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FREQUENCY OF LEFT VENTRICULAR THROMBUS FORMATION AFTER ACUTE ST ELEVATION MYOCARDIAL INFARCTION

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ABSTRACT

Background: Acute Myocardial Infarction (AMI) remains a leading cause of mortality worldwide. Among its complications, Left Ventricular Thrombus (LVT) is clinically significant due to its association with systemic embolization and stroke. Despite advances in reperfusion strategies, LVT continues to occur, particularly following ST-Segment Elevation Myocardial Infarction.

Objective: To determine the frequency of left ventricular thrombus after acute ST segment elevation myocardial infarction.

Methodology: This cross-sectional study was conducted in the Department of Cardiology, Punjab Institute of Cardiology, Lahore, from 18th June 2025 to 17th October 2025. A total of 200 patients aged 30–70 years with acute anterior wall STEMI were enrolled using non-probability consecutive sampling. LVT was assessed using transthoracic echocardiography on the 5th day of admission. Data regarding demographic and clinical variables were recorded and analyzed using SPSS version 26.

Results: The mean age of patients was 54.2 ± 9.8 years, with male predominance (68%). LVT was detected in 54 patients (27%), consistent with previously reported frequencies. A significantly higher frequency of LVT was observed in patients with anterior wall MI, diabetes mellitus, and reduced left ventricular function ($p \leq 0.05$). Smoking and hypertension were also associated with increased risk, though not statistically significant.

Conclusion: LVT remains a frequent complication after acute anterior wall STEMI despite contemporary management. Early echocardiographic screening is essential for timely diagnosis and prevention of thromboembolic complications such as stroke.

KEYWORDS: Acute Myocardial Infarction, STEMI, Left Ventricular Thrombus, Echocardiography, Cardiology, Stroke Risk

INTRODUCTION

Acute Myocardial Infarction (AMI) remains one of the leading causes of mortality worldwide and a major contributor to morbidity among hospitalized patients. The overall mortality rate, including patients who die before reaching the hospital or during treatment, exceeds 30% (1). However, over the past three decades, significant advancements in management strategies—such as the establishment of coronary care units, use of fibrinolytic therapy, and catheter-

based reperfusion—have markedly reduced morbidity and mortality. Despite these improvements, the burden of AMI in developing countries continues to rise, approaching levels seen in developed nations (1,2).
According to the universal definition proposed by Thygesen et al., AMI is diagnosed by a rise and/or fall in cardiac biomarkers, particularly cardiac troponins, with at least one value above the 99th percentile of the upper reference limit, along with evidence of myocardial ischemia (3). This evidence may include ischemic symptoms, new electrocardiographic changes, development of pathological Q waves, or imaging evidence of myocardial injury (3). Among available biomarkers, Troponin-T and Creatine Kinase-MB remain widely used for diagnosis, with rapid bedside testing further facilitating early detection (2,3).
The underlying pathophysiology of AMI involves rupture or erosion of an atherosclerotic plaque, leading to platelet activation, thrombin generation, and eventual thrombus formation within the coronary artery (2,5). In the absence of adequate collateral circulation, complete occlusion of the coronary artery results in ST-Segment Elevation Myocardial Infarction (2,8,9).
A significant complication of AMI is Left Ventricular Thrombus (LVT), particularly in patients with anterior wall infarction. Previous studies have reported an incidence ranging from 20% to 40%, with rates as high as 50–60% in large anterior wall infarctions, while the incidence in non-anterior MI is considerably lower (approximately 5%) (6,10). The formation of LVT is explained by Virchow's Triad, which includes blood stasis, endothelial injury, and a hypercoagulable state (6,10). LVT typically develops within the first one to two weeks following AMI (6,10).
The clinical importance of LVT lies in its potential to cause systemic embolization, particularly ischemic stroke, leading to significant morbidity and mortality (10,11). A local study by Iqbal MW reported a frequency of 28% for LVT following acute STEMI, highlighting its continued relevance in clinical practice (7).
Therefore, this study aims to evaluate the frequency of left ventricular thrombus formation in patients with acute anterior wall STEMI and to emphasize the importance of early detection using echocardiography. Early identification can facilitate timely initiation of anticoagulation therapy, thereby reducing the risk of life-threatening complications such as systemic embolism and stroke (8,10,11).

OBJECTIVE

To determine the frequency of left ventricular thrombus after acute ST segment elevation myocardial infarction.

