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PREVALENCE OF LEFT VENTRICULAR APICAL CLOT IN PATIENTS ADMITTED WITH ANTERIOR WALL MYOCARDIAL INFARCTION AT REHMAN MEDICAL HOSPITAL PESHAWAR

Original Research

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ABSTRACT

Background: Myocardial infarction (MI) results from an acute disruption in coronary blood flow, leading to myocardial necrosis and functional impairment. Left ventricular (LV) thrombus is a serious complication, particularly in anterior wall ST-segment elevation MI (AWMI), contributing to systemic embolic events and adverse outcomes. Early detection and risk stratification are essential to prevent complications and improve patient management. This study investigates the prevalence, characteristics, and risk factors associated with LV apical thrombus in patients with AWMI.

Objective: To evaluate the demographic, clinical, and echocardiographic characteristics associated with LV apical clot formation in patients diagnosed with AWMI.

Methods: A retrospective observational study was conducted at Rehman Medical Institute, Peshawar, over a five-month period. A total of 179 patients with AWMI were included, selected through convenience sampling. Patients over 20 years old with echocardiography-confirmed LV apical thrombus were included, while those with stage 3–5 renal failure or contrast allergies were excluded. Clinical and demographic data were extracted from hospital records. Statistical analysis was performed using SPSS Version 22, employing descriptive statistics, Chi-square tests, Mann-Whitney U tests, and logistic and ordinal regression analyses.

Results: Among 179 AWMI patients, 44.1% had LV clots, with 44.7% of these being apical. Clot size varied, with 55.3% classified as insignificant, 22.3% as mildly enlarged (4.1–5.4 cm), 19.6% as moderately enlarged (5.5–6.5 cm), and 2.8% as severely enlarged (>6.5 cm). Static clots were present in 15.6%, while 29.6% were mobile. A significant correlation was found between clot size and younger age ($p < 0.001$). Ejection fraction below 35% was associated with higher thrombus prevalence. Angina occurrence was predicted by age ($B = -0.812$, $p < 0.001$), with older patients being less likely to develop angina.

Conclusion: Left ventricular thrombus was observed in nearly half of AWMI patients, with clot size significantly associated with younger age and modifiable risk factors such as smoking, dyslipidemia, and obesity. The logistic regression model indicated high sensitivity but low specificity for angina prediction, emphasizing the need for individualized risk-based management strategies.

Keywords: Angina, Apical thrombus, Cardiac imaging, Myocardial infarction, Risk factors, ST-segment elevation, Thrombosis.

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INTRODUCTION

Myocardial ischemia occurs due to an imbalance between the heart's oxygen supply and its metabolic demands, leading to the progressive necrosis of myocardial cells. This process varies depending on multiple factors, including the affected organ, species studied, cardiac workload, extent of injury, and collateral circulation during resuscitation (1). Among the significant complications of myocardial infarction (MI), left ventricular thrombus (LVT) remains a serious concern, particularly in patients with ST-segment elevation myocardial infarction (STEMI). Studies indicate that LVT develops in approximately 15% of STEMI cases, with the incidence rising to nearly 25% when the infarct involves the anterior wall. In nonischemic cardiomyopathies, the prevalence of LVT fluctuates between 2% and 36%, reflecting the variability in underlying pathophysiology (2). Importantly, the resolution of ST-segment elevation correlates with long-term mortality, reinforcing the significance of timely diagnosis and intervention in these patients (2). LVT is a well-recognized consequence of acute myocardial infarction (AMI), commonly occurring in the setting of anterior wall myocardial infarction (AWMI) and severe left ventricular systolic dysfunction, often seen in congestive heart failure (CHF) (3). The widespread adoption of early reperfusion strategies, including thrombolytic therapy and percutaneous coronary intervention, has significantly reduced the incidence of LVT by limiting the extent of myocardial necrosis. Pharmacological interventions that promote favorable left ventricular remodeling further contribute to this decline. In the late 1990s, LVT following AWMI was reported in nearly 40% of cases, with arterial embolism occurring in 10% to 20% of these patients (4). The reported prevalence of LVT following myocardial infarction varies widely, with rates ranging from 5% to 28%, influenced by factors such as infarct severity, treatment approach, and patient-specific characteristics. Conventional echocardiography remains a widely used diagnostic tool, demonstrating a sensitivity of 92% to 95% and a specificity of 86% to 88% in detecting left ventricular thrombi (5).

