stenosis (6). Another study found this frequency to be 16.66% (9 out of 54 patients) (7), while research by Gill et al. reported a lower frequency of 8.4% (8). The wide variation in reported frequencies underscores the need for further investigation to refine risk assessment and guide clinical decision-making (8). Despite the increasing focus on left atrial thrombus in patients with mitral stenosis, most available studies have primarily examined its occurrence in individuals with atrial fibrillation or other associated thromboembolic risk factors. There is a relative paucity of data specifically addressing the frequency of left atrial thrombus in patients with mitral stenosis who maintain sinus rhythm (9). Given the clinical significance of this condition, further research is warranted to assess the actual burden of left atrial thrombus in this subset of patients. The findings of this study will contribute to the preoperative risk stratification of patients scheduled for percutaneous trans-mitral commissurotomy and may help in devising preventive strategies to mitigate the risk of thromboembolic complications. Thus, the objective of this study is to determine the frequency of left atrial thrombus in patients with mitral stenosis and sinus rhythm undergoing transesophageal echocardiography prior to percutaneous trans-mitral commissurotomy (10,11).

METHODS

A cross-sectional study was conducted at the Department of Cardiology, National Institute of Cardiovascular Diseases (NICVD), Karachi, over a six-month period following approval from the College of Physicians and Surgeons Pakistan (CPSP). Ethical approval was obtained from the Research Evaluation Unit, CPSP (Ref No: CPSP/REU/CRD-2022-195-2762, dated June 24, 2024). The study aimed to determine the frequency of left atrial thrombus in patients with mitral stenosis and sinus rhythm undergoing transesophageal echocardiography (TEE) before percutaneous trans-septal mitral commissurotomy (PTMC) (12). The sample size was calculated using the WHO sample size calculator, based on a reported frequency of left atrial thrombus in patients with mitral stenosis and sinus rhythm as 8.4% (8), with a 4% margin of error and a 95% confidence level, yielding a required sample size of 185 participants. A consecutive sampling technique was employed to enroll eligible patients. Inclusion criteria consisted of patients aged 18 to 70 years of either gender, diagnosed with mitral stenosis as per the operational definition, confirmed to have sinus rhythm on a 12-lead electrocardiogram (ECG), and scheduled for TEE before PTMC. Patients were excluded if they had an ejection fraction below 30%, were pregnant, or had a known history of renal failure, chronic liver disease, malignancy, or cardiogenic shock. The original exclusion criterion of acute pulmonary edema was reconsidered, as it may introduce selection bias by omitting patients with more advanced disease who are at a higher risk for left atrial thrombus. Instead of outright exclusion, these patients were included with specific sub-stratification to ensure a more comprehensive risk assessment (13).

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Informed written consent was obtained from all participants before enrollment. Baseline demographic and clinical data were systematically recorded using a predesigned proforma. A 12-lead ECG was performed to confirm sinus rhythm, followed by TEE to evaluate the presence of left atrial thrombus. The thrombus was diagnosed based on the presence of spontaneous echo contrast, characterized by dynamic, smoke-like swirling echoes in the left atrial cavity and appendage, distinct from white noise artifacts after appropriate gain adjustment. Additional study variables such as age, gender, residence, duration of mitral stenosis, diabetes mellitus, hypertension, and smoking status were also documented (14). Statistical analysis was performed using SPSS version 26. Quantitative variables, including age and duration of mitral stenosis, were assessed for normality using the Shapiro-Wilk test and reported as mean ± standard deviation or median with interquartile range (IQR), depending on data distribution. Qualitative variables, such as gender, residence, diabetes, hypertension, smoking status, and presence of left atrial thrombus, were presented as frequencies and percentages. To control potential confounders, stratification was applied for age, gender, residence, duration of mitral stenosis, diabetes, hypertension, and smoking. Post-stratification analysis was conducted using the chi-square test or Fisher's exact test, with a p-value ≤ 0.05 considered statistically significant (15).

RESULTS

The study included a total of 185 patients diagnosed with mitral stenosis and sinus rhythm. The mean age of the participants was 45.0 ± 10.1 years. Males constituted the majority of the sample, comprising 58.4% (108/185) of the patients, while females accounted for 41.6% (77/185). In terms of residential distribution, 58.9% (109/185) of patients were from urban areas, whereas 41.1% (76/185) resided in rural regions. Comorbidities were prevalent among the study population, with 28.1% (52/185) of the patients diagnosed with diabetes mellitus and 51.4% (95/185) having hypertension. Smoking history was present in 28.1% (52/185) of patients, while the remaining 71.9% (133/185) were non-smokers. The mean duration of mitral stenosis was recorded at 73.0 ± 23.7 months, indicating chronic progression of the disease in most patients.

