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FREQUENCY OF LEFT ATRIAL THROMBUS IN PATIENTS WITH MITRAL STENOSIS

Original Research

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ABSTRACT

Background: Mitral stenosis is a progressive valvular disorder commonly associated with rheumatic heart disease, particularly in low- and middle-income regions. Left atrial (LA) thrombus is a serious complication of mitral stenosis, increasing the risk of thromboembolic events such as stroke. While echocardiography remains the cornerstone of diagnosis, the prevalence and clinical associations of LA thrombus remain underexplored in regional populations, necessitating focused investigations to guide risk assessment and therapeutic strategies.

Objective: To determine the frequency of left atrial thrombus in patients diagnosed with mitral stenosis and assess its association with comorbid conditions.

Methods: A cross-sectional study was conducted at the Department of Cardiology, Mardan Medical Complex, from April to October 2024. One hundred patients aged 18–70 years with echocardiographically confirmed mitral stenosis (mitral valve area <1.5 cm²) were included using purposive sampling. Patients with mitral regurgitation, aortic valve disease, prior mitral interventions, or on anticoagulation therapy were excluded. LA thrombus was diagnosed through transthoracic echocardiography by detecting spontaneous echo contrast with dynamic, smoke-like patterns in the LA cavity and appendage. Data were analyzed using SPSS v21. Associations with comorbidities were assessed using chi-square and Fisher's exact tests.

Results: Among 100 patients, 49 (49.0%) were male and 51 (51.0%) female, with a mean age of 43.7±13.4 years and mean BMI of 25.9±2.3 kg/m². LA thrombus was identified in 19 (19.0%) patients. Significant associations were observed with diabetes (63.2% vs. 14.8%, p<0.001), hypertension (78.9% vs. 7.4%, p<0.001), and smoking (73.7% vs. 11.1%, p<0.001). Thrombus was more frequent in patients with BMI 25–29.9 kg/m² (68.4%).

Conclusion: LA thrombus was prevalent in nearly one-fifth of mitral stenosis patients, particularly among those with metabolic and lifestyle-related comorbidities. Routine echocardiographic screening and integrated management of modifiable risk factors are essential to reduce thromboembolic complications.

Keywords: Comorbidity, Echocardiography, Hypertension, Left atrial thrombus, Mitral stenosis, Smoking, Thromboembolism.

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INTRODUCTION

Mitral stenosis is a progressive valvular heart disease predominantly caused by rheumatic heart disease, particularly in low- and middle-income countries, despite significant advancements in medical care (1). It typically presents 10 to 15 years after an episode of rheumatic fever and is most commonly diagnosed in individuals between 20 and 40 years of age. In contrast, degenerative calcific mitral stenosis, though less prevalent, is more often observed in elderly patients (1,2). The clinical spectrum of mitral stenosis includes left atrial (LA) enlargement, atrial fibrillation, and symptoms of congestive heart failure. Additionally, the risk of systemic thromboembolism remains a major concern in these patients (3). One of the most serious complications associated with mitral stenosis is the development of thrombus in the left atrium, primarily attributed to blood stasis and atrial dysfunction (4). The left atrial appendage, due to its narrow anatomy and propensity for turbulent flow, is the most common site for thrombus formation, while thrombi outside this region are rarely observed (5,6). Multiple factors have been associated with LA thrombus development, including the severity and duration of mitral stenosis, age, left atrial size, and reduced cardiac output (7,8). In fact, studies have reported the incidence of LA thrombus to be as high as 25% among patients with mitral stenosis (9). This poses a significant risk of embolic complications such as stroke, which can result in considerable morbidity and mortality if not promptly identified and managed.

Though contrast-enhanced magnetic resonance imaging (MRI) offers high sensitivity and specificity for detecting LA thrombus, it remains less accessible compared to echocardiographic modalities. Transthoracic echocardiography (TTE) is widely used as a non-invasive diagnostic tool; however, its ability to detect thrombi, particularly in the LA appendage, can be limited. In contrast, transesophageal echocardiography (TEE) has demonstrated superior sensitivity and accuracy for this purpose, and is thus regarded as the imaging modality of choice in such clinical scenarios (10,11). Despite the clinical importance of detecting LA thrombus in mitral stenosis and the implications for anticoagulation management, there is a notable absence of data at the regional level. This gap in knowledge highlights the need for population-specific research to understand the prevalence and associated risk factors of LA thrombus in mitral stenosis. Therefore, the objective of the present study is to evaluate the prevalence of left atrial thrombus in patients with mitral stenosis, thereby contributing to evidence-based risk stratification and emphasizing the critical role of anticoagulant therapy in reducing embolic complications.