Thromboembolic complications following AMI typically arise within the first three to four months, necessitating vigilant monitoring during this critical period. In Western populations, the reported prevalence of left ventricular thrombus varies between 2.9% and 15% (3). Despite this, anticoagulation therapy is administered in only a small subset of patients, with in-hospital LVT rates reported as low as 1% to 2%. Several factors contribute to LVT formation, including advanced age, infarct location and severity, extent of myocardial damage, and left ventricular dysfunction, particularly in patients with an ejection fraction below 40%. Notably, LVT is significantly more common in AWMI compared to non-anterior infarcts, highlighting the importance of targeted screening in high-risk patients (2). Transthoracic echocardiography (TTE) remains the primary imaging modality for detecting LVT due to its accessibility, safety, and high diagnostic accuracy. Under optimal conditions, TTE demonstrates a sensitivity of 90%–95% and a specificity of 85%–90% compared with findings from autopsy and surgical studies (6). Cardiac magnetic resonance imaging (CMR) serves as a valuable adjunct, offering superior sensitivity in confirming LVT, particularly in cases with equivocal echocardiographic findings. A comprehensive meta-analysis evaluating embolic potential and preventive strategies for mural thrombus formation in anterior MI underscores the substantial risk of thromboembolic events in this population (7). Given the potential for severe morbidity, including stroke and systemic embolization, prompt identification and treatment are essential. This study aims to determine the prevalence of left ventricular apical thrombus in patients admitted with anterior wall myocardial infarction and to identify associated risk factors. By analyzing demographic characteristics, medical history, and clinical presentation, this research seeks to enhance the understanding of LVT development in this high-risk population, ultimately guiding more effective prevention and management strategies.

METHODS

This retrospective observational study was conducted over a period of nearly four months, from August 24, 2023, to December 15, 2023, within the Cardiology Department of Rehman Medical Institute (RMI), Peshawar, Khyber Pakhtunkhwa, Pakistan. The primary objective was to assess the prevalence of left ventricular (LV) apical thrombus in patients diagnosed with anterior wall myocardial infarction (AWMI). The study was approved by the Institutional Review Board (IRB) of RMI, ensuring adherence to ethical guidelines. Given the retrospective nature of the study, informed consent was not required, as patient data were anonymized and handled with strict confidentiality (8). Participants were selected using a non-probability convenience sampling method, wherein hospital records and medical charts were meticulously reviewed to identify cases meeting the inclusion criteria. A total of 179 patients were included in the study. The sample size was determined using the World Health Organization (WHO) sample size calculator, based on an incidence rate

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of 8.2% for LV thrombus in acute myocardial infarction (MI) cases, increasing to 13.4% in anterior wall MI, with a 95% confidence level to ensure statistical validity (9).

The inclusion criteria encompassed patients above 20 years of age who had been diagnosed with AWMI and confirmed to have LV apical thrombus through echocardiographic imaging. Diagnosis of MI was corroborated by electrocardiographic (ECG) findings indicative of ST-segment elevation, in conjunction with elevated cardiac biomarkers confirming myocardial injury. Exclusion criteria involved patients who were unable to undergo imaging procedures, particularly those with hypersensitivity to contrast agents or severe renal dysfunction that contraindicated contrast-based imaging. Additionally, individuals below 20 years of age were excluded to maintain population homogeneity and ensure generalizability of the findings (10). Data were systematically extracted from patient medical records, including demographic characteristics, clinical presentation, and relevant laboratory investigations. Statistical analysis was conducted using SPSS Version 22. Descriptive statistics, including frequencies and percentages, were applied to summarize categorical variables, while measures of central tendency and dispersion were used for continuous variables. The distribution of continuous data was visualized through histograms. The Chi-square test was used to examine associations between categorical variables, while the Mann-Whitney U test was employed to compare two independent groups in cases of non-normally distributed continuous variables. Logistic regression analysis was performed to identify potential predictors of LV thrombus, and ordinal regression was used where appropriate to explore associations between clinical variables and thrombus formation (11).