The presence of left atrial thrombus was identified in 11.4% (21/185) of the patients, whereas the remaining 88.6% (164/185) showed no thrombus formation on transesophageal echocardiography. The findings highlight a considerable burden of comorbid conditions and chronic disease duration among patients undergoing assessment for percutaneous trans-mitral commissurotomy. Although left atrial thrombus was detected in a minority of cases, its presence remains clinically significant, warranting preoperative risk assessment and individualized management strategies.

Table 1 Age Statistics

Variable	Mean	Standard Deviation
Age (Years)	45.0	10.1

Table 2 Frequency and Percentage of Categorical Variables

Variable		Value
Gender	Female	77 (41.6%)
	Male	108 (58.4%)
Residence	Rural	76 (41.1%)
	Urban	109 (58.9%)
Diabetes	No	133 (71.9%)
	Yes	52 (28.1%)
Hypertension	No	90 (48.6%)

Variable		Value
	Yes	95 (51.4%)
Smoking	No	133 (71.9%)
	Yes	52 (28.1%)

Table 3 Frequency and Percentage of LAT

Variable		Value
Left Atrial Thrombus	No	164 (88.6%)
	Yes	21 (11.4%)

Table 4 Duration of Mitral Stenosis Statistics

Variable	Mean	Standard Deviation
Duration of Mitral Stenosis (Months)	73.0	23.7

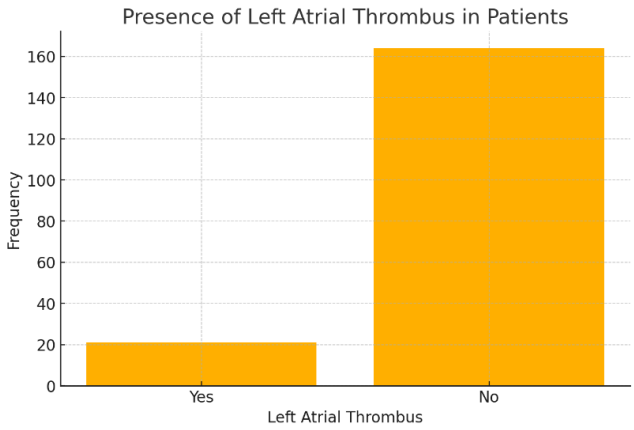

Figure 1 Presence of Left Atrial Thrombus in Patients

DISCUSSION

The findings of this study contribute to the growing body of literature on the burden of left atrial thrombus in patients with mitral stenosis and sinus rhythm, a subgroup that has been relatively underexplored. The presence of left atrial thrombus in 11.4% of the study population aligns with previous reports, where thrombus prevalence in similar patients has varied between 8.4% and 16.6%. The wide variation in reported frequencies across different studies highlights the influence of factors such as echocardiographic assessment techniques, population characteristics, and the severity of underlying disease. Unlike studies focusing on patients with atrial fibrillation, this research specifically evaluated thrombus occurrence in sinus rhythm patients, emphasizing the importance of left atrial hemodynamics in thrombus formation beyond the classical arrhythmic predisposition (16,17). This trend is consistent with patterns observed in low- and middle-income countries, where limited access to healthcare and delayed intervention contribute to progressive valvular deterioration. The mean disease duration of 73.0 ± 23.7 months further supports the notion that a significant number of patients remain undiagnosed or untreated for prolonged periods, increasing the likelihood of left atrial thrombus formation and subsequent thromboembolic events (18,19).

The association of mitral stenosis with comorbid conditions was evident, with hypertension present in 51.4% of the participants and diabetes mellitus affecting 28.1%. These conditions may contribute to adverse cardiovascular remodeling and endothelial dysfunction, further exacerbating thrombotic risk. While smoking was reported in 28.1% of patients, its role in thrombus formation remains complex and multifactorial, involving pro-inflammatory pathways and endothelial injury. These findings suggest that a more comprehensive risk stratification model incorporating metabolic and lifestyle factors may be necessary when evaluating thromboembolic risk in mitral stenosis (20,21). One of the strengths of this study lies in its focus on a relatively understudied population of patients with mitral stenosis and sinus rhythm. Most available research has predominantly examined thrombus formation in those with atrial fibrillation, often overlooking the role of left atrial stasis in structurally abnormal yet rhythmically preserved hearts. The use of transesophageal

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

echocardiography provided a more definitive evaluation of left atrial thrombus, minimizing diagnostic uncertainty compared to transthoracic echocardiography (22,23).