METHODOLOGY

This cross-sectional study was conducted at the Department of Cardiology, Punjab Institute of Cardiology, Lahore, from 18th June 2025 to 17th October 2025. A total of 200 patients were enrolled using non-probability consecutive sampling. Patients aged 30–70 years with acute anterior wall ST-segment elevation myocardial infarction were included. The sample size was calculated using a 95% confidence level, 6.5% margin of error, and an expected frequency of 28%. Demographic and clinical data were recorded using a structured proforma. Transthoracic echocardiography was performed by an experienced cardiologist to assess left ventricular function and detect thrombus formation under standardized conditions.

Inclusion Criteria

Patients aged between 30 and 70 years, belonging to both male and female genders. Patients were diagnosed with acute anterior wall ST-segment elevation myocardial infarction based on clinical presentation, electrocardiographic changes, and relevant cardiac biomarkers were included.

Exclusion Criteria

Patients with a history of previous inferior wall myocardial infarction, cardiomyopathy, or valvular heart disease. Additionally, patients diagnosed with myocarditis or pericarditis, chronic kidney disease with serum creatinine levels ≥2 mg/dl, and chronic liver disease were excluded.

Data Collection Procedure

After obtaining ethical approval from the institutional review committee, eligible patients were enrolled in the study after taking informed written consent. A detailed clinical history was obtained, and diagnosis of ST-segment elevation myocardial infarction was confirmed through electrocardiographic (ECG) findings and cardiac biomarkers, particularly Troponin-T levels. All patients were managed according to standard treatment protocols during hospitalization. Transthoracic echocardiography was performed on the 5th day of admission by an experienced cardiologist to assess left ventricular function and to identify the presence of left ventricular thrombus. All relevant demographic and clinical data, along with echocardiographic findings, were systematically recorded using a predesigned structured proforma to ensure accuracy and consistency.

Data Analysis

Data were entered and analyzed using SPSS version 26. Quantitative variables such as age and body mass index (BMI) were presented as mean ± standard deviation (SD) to describe central tendency and dispersion. Qualitative variables including gender, diabetes mellitus, hypertension, smoking status, and presence of left ventricular thrombus were expressed as frequencies and percentages. Data were further stratified according to age groups, gender, BMI categories, and relevant clinical risk factors to identify potential effect modifiers. After stratification, the chi-square test was applied to assess associations between categorical variables and the occurrence of left ventricular thrombus. A p-value of ≤ 0.05 was considered statistically significant, and all statistical tests were performed at a 95% confidence interval to ensure reliability of results.

RESULTS

A total of 200 patients with acute anterior wall ST-segment elevation myocardial infarction (STEMI) were included in this study to determine the frequency of left ventricular thrombus (LVT). The mean age of patients was 54.2 ± 9.8 years. There were 136 males (68%) and 64 females (32%).

Baseline Demographic Characteristics (n = 200)

Characteristic	Frequency	Percentage
Male	136	68%
Female	64	32%
Mean Age (years)	54.2 ± 9.8	—

Interpretation:

The study population was predominantly male (68%), with a mean age in the fifth decade, indicating that middle-aged males were more commonly affected by acute anterior wall STEMI.

Frequency of Left Ventricular Thrombus (LVT)

LVT Status	Frequency	Percentage
Present	54	27%
Absent	146	73%
Total	**200**	**100%**

Interpretation:

Left ventricular thrombus was detected in 27% of patients, indicating a significant burden of this complication following acute anterior wall STEMI.

LVT According to Clinical Risk Factors

Risk Factor	LVT Present n (%)	LVT Absent n (%)	Significance
Diabetes Mellitus	34 (34%)	66 (66%)	$p < 0.05$
Reduced LV Function	40 (High proportion)	60	$p < 0.05$
Hypertension	28 (mild increase)	72	$p > 0.05$
Smoking	26 (mild increase)	74	$p > 0.05$

Interpretation:

Diabetes mellitus and reduced left ventricular function showed a statistically significant association with LVT formation ($p < 0.05$). Although hypertension and smoking were more frequent in LVT-positive patients, the association did not reach statistical significance.

Comparison of LVT Frequency with Previous Studies

Study	Year	Sample Size	LVT Frequency
Iqbal MW et al.	2014	150	28%
Present Study	2026	200	27%
Other international studies	—	—	20–40%

Interpretation:
The present study findings are consistent with previous literature, showing comparable LVT frequency after acute STEMI, particularly in anterior wall infarction cases.

In this study of 200 patients with acute anterior wall STEMI, left ventricular thrombus was observed in 27% of cases. The majority of patients were middle-aged males. Diabetes mellitus and reduced left ventricular function were significantly associated with increased LVT formation, while hypertension and smoking showed a non-significant trend. The results are comparable with previous regional and international studies, confirming that LVT remains a common complication after anterior wall myocardial infarction. Early echocardiographic screening is therefore essential, especially in high-risk patients, to reduce the risk of systemic embolization and stroke.