METHODS

A cross-sectional study was conducted at the Department of Cardiology, Mardan Medical Complex, Mardan, from April 27, 2024, to October 27, 2024, following approval from the Institutional Review Board (IRB) under approval number 423/BKMC, dated November 30, 2023. The study was designed to assess the prevalence of left atrial (LA) thrombus in patients diagnosed with mitral stenosis. A sample size of 100 participants was calculated using the World Health Organization (WHO) sample size calculator, based on an anticipated 25% prevalence of LA thrombus in patients with mitral stenosis (9), an absolute precision of 8.5%, and a 95% confidence level. Participants were recruited using non-probability purposive sampling. The inclusion criteria comprised adult patients aged between 18 and 70 years with a confirmed diagnosis of mitral stenosis, defined by a mitral valve area (MVA) of less than 1.5 cm^2 as determined by echocardiography. Patients were excluded if they had coexisting aortic valve disease, mitral regurgitation, a prior history of closed mitral valvotomy, or were receiving any form of antiplatelet or anticoagulation therapy at the time of enrollment.

Informed written consent was obtained from all participants. Data collection involved the use of a structured and pre-tested proforma to document demographic information such as age, gender, address, occupation, socioeconomic status, and area of residence. Medical history including hypertension, diabetes mellitus, and smoking status was also recorded. Diagnosis of LA thrombus was based on echocardiographic findings, specifically the detection of spontaneous echo contrast—defined as dynamic, smoke-like echoes within the LA cavity and appendage—while ensuring appropriate gain settings to eliminate artifact interference. All echocardiographic assessments were performed under the supervision of a consultant cardiologist with a minimum of five years of post-fellowship experience in echocardiography. The collected data were analyzed using SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Numerical variables such as age, weight, height, and body mass index (BMI) were reported as means with standard deviations. Categorical variables, including gender, presence of LA thrombus, occupation, socioeconomic status, area of residence, and presence of comorbidities, were

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expressed as frequencies and percentages. Stratification was applied to account for potential confounding variables such as age, gender, BMI, socioeconomic status, occupation, comorbid conditions, and smoking. Post-stratification analysis was conducted using the chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant. Results were presented in tables and charts for enhanced clarity and interpretability.

RESULTS

The study included 100 patients diagnosed with mitral stenosis, with a mean age of 43.7 ± 13.4 years and a mean body mass index (BMI) of 25.9 ± 2.3 kg/m². Age-wise distribution revealed that 35.0% of participants were aged 18–35 years, 31.0% were 36–50 years, and 34.0% belonged to the 51–70-year age group. The gender distribution was nearly equal, with 49.0% males and 51.0% females. Regarding residential status, 57.0% of individuals were from rural areas, and 43.0% resided in urban settings. Occupational data showed that 57.0% were unemployed, while 43.0% were employed. Socioeconomic classification identified 53.0% as middle-class, 34.0% as lower-class, and 13.0% as upper-class. Comorbid conditions were observed in a significant proportion of the cohort. Diabetes mellitus was present in 24.0% of patients, hypertension in 21.0%, and a history of smoking in 23.0%. Left atrial thrombus was detected in 19.0% of the patients, whereas 81.0% had no evidence of thrombus on echocardiographic evaluation. Stratification analysis revealed strong associations between thrombus presence and the presence of comorbidities. Among those with thrombus, 63.2% had diabetes, 78.9% had hypertension, and 73.7% reported a history of smoking. In contrast, the corresponding proportions in the non-thrombus group were 14.8% for diabetes, 7.4% for hypertension, and 11.1% for smoking, all yielding statistically significant p-values ($p < 0.001$). BMI-based stratification showed that the majority of thrombus-positive cases (68.4%) had a BMI within the 25–29.9 kg/m² range, while thrombus-negative cases were more frequently observed in individuals with a BMI <24.9 kg/m² (50.6%). This difference was also statistically significant ($p = 0.04$). No significant associations were observed between thrombus formation and variables such as age, gender, occupation, socioeconomic status, or area of residence ($p > 0.05$).