Despite these strengths, certain limitations must be acknowledged. The single-center nature of the study restricts the generalizability of the findings, as institutional referral patterns and patient demographics may not fully represent the broader population. Additionally, while the study controlled for key clinical variables, potential confounding factors such as anticoagulation history, left atrial strain analysis, and inflammatory biomarkers were not assessed. The exclusion of patients with severe heart failure, cardiogenic shock, or advanced comorbidities may have underestimated the true burden of left atrial thrombus, as such individuals often represent the highest-risk group (24). Future research should aim to incorporate larger, multicenter cohorts with longitudinal follow-up to determine the impact of left atrial thrombus on long-term clinical outcomes, including stroke risk and post-procedural embolic events. Further studies evaluating the role of advanced echocardiographic techniques, such as left atrial strain imaging and three-dimensional reconstruction, may provide deeper insights into the pathophysiological mechanisms underlying thrombus formation in sinus rhythm patients with mitral stenosis. Additionally, exploring the effectiveness of targeted anticoagulation strategies in this subgroup could aid in refining therapeutic guidelines and optimizing pre-procedural management (12,21).

The findings of this study reinforce the necessity of comprehensive preoperative evaluation in patients with mitral stenosis undergoing percutaneous trans-mitral commissurotomy. Although left atrial thrombus remains more commonly associated with atrial fibrillation, its presence in sinus rhythm patients cannot be overlooked. A tailored risk assessment approach integrating clinical, echocardiographic, and metabolic factors may improve patient selection for intervention and reduce the incidence of thromboembolic complications.

CONCLUSION

This study highlights the presence of left atrial thrombus in patients with mitral stenosis and sinus rhythm, emphasizing its clinical relevance in preoperative risk assessment. The findings reinforce that thrombus formation is not solely confined to patients with atrial fibrillation but can also occur in structurally compromised yet rhythmically stable hearts. The significant proportion of patients presenting with advanced mitral stenosis and associated comorbidities underscores the need for early detection and comprehensive management strategies. Incorporating thorough echocardiographic evaluation, particularly transesophageal echocardiography, remains crucial in identifying thrombus and mitigating potential thromboembolic complications. These insights contribute to refining patient selection and optimizing procedural outcomes in those undergoing percutaneous trans-mitral commissurotomy, ultimately enhancing the safety and efficacy of intervention strategies in clinical practice.

Author Contribution

Author	Contribution
Jibran Ul Haq*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Ehtisham Ul Haq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Amin Ullah	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Younis	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Aisha Hussain	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Tahir Saghir	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Mahin Saif	Contributed to study concept and Data collection Has given Final Approval of the version to be published

REFERENCES

1. Turi ZG. The 40th anniversary of percutaneous balloon valvuloplasty for mitral stenosis: current status. Structural Heart. 2022;6(5):100087.

2. Ito T, Suwa M. Assessment of left atrial appendage function by echocardiography. Heart Failure Reviews. 2023;28(5):1177-87.

3. Mutagaywa RK, Cramer MJ, Chillo P, Barongo A, Kifai E, Chamuleau S, et al. Characteristics and immediate outcomes of patients who underwent percutaneous balloon mitral valvuloplasty at the Jakaya Kikwete Cardiac Institute, Tanzania. Cardiovascular Journal of Africa. 2024;35(1):16-26.

4. Ali SN, Akram M, Zareef A. Comparison of Frequencies of Left Atrial Thrombus in Patients of Severe Mitral Stenosis with and Without Atrial Fibrillation Undergoing Transesophageal Echocardiography for Percutaneous Transv-septal Mitral Commissurotomy. Pak J Med Health Sci. 2015;9(4):1166-69.

5. Malik M, Maqbool M, Nisar T, Akhter T, Ujan JA, Algarni AS, Al Joufi FA, Alanazi SS, Almotared MH, Bekhit MM, Jamil M. Deciphering key genes involved in cisplatin resistance in kidney renal clear cell carcinoma through a combined in silico and in vitro approach. Oncology Research. 2023 Sep 15;31(6):899–916. doi: 10.32604/or.2023.030760

6. Burkule NJ, Bansal M, Govind SC, Alagesan R, Ponde CK, Parashar SK. Corrected and Republished: Indian Academy of Echocardiography Guidelines for Performance of Transesophageal Echocardiography in Adults. Journal of The Indian Academy of Echocardiography & Cardiovascular Imaging. 2022;6(3):255-92.

7. Dwigustiningrum NK, Rahimah AF, Karolina W, Martini H. Echocardiography Features in Patient Rheumatic Mitral Stenosis. Heart Science Journal. 2024;5(2):23-30.