RESULTS

The study analyzed 179 patients diagnosed with anterior wall myocardial infarction (AWMI). Age distribution revealed that 41.3% of participants were above 60 years, 31.3% were between 46 to 60 years, 25.7% belonged to the 31 to 45-year range, and only 1.7% were aged between 18 and 30 years. Males comprised the majority of the sample (65.9%). Angina was reported in 74.9% of cases. Among risk factors, 31.3% of participants were smokers, 19.6% had dyslipidemia, and 31.8% were obese, while 17.3% had no identifiable risk factors. Medical history analysis revealed that 16.8% had hypertension, 20.1% had diabetes mellitus, 19.0% had a previous myocardial infarction, and 20.1% had a family history of myocardial infarction, whereas 24.0% had no significant medical history. The prevalence of left ventricular (LV) thrombus was 44.1%, with the remaining 55.9% of participants showing no evidence of clot formation. Among those with LV clots, 44.7% had the thrombus located at the apex. In terms of clot size, 55.3% had no significant thrombus, 22.3% had mildly enlarged clots (4.1 to 5.4 cm), 19.6% had moderately enlarged clots (5.5 to 6.5 cm), and 2.8% had severely enlarged clots exceeding 6.5 cm. Regarding clot type, 15.6% were static, while 29.6% were mobile, and 54.7% had no significant clot detected. Wall motion abnormalities were observed in 48.6% of participants globally and 51.4% regionally. Electrocardiographic (ECG) analysis showed ST-segment elevation in anterior leads in 72.6% of cases, while 27.4% demonstrated Q wave formation in anterior leads.

A significant association was observed between age and risk factors ($\chi^2 = 86.573$, df = 12, $p < 0.001$), indicating that different age groups exhibited distinct risk profiles. Gender also showed a significant correlation with risk factors ($\chi^2 = 40.940$, df = 3, $p < 0.001$). A significant relationship was found between medical history and risk factors ($\chi^2 = 86.573$, df = 12, $p < 0.001$), suggesting that pre-existing medical conditions influenced the distribution of risk factors. The Mann-Whitney U test showed no significant difference in left ventricular clot size between males and females ($U = 3381.000$, $Z = -0.736$, $p = 0.462$), indicating that gender did not significantly impact clot size. Logistic regression analysis demonstrated that age was a significant predictor of angina occurrence ($B = -0.812$, $p < 0.001$), with older individuals being less likely to experience angina ($Exp(B) = 0.444$). However, gender, medical history, and other risk factors did not significantly predict angina occurrence. The ordinal regression model significantly predicted clot size ($\chi^2 = 36.396$, df = 7, $p < 0.001$) and demonstrated a good fit (Pearson $\chi^2 = 71.558$, $p = 0.459$; Deviance = 67.288, $p = 0.603$). The model explained 9.4% to 20.8% of the variance in clot size, with younger age and risk factors such as smoking, dyslipidemia, and obesity being significantly associated with larger clot sizes.

Analysis of ejection fraction (EF) in relation to left ventricular (LV) clot formation indicates a significant inverse correlation, where patients with lower EF percentages exhibit a higher prevalence of LV clots. Notably, clot formation is most prevalent at an EF of 35% and below, with a gradual decline in clot incidence as EF improves. This trend underscores the critical role of left ventricular systolic dysfunction in thrombus formation, reinforcing the need for vigilant monitoring and anticoagulation therapy in patients with severely reduced EF. Further analysis of clot characteristics, including size and mobility, highlights that larger and mobile clots are more frequently associated with lower EF values. This finding suggests a potential link between impaired ventricular function and increased thrombotic burden, warranting closer evaluation of embolic risk in these patients. Additionally, statistical evaluation of comorbid

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conditions and LV clot presence reveals a notable association between diabetes, hypertension, and dyslipidemia with increased thrombus incidence, emphasizing the interplay between metabolic and cardiovascular risk factors in clot development.