Table 1. Demographic data of the study population at baseline

Demographic characteristics		Frequency	Percentage
Gender	Male	49	49.0%
	Female	51	51.0%
Occupation status	Employed	43	43.0%
	Unemployed	57	57.0%
Socioeconomic background	Upper-Class	13	13.0%
	Middle-Class	53	53.0%
	Lower Class	34	34.0%
Residence area	Urban	43	43.0%
	Rural	57	57.0%

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Table 2. Prevalence of comorbidities in the study population

Comorbidities		Frequency	Percentage
Diabetes	Yes	24	24.0%
	No	76	76.0%
Hypertension	Yes	21	21.0%
	No	79	79.0%
Smoking	Yes	23	23.0%
	No	77	77.0%

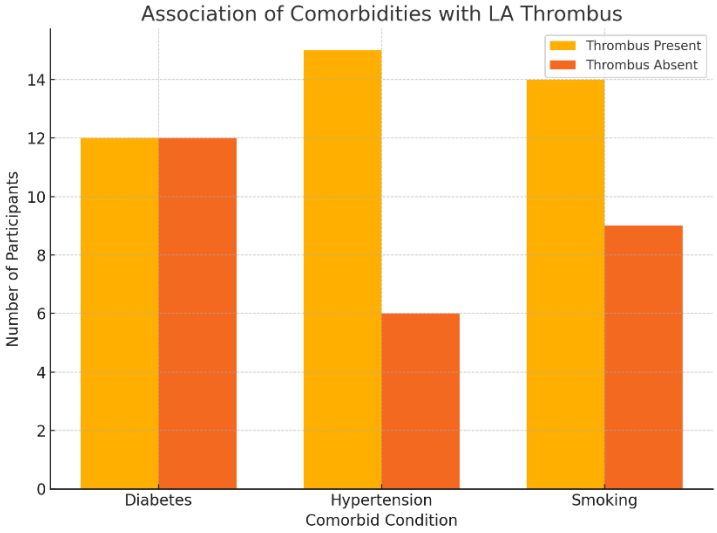
Table 3. Frequency of left atrial thrombus

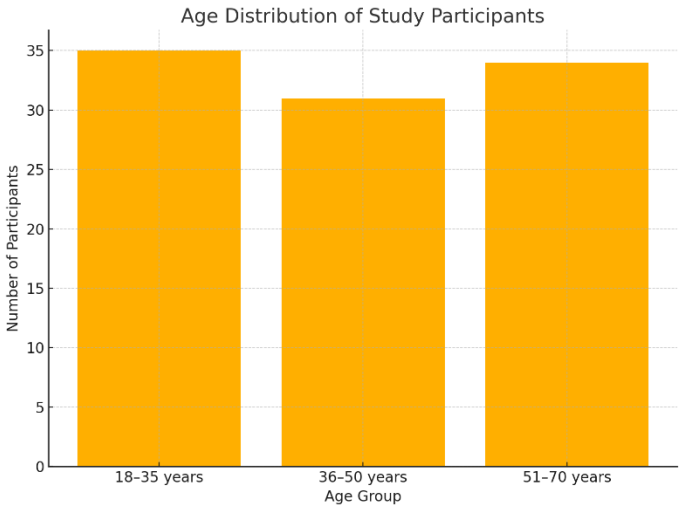
LA thrombus	Frequency	Percent
Yes	19	19.0
No	81	81.0
Total	100	100.0

Table 4. Stratification of left atrial thrombus with comorbidities and BMI

Comorbidities and BMI		LA thrombus				P value
		Yes		No		
		N	%	N	%	
Diabetes	Yes	12	63.2%	12	14.8%	0.0001
	No	7	36.8%	69	85.2%	
Hypertension	Yes	15	78.9%	6	7.4%	0.0001
	No	4	21.1%	75	92.6%	
Smoking	Yes	14	73.7%	9	11.1%	0.0001
	No	5	26.3%	72	88.9%	
BMI (Kg/m2)	18 to 24.9	4	21.1%	41	50.6%	0.04
	25 to 29.9	13	68.4%	37	45.7%	
	> 29.9	2	10.5%	3	3.7%	

