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FREQUENCY OF SIGNIFICANT LEFT MAIN CORONARY ARTERY INVOLVEMENT IN ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (STEMI) VERSUS NON-ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION (NSTEMI)

Original Research

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ABSTRACT

Background: Left main coronary artery (LMCA) disease is a high-risk condition associated with significant morbidity and mortality in acute myocardial infarction (MI). While ST-segment elevation myocardial infarction (STEMI) often prompts emergent management, the burden of LMCA involvement in non-ST-segment elevation myocardial infarction (NSTEMI) remains under-recognized, despite its clinical relevance.

Objective: To determine the frequency of LMCA involvement in MI and compare its prevalence between STEMI and NSTEMI patients.

Methods: A cross-sectional study was conducted over six months at the National Institute of Cardiovascular Diseases (NICVD), Karachi. A total of 146 MI patients (≥18 years, both genders) diagnosed with STEMI or NSTEMI were included using non-probability consecutive sampling. LMCA involvement was defined angiographically as ≥70% luminal narrowing. Demographic data, clinical characteristics, and angiographic findings were recorded and analyzed using SPSS v25. Chi-square and Fisher's exact tests were used to compare LMCA frequency between groups, with $p \leq 0.05$ considered significant.

Results: Out of 146 patients, 83 (56.8%) had STEMI and 63 (43.2%) had NSTEMI. Overall, LMCA involvement was identified in 48 (32.9%) patients. Among STEMI patients, 28 (33.7%) had LMCA involvement, compared to 20 (31.7%) in the NSTEMI group ($p = 0.78$). No statistically significant difference was found across major demographic or clinical subgroups. Confidence intervals confirmed overlapping prevalence between the groups.

Conclusion: LMCA involvement is common in both STEMI and NSTEMI, with no significant difference between the two. Early angiographic evaluation should be considered for all MI patients to ensure appropriate risk stratification and timely management.

Keywords: Angiography, Coronary artery disease, LMCA, Myocardial infarction, NSTEMI, Percutaneous coronary intervention, Revascularization, Risk stratification, STEMI, Vascular stenosis.

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INTRODUCTION

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide, including in the United States, where it continues to represent one of the most common causes of death (1). Among its acute presentations, acute coronary syndrome (ACS) encompasses unstable angina (UA), ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation myocardial infarction (NSTEMI) (2). Timely identification of clinical and electrocardiographic features associated with high-risk coronary lesions, particularly those involving the left main coronary artery (LMCA), is essential for prompt and effective management (3). The LMCA supplies a major portion of the myocardium, and its significant stenosis is often associated with severe outcomes. In fact, approximately 70% of LMCA lesions occur in the context of multi-vessel coronary artery disease, underscoring its clinical significance (4). Occlusion or critical narrowing of the LMCA compromises more than 75% of the blood supply to the left ventricle, unless offset by well-developed collateral circulation or patent bypass grafts to the left anterior descending (LAD) or left circumflex (LCX) arteries (5). This anatomical burden translates to high-risk symptomatology and poor prognosis in affected individuals. Before the widespread adoption of coronary artery bypass grafting (CABG), patients with LMCA disease experienced poor long-term outcomes, with an average three-year survival rate as low as 37% (6). CABG has since demonstrated superior clinical outcomes compared to other medical therapies, including significant reductions in mortality and cardiovascular complications, especially in patients with complex or extensive coronary artery disease (7).

Significant LMCA stenosis is defined angiographically as a luminal narrowing of ≥70% and is found in approximately 6% of all patients undergoing coronary angiography for myocardial infarction (8). However, the frequency of LMCA involvement appears to differ between STEMI and NSTEMI presentations. In one study, 98.4% of STEMI patients showed evidence of LMCA disease, compared to 58.4% of NSTEMI patients, suggesting a possible variation in pathophysiological mechanisms and clinical implications between the two MI subtypes (9,10). These findings indicate the need for deeper investigation into the comparative burden of LMCA involvement across different types of myocardial infarction. Given the high mortality associated with LMCA disease and the large myocardial territory at risk, understanding the frequency of LMCA involvement in patients presenting with STEMI versus NSTEMI is of paramount clinical importance. The present study is thus designed to determine and compare the frequency of LMCA involvement in these two major types of myocardial infarction, with the goal of informing timely risk stratification, guiding revascularization decisions, and ultimately improving patient outcomes.