8. Wahab MA, ur Rahman SK, Ghaffori ZAF, Shafiq U. Effect of Percutaneous Transvenous Mitral Commissurotomy on Right Ventricular Function: A Quasi-Experimental Study. Pakistan Heart Journal. 2024;57(3):225-30.

9. Gill BUA, Abbas T, Haq RU, Qureshi BA, Hashmi KA, Ahmed I, et al. Frequency of left atrial thrombus in patients of mitral stenosis suitable for percutaneous trans-septal mitral commissurotomy. Pakistan Heart Journal. 2015;48(1).

10. Ahmed K, Rehman Memon A, Liaquat H, Sr., Mujtaba M, Parkash C, Sultan FAT, et al. The Frequency of Left Atrial Thrombus on Transthoracic Echocardiogram in Patients with Mitral Stenosis. Cureus. 2020;12(3):e7453.

11. Mamo M, Woldeyes E, Zegeye S, Feleke S, Melaku EE. Immediate and short-term outcomes of percutaneous balloon mitral commissurotomy for severe mitral stenosis at a Resource Limited Setting, Addis Ababa, Ethiopia. Progress in Pediatric Cardiology. 2024;75:101754.

12. Burkule NJ, Bansal M, Govind SC, Alagesan R, Ponde CK, Parashar SK. Indian academy of echocardiography guidelines for performance of transesophageal echocardiography in adults. Journal of The Indian Academy of Echocardiography & Cardiovascular Imaging. 2021;5(2):89-126.

13. Ohte N, Ishizu T, Izumi C, Itoh H, Iwanaga S, Okura H, et al. JCS 2021 guideline on the clinical application of echocardiography. Circulation Journal. 2022;86(12):2045-119.

14. Sharma P, Garg S, Malani SK. Left atrial strain predicts improvement in left atrial functions of severe rheumatic mitral stenoses undergoing successful percutaneous transmitral commissurotomy. Echocardiography. 2023;40(7):642-6.

15. Galusko V, Ionescu A, Edwards A, Sekar B, Wong K, Patel K, et al. Management of mitral stenosis: a systematic review of clinical practice guidelines and recommendations. European Heart Journal-Quality of Care and Clinical Outcomes. 2022;8(6):602-18.

16. Cupido B, Zühlke L, Osman A, van Dyk D, Sliwa K. Managing rheumatic heart disease in pregnancy: a practical evidence-based multidisciplinary approach. Canadian Journal of Cardiology. 2021;37(12):2045-55.

17. Toufan Tabrizi M, Faraji Azad H, Khezerlouy-Aghdam N, Sakha H. Measurement of mitral valve area by direct three dimensional planimetry compared to multiplanar reconstruction in patients with rheumatic mitral stenosis. The International Journal of Cardiovascular Imaging. 2022;38(6):1341-9.

18. Dadjo Y, Moshkani Farahani M, Nowshad R, Sadeghi Ghahrodi M, Moaref A, Kojuri J. Mid-term (up to 12 years) clinical and echocardiographic outcomes of percutaneous transvenous mitral commissurotomy in patients with rheumatic mitral stenosis. BMC Cardiovascular Disorders. 2021;21:1-10.

19. Namasivayam M, Cigarroa RJ, Inglessis I, Hung JW. Mitral and Tricuspid Valve Disease. MGH Cardiology Board Review. 2021:439-66.

20. Khan B, Awan R, Hussain S, Saghir T, Paracha Y. Percutaneous Transmitral Commissurotomy-Clinical and Echocardiographic Follow-up in Severe Mitral Stenosis. Pakistan Heart Journal. 2023;56(1):72-6.

21. Durrani T, Nasir H, Asma S, Hussain I, Gul S, Aziz S. Procedural success and immediate post. 2023.

22. Parikh R, Singh G, Mishra A, Sharma K. Re-intervention percutaneous balloon mitral valvuloplasty in a patient with left atrial appendage thrombus: a case report. European Heart Journal-Case Reports. 2022;6(10):ytac374.

23. Napoli F, Vella C, Ferri L, Ancona MB, Bellini B, Russo F, et al. Rheumatic and Degenerative Mitral Stenosis: From an Iconic Clinical Case to the Literature Review. Journal of Cardiovascular Development and Disease. 2024;11(5):153.

24. Sarkar B, Mondal M, Bagchi PC, Bar M. Study of Left Atrial Function in Mitral Stenosis by Tissue Doppler and Strain Imaging Before and After Balloon Mitral Valvotomy. European Journal of Cardiovascular Medicine. 2023;13(2).