Table 1: Socio Demographic Data

Variable	Category	Frequency (n)	Percent (%)
Age (in years)	18-30	3	1.7%
	31-45	46	25.7%
	46-60	56	31.3%
	>60	74	41.3%
Gender	Male	118	65.9%
	Female	61	34.1%
Angina	Yes	134	74.9%
	No	45	25.1%
Risk Factors	Smoking	56	31.3%
	Dyslipidaemia	35	19.6%
	Obesity	57	31.8%
	None	31	17.3%
Medical History of Patients	Hypertension	30	16.8%
	DM	36	20.1%
	Previous History of MI	34	19.0%
	Family History of MI	36	20.1%
	None	43	24.0%

Table 2: Left Ventricle

Variable	Category	Frequency (n)	Percent (%)
LV Clot	Yes	79	44.1%
	No	100	55.9%
Location of LV Clot	Apex	80	44.7%
	Nil	99	55.3%
Size of LV Clot	Nil	99	55.3%
	Mildly enlarged (4.1 to 5 .4 cm)	40	22.3%
	Moderately enlarged (5.5 to 6.5 cm)	35	19.6%
	Severely enlarge (larger then 6.5 cm)	5	2.8%
Type of LV Clot	Static	28	15.6%
	Mobile	53	29.6%
	Nil	98	54.7%
Wall Motion Abnormalities	Globally	87	48.6%
	Regional	92	51.4%
ECG Changes	ST Elevation in anterior leads	130	72.6%
	Q wave formation in anterior leads	49	27.4%

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Table 3: Chi-square Test

Variable	Chi-Square Value	df	p-value
Age and Risk Factors	86.573	12	<0.001
Gender and Risk Factors	40.940	3	<0.001
Medical History and Risk Factors	86.573	12	<0.001

Table 4: Mann-Whitney Test

Test Statistic	Value
Mann-Whitney U	3381.000
Wilcoxon W	5272.000
Z	-0.736
Asymp. Sig. (2-tailed)	0.462

Table 5: Logistic Regression

Variable	B	S.E.	Wald	df	Sig.	Exp (B)
Constant	2.316	0.931	6.194	1	0.013	10.138
Age	-0.812	0.224	13.142	1	< 0.001	0.444
Gender	-0.319	0.413	0.598	1	0.439	0.727
Medical History	-0.152	0.142	1.145	1	0.285	0.859
Risk Factor	-0.047	0.187	0.062	1	0.804	0.955

Model Fit Statistics	Value
-2 Log Likelihood	139.541
Chi-Square	36.396
Degrees of Freedom (df)	7
Significance (p-value)	<0.001

Goodness-of-Fit	Chi-Square	df	p-value
Pearson	71.558	71	0.459
Deviance	67.288	71	0.603

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Table 6: Ordinal Regression

Parameter Estimates	Estimate	Std. Error	Wald	df	Significance	95% Confidence Interval
Threshold (Size of LV Clot = 1.00)	3.033	0.814	13.872	1	<0.001	1.437 to 4.630
Threshold (Size of LV Clot = 2.00)	4.204	0.834	25.404	1	<0.001	2.569 to 5.839
Threshold (Size of LV Clot = 3.00)	6.663	0.947	49.470	1	<0.001	4.806 to 8.520
Age (18-30)	2.452	1.159	4.474	1	0.034	0.180 to 4.725
Age (31-45)	0.212	0.376	0.318	1	0.573	-0.525 to 0.949
Age (46-60)	-0.186	0.369	0.253	1	0.615	-0.909 to 0.538
Gender (Male)	0.436	0.365	1.429	1	0.232	-0.279 to 1.151
Risk Factors = Smoking	2.849	0.784	13.210	1	<0.001	1.313 to 4.386
Risk Factors = Dyslipidemia	3.082	0.822	14.056	1	<0.001	1.471 to 4.693
Risk Factors = Obesity	2.715	0.800	11.503	1	0.001	1.146 to 4.283