METHODS

This cross-sectional study was conducted in the Department of Cardiology at the National Institute of Cardiovascular Diseases (NICVD), Karachi, over a period of six months following the approval of the research by the Institutional Review Board (IRB) and the College of Physicians and Surgeons Pakistan (CPSP). Ethical clearance was obtained prior to data collection, and written informed consent was secured from all participants after clearly explaining the study's objectives, procedures, benefits, and risks. The sample size was calculated using the WHO sample size calculator, based on an anticipated proportion of left main coronary artery (LMCA) involvement in NSTEMI patients of 58.4% as reported in existing literature (6), a confidence level of 95%, and a margin of error of 8%, yielding a required sample size of 146. A non-probability consecutive sampling technique was employed for participant recruitment. The study population included patients above 18 years of age, of either gender, presenting within 48 hours of chest pain onset, and diagnosed with myocardial infarction (MI)—either ST-segment elevation MI (STEMI) or non-ST-segment elevation MI (NSTEMI)—based on standard clinical, biochemical, and electrocardiographic criteria. Patients were excluded if they had chronic kidney disease on dialysis (GFR <15 mL/min/1.73 m²), severe anemia (Hb <7 g/dL), dextrocardia (confirmed via chest X-ray), circulatory collapse requiring cardiopulmonary resuscitation (CPR), or complications prior to angiography such as cardiogenic shock, acute renal failure, cerebrovascular accident, or unconsciousness. Additional exclusion criteria included a left ventricular ejection fraction below 20% or a known history of coronary artery bypass graft (CABG).

Data collection was performed systematically by the principal investigator using a structured proforma. Demographic details including age, gender, residence, education, occupation, socioeconomic status, and clinical characteristics such as duration of pain, presence of

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hypertension, diabetes mellitus, smoking status, height, and weight were documented. Body mass index (BMI) was calculated using the standard formula (kg/m²), with weight measured in light clothing on a digital scale and height recorded using a wall-mounted stadiometer. Patients presenting with symptoms of myocardial infarction were initially evaluated as per institutional protocol. A 12-lead electrocardiogram (ECG) was performed on presentation and interpreted by a consultant cardiologist blinded to the clinical history. All patients underwent diagnostic coronary angiography performed by experienced interventional cardiologists with more than five years of clinical practice. The procedure involved radial or femoral arterial access, contrast dye administration, and fluoroscopic imaging to assess coronary anatomy. LMCA involvement was defined angiographically as ≥70% luminal narrowing, consistent with established diagnostic criteria. Data were analyzed using IBM SPSS Statistics version 25. Continuous variables such as age, BMI, and pain duration were summarized as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the distribution assessed via the Shapiro-Wilk test. Categorical variables including gender, risk factors, MI type (STEMI vs. NSTEMI), and LMCA involvement were expressed as frequencies and percentages. The primary analysis compared the frequency of LMCA involvement between STEMI and NSTEMI groups using chi-square or Fisher's exact test, with a p-value ≤0.05 considered statistically significant. Stratified analysis was also performed to assess potential effect modifiers, including age, gender, BMI, pain duration, and cardiovascular risk factors, with post-stratification significance testing conducted accordingly.