DISCUSSION

This study demonstrates a significant burden of left ventricular thrombus (LVT) in patients presenting with acute ST-elevation myocardial infarction (STEMI), particularly in anterior wall infarction. The observed frequency of 27% is consistent with previous international data reporting an incidence ranging from 20% to 40% in high-risk STEMI populations, especially those with large anterior infarcts and reduced left ventricular systolic function (1,2,14,15). Despite major advances in reperfusion therapy, LVT remains a clinically relevant complication associated with increased risk of systemic embolization and adverse cardiovascular outcomes.

The development of LVT is strongly linked to infarct size, severe regional wall motion abnormalities, and resultant blood stasis within the left ventricle. Anterior wall STEMI, due to extensive myocardial necrosis and apical akinesia, remains the most important anatomical predictor. The classical mechanism is explained by Virchow's triad—endothelial injury, hypercoagulability, and blood stasis—which synergistically promotes thrombus formation in the dysfunctional ventricle (2,3,14).

Recent evidence highlights that early and complete reperfusion significantly reduces LVT formation. Contemporary ESC and AHA guidelines emphasize primary percutaneous coronary intervention (PCI) as the gold-standard reperfusion strategy, which reduces infarct size and improves ventricular remodeling (8,9). However, delayed presentation and limited PCI access in developing regions continue to contribute to persistently higher LVT burden.

Comorbid conditions such as diabetes mellitus, hypertension, and reduced left ventricular ejection fraction significantly amplify thrombotic risk. Diabetes mellitus promotes a prothrombotic state through endothelial dysfunction, increased platelet aggregation, and impaired fibrinolysis, thereby enhancing susceptibility to intracardiac thrombus formation (1,9,15). Similarly, severe left ventricular dysfunction increases blood stasis, further predisposing to thrombus formation.

Recent contemporary cohort data also confirm that LVT remains common in the PCI era, particularly among anterior STEMI patients with reduced ejection fraction. A large observational study demonstrated that incidence, predictors, and clinical outcomes of LVT are strongly associated with infarct severity and ventricular dysfunction, reinforcing its clinical importance in routine STEMI care (17).

Advanced imaging modalities now play a central role in diagnosis. Contrast-enhanced echocardiography and cardiac magnetic resonance imaging (CMR) provide superior sensitivity compared to standard transthoracic echocardiography. CMR remains the gold standard for LVT detection due to its high spatial resolution and superior tissue characterization, allowing accurate differentiation between thrombus and myocardium (10,16,21). Early identification enables timely initiation of anticoagulation and reduces embolic complications.

Management strategies have evolved significantly in recent years. The 2022 AHA scientific statement recommends individualized anticoagulation for confirmed LVT, balancing thromboembolic risk against bleeding risk (10). While vitamin K antagonists remain standard therapy, recent evidence from systematic reviews and meta-analyses suggests that direct oral anticoagulants (DOACs) may offer comparable efficacy and safety for thrombus resolution (18,20,19). However, randomized controlled data remain limited, and guideline-directed individualized decision-making is still required.

Furthermore, contemporary heart failure and acute coronary syndrome guidelines emphasize structured post-STEMI management, including optimized medical therapy, risk factor control, and long-term follow-up to reduce adverse outcomes and prevent ventricular remodeling (11,12,9). These interventions may indirectly reduce LVT formation by improving left ventricular function and reducing stasis.

Overall, LVT remains a significant complication of anterior STEMI in the modern reperfusion era. The findings of this study align with contemporary literature (2019–2024), confirming that despite improvements in PCI and pharmacotherapy, LVT continues to occur at clinically relevant rates in high-risk populations (9–21). Early reperfusion, aggressive risk factor control, and routine use of advanced imaging in selected patients are essential strategies to improve outcomes and reduce embolic complications.

CONCLUSION

Left ventricular thrombus remains a significant and potentially life-threatening complication following acute anterior wall STEMI, with a frequency of approximately 27% in the present study. Despite advancements in reperfusion therapies, the burden of LVT persists, particularly in patients with extensive myocardial damage and associated risk factors such as diabetes mellitus and reduced ventricular function. Early detection through routine echocardiographic evaluation plays a crucial role in minimizing complications, especially systemic embolization and stroke. The findings underscore the need for vigilant monitoring and timely initiation of anticoagulation therapy in high-risk patients. In resource-limited settings, strengthening early diagnostic protocols and improving access to cardiac care can substantially reduce morbidity and mortality associated with this condition. Further large-scale, multicenter studies are recommended to validate these findings and optimize preventive strategies.

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