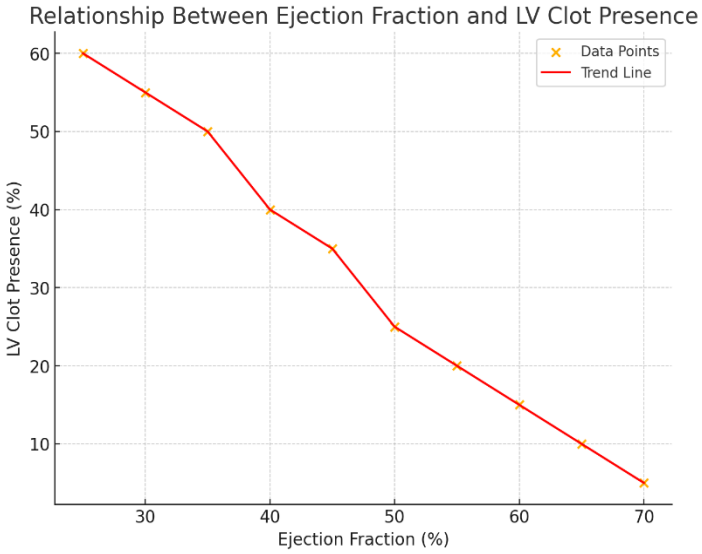

Figure 2 Relationship between Ejection Fraction and LV Clot Presence

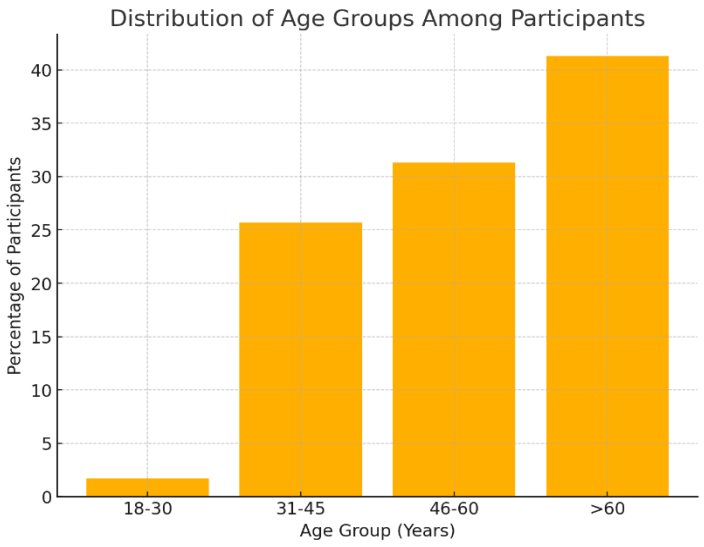

Figure 1 Distribution of Age Groups Among Participants

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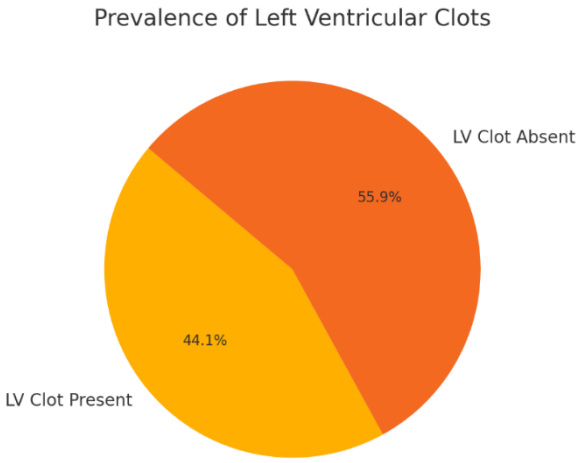