RESULTS

A total of 146 patients diagnosed with myocardial infarction were included in the study over a six-month period. The mean age of participants was 57.8 ± 10.4 years, with a range of 34 to 80 years. Among the study population, 92 (63%) were male and 54 (37%) were female. The average body mass index (BMI) was 27.1 ± 3.5 kg/m². In terms of socioeconomic distribution, 61 (41.8%) belonged to the lower class, 56 (38.4%) to the middle class, and 29 (19.9%) to the upper class. Hypertension was documented in 89 (61%) patients, diabetes mellitus in 73 (50%), and 97 (66.4%) had a history of smoking (current or ex-smokers). The median duration of chest pain prior to presentation was 10 hours (IQR: 6–16 hours). Out of the 146 patients, 83 (56.8%) were diagnosed with ST-segment elevation myocardial infarction (STEMI), while 63 (43.2%) were diagnosed with non-ST-segment elevation myocardial infarction (NSTEMI). Left main coronary artery (LMCA) involvement, defined as ≥70% luminal narrowing on angiography, was identified in 48 (32.9%) patients overall. Among the STEMI subgroup, 28 (33.7%) had LMCA involvement, while in the NSTEMI subgroup, 20 (31.7%) had LMCA involvement. The difference in LMCA involvement between the two groups was not statistically significant (p = 0.78), as shown in Table 2. Stratification based on age revealed that patients aged ≥60 years had a higher frequency of LMCA involvement (38.1%) compared to those <60 years (27.3%), although the difference did not reach statistical significance (p = 0.18). Gender-wise comparison showed that LMCA involvement was observed in 35.9% of males and 27.8% of females (p = 0.29). Among patients with hypertension, LMCA disease was found in 35.9%, compared to 28.1% in non-hypertensive patients (p = 0.33). Similarly, LMCA involvement in diabetic patients was 36.9% versus 28.8% in non-diabetics (p = 0.31). Regarding BMI, patients classified as overweight or obese (BMI ≥25 kg/m²) showed a slightly higher rate of LMCA involvement (34.6%) compared to those with normal BMI (<25 kg/m²) at 27.7% (p = 0.45). Smoking status also showed no significant association, with 33% of smokers and 32.6% of non-smokers having LMCA involvement (p = 0.97). The overall proportion of LMCA involvement among patients with myocardial infarction was 32.9%, with a 95% confidence interval (CI) ranging from 25.8% to 40.9%. Among STEMI patients, LMCA involvement was observed in 33.7% of cases (95% CI: 24.5% to 44.4%), while in NSTEMI patients, the proportion was 31.7% (95% CI: 21.6% to 44.0%). These confidence intervals indicate that the estimates are relatively precise, and there is a considerable overlap between STEMI and NSTEMI groups, supporting the earlier finding of no statistically significant difference in LMCA involvement based on MI type.

Table 1: Baseline Demographics and Clinical Characteristics of Study Population

Variable	Mean ± SD / n (%)
Age (years)	57.8 ± 10.4
Gender (Male/Female)	92 (63%) / 54 (37%)
BMI (kg/m²)	27.1 ± 3.5
Socioeconomic status	Low: 61 (41.8%)
	Middle: 56 (38.4%)
	Upper: 29 (19.9%)
Hypertension	89 (61%)

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Variable	Mean ± SD / n (%)
Diabetes Mellitus	73 (50%)
Smoking History	97 (66.4%)
Duration of Pain (hours)	Median 10 (IQR 6–16)

Table 2: Frequency of LMCA Involvement by MI Type

MI Type	n	LMCA Involvement n (%)	p-value
STEMI	83	28 (33.7%)	
NSTEMI	63	20 (31.7%)	0.78

Table 3: LMCA Involvement Stratified by Demographic and Risk Factors

Variable	LMCA Involvement n (%)	p-value
Age ≥60 years	24/63 (38.1%)	0.18
Male	33/92 (35.9%)	0.29
Hypertension	32/89 (35.9%)	0.33
Diabetes Mellitus	27/73 (36.9%)	0.31
BMI ≥25 kg/m²	36/104 (34.6%)	0.45
Smokers	32/97 (33.0%)	0.97