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DISCUSSION

Among the 100 patients enrolled in this study, the mean age was 43.7 ± 13.4 years, with a nearly equal gender distribution, reflecting a younger and more balanced cohort compared to earlier reports from other regions. One study with a similar gender composition reported slightly more females than males (53.5% vs. 46.5%), aligning closely with the present findings (12). In contrast, another investigation demonstrated a notably older population with a higher female predominance, likely reflecting differences in demographic profiles and the epidemiology of rheumatic heart disease across geographic settings (13). The younger age group observed in the current study may be attributable to earlier exposure to rheumatic fever and limited access to early preventive interventions in certain low- to middle-income regions. The prevalence of left atrial (LA) thrombus in this study was 19%, which falls between the previously reported rates of 8.4% and 25% (14). The lower thrombus frequency observed in some studies could be explained by the inclusion of patients in sinus rhythm or those with milder forms of mitral stenosis (15). Conversely, studies reporting higher prevalence often focused on patients with severe disease, defined by a mitral valve area (MVA) less than 1.0 cm^2, a variable not assessed in this analysis (15,16).

The findings provided strong evidence linking LA thrombus to systemic comorbidities. Diabetes, hypertension, and smoking showed highly significant associations with thrombus presence, underscoring the interplay between metabolic, vascular, and inflammatory pathways in thrombogenesis. The mean BMI of 25.9 ± 2.3 kg/m^2, coupled with the highest thrombus frequency among overweight individuals (BMI 25–29.9 kg/m^2), further supports a possible role of metabolic dysfunction in the pathophysiology of LA thrombus (17). While prior studies have predominantly focused on LA size and rhythm abnormalities as predictors of thrombus (18), the current data suggest that BMI and associated metabolic disturbances could serve as supplementary or alternative markers of thrombotic risk. This warrants more comprehensive future investigations, integrating both structural and systemic parameters for improved risk stratification.

One significant limitation of this study was the unavailability of echocardiographic details such as LA diameter, LA appendage morphology, MVA grading, and flow velocities, all of which are essential for precise thrombus risk modeling. Additionally, the study excluded patients on anticoagulant therapy to avoid confounding, which may have inadvertently led to an underestimation of the real-world thrombus burden in patients with mitral stenosis (19). Moreover, the lack of documentation regarding anticoagulation status limits insight into treatment adequacy and therapeutic impact on thrombus prevention. These methodological gaps, while intentional for internal validity, restrict generalizability and external applicability of the findings. Nevertheless, the study holds several strengths. It offers valuable insight into a younger demographic often underrepresented in mitral stenosis literature and highlights the significance of systemic comorbidities as modifiable risk factors. The robust statistical associations presented reinforce the need for comprehensive cardiovascular risk management beyond conventional structural cardiac monitoring (20). The study also establishes a foundational prevalence estimate for LA thrombus in the regional context, a contribution previously absent in local data. Future research should aim to integrate detailed echocardiographic assessment, rhythm analysis, and therapeutic profiles including anticoagulation adherence.

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Combining systemic, structural, and treatment-related variables will enable the development of refined, patient-specific models for thrombus risk prediction and guide targeted interventions to prevent thromboembolic complications in mitral stenosis.

CONCLUSION

This study concludes that left atrial thrombus is a notable complication among patients with mitral stenosis, with strong associations observed between thrombus formation and the presence of common comorbid conditions such as diabetes, hypertension, and smoking. These findings emphasize the importance of a holistic clinical approach that not only addresses valvular pathology but also incorporates aggressive management of metabolic risk factors. Incorporating routine transesophageal echocardiography for early detection, alongside ensuring adequate anticoagulation, can play a critical role in mitigating the risk of thromboembolic events in vulnerable patient populations.

Author Contributions

Author	Contribution
Ayesha*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Noor Ul Hadi	Substantial Contribution to study design, Critical Input Critical Review and Manuscript Writing Has given Final Approval of the version to be published

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