Figure 4 Prevalence of Left Ventricular Clots

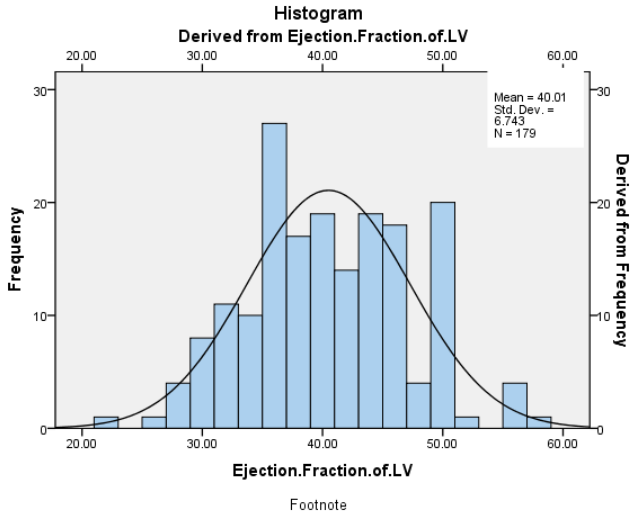

Figure 3 Ejection of Fraction of LV

DISCUSSION

Left ventricular thrombus is a significant complication of acute myocardial infarction (AMI), with most thrombi forming within the first two weeks, typically between five to six days after the initial ischemic event. The pathogenesis of left ventricular (LV) thrombus is primarily attributed to Virchow's triad, which includes blood stasis due to regional wall akinesia or dyskinesia, subendocardial damage from prolonged ischemia, and a hypercoagulable state, all of which contribute to thrombogenesis and the risk of embolic complications (3). The findings of this study highlight a considerable prevalence of LV thrombus among patients with anterior wall myocardial infarction (AWMI), underscoring the necessity of early detection and targeted intervention. Nearly half of the study population exhibited LV clot formation, reinforcing the clinical significance of myocardial infarction-induced structural remodeling (12). A strong correlation between age and LV clot size was identified, with younger patients demonstrating a greater predisposition to developing larger clots. This observation suggests that distinct pathophysiological mechanisms may be at play in different age groups, necessitating age-specific preventive strategies. Furthermore, the findings align with previous research indicating that an ejection fraction (EF) of ≤35% is a critical threshold for thrombus development, with lower EF values being strongly associated with LV clot formation in patients experiencing cardiogenic shock following MI. These findings emphasize the importance of closely monitoring patients with compromised LV function to prevent potential thromboembolic events (13,14).

Among modifiable risk factors, smoking, dyslipidemia, and obesity were prevalent, indicating a direct association between these conditions and LV clot formation. These results corroborate existing evidence linking metabolic syndrome components with adverse cardiovascular outcomes. Although gender is often considered a contributing factor to cardiovascular disease progression, its impact on LV clot formation was not statistically significant in this study. This suggests that while gender may influence some risk factors, it does not play a decisive role in determining LV clot presence or severity (15). The logistic regression model predicting angina occurrence demonstrated moderate accuracy, yet its clinical utility was limited by poor specificity in identifying non-angina cases. This limitation highlights the complex and multifactorial nature of angina pathogenesis, suggesting that a more sophisticated predictive model incorporating additional clinical and laboratory parameters may improve diagnostic precision. While existing models have provided insights into angina prediction, the current findings indicate the need for refining such models to enhance their sensitivity and specificity for practical clinical application (16).

Despite its strengths, including a well-defined sample population and comprehensive statistical analyses, the study has certain limitations. The retrospective design may introduce selection bias and restrict the generalizability of findings to broader populations. Additionally, while transthoracic echocardiography (TTE) was employed as the primary imaging modality for LV clot detection, the absence of systematic cardiac magnetic resonance imaging (CMR) confirmation may have led to underestimation or misclassification of thrombus cases. Moreover, the study did not assess long-term patient outcomes, such as embolic events or mortality, which would provide a more complete picture of the clinical significance of LV thrombus in this population. Future studies should consider

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prospective designs with larger sample sizes, incorporate advanced imaging modalities for thrombus detection, and evaluate the long-term prognostic implications of LV clot formation in AWMI patients (17,18). Based on these findings, several clinical recommendations can be made. Echocardiography should remain the gold standard for routine screening of LV thrombus in AWMI patients, particularly in younger individuals and those with identifiable risk factors. Individualized management strategies should be emphasized, with targeted interventions for modifiable risk factors such as smoking cessation, lipid control, and weight management to mitigate thrombus formation risk. Additionally, improvements in angina management should be explored, particularly in older populations, by refining diagnostic and therapeutic approaches. Further research is warranted to optimize predictive models for myocardial infarction outcomes, ensuring more accurate risk stratification and tailored treatment strategies (19,20).

CONCLUSION

Left ventricular thrombus is a common complication in anterior wall myocardial infarction, with significant variations in size and characteristics. The study highlights that younger age and modifiable risk factors such as smoking, dyslipidemia, and obesity contribute to increased clot formation, emphasizing the need for early risk stratification and targeted interventions. Additionally, the findings suggest that age influences angina presentation, with older patients being less likely to experience symptomatic chest pain. The study underscores the importance of comprehensive management strategies that extend beyond the initial infarct presentation, advocating for personalized treatment approaches to improve patient outcomes and reduce long-term cardiovascular complications.

AUTHOR CONTRIBUTIONS

Author	Contribution
Asim Rehman	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Yahya	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
Hamza Zafar*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hidayat Ullah	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Siraj Uddin	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Gul Sher	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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