Table 4: Confidence Intervals for LMCA Involvement

Group	Proportion of LMCA Involvement (%)	95% CI Lower Bound (%)	95% CI Upper Bound (%)
Total MI Patients	32.877	25.781	40.850
STEMI Patients	33.735	24.484	44.425
NSTEMI Patients	31.746	21.587	44.004

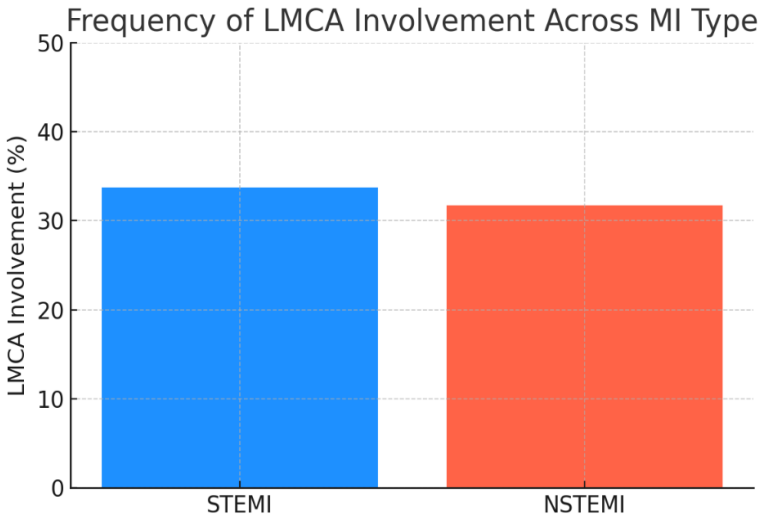


Figure 1 Frequency of Involvement Across MI Type

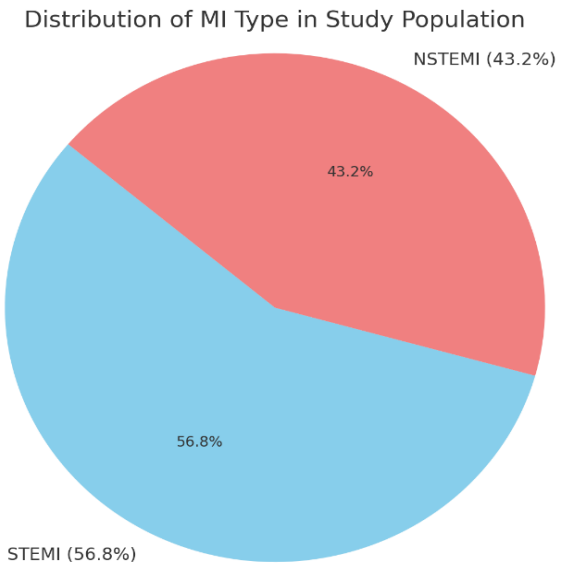


Figure 2 Distribution of MI Type in Study Population

DISCUSSION

The present study assessed and compared the frequency of left main coronary artery (LMCA) involvement in patients presenting with ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI). The results demonstrated that approximately one-third of patients in both groups had angiographically significant LMCA disease, with no

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statistically significant difference between STEMI (33.7%) and NSTEMI (31.7%) patients. These findings suggest that LMCA involvement is a serious concern across both types of myocardial infarction and cannot be presumed more likely based solely on ECG presentation. Previous literature has reported varied frequencies of LMCA involvement depending on the study design, population, and angiographic definitions. For instance, a study found a notably high LMCA involvement rate of 37.1% in NSTEMI patients in a cross-sectional cohort from Pakistan, advocating for urgent revascularization strategies in this subset (11,12). Similarly, a study reported that LMCA disease was more frequent in NSTEMI patients with ST elevation in lead aVR, reinforcing the prognostic value of this ECG finding (13,14). Other large-scale observational registries have also highlighted the nuanced risk LMCA poses. For example, a study observed that, while STEMI patients had a higher short-term mortality risk, NSTEMI patients with LMCA disease carried a higher long-term mortality burden (15,16). These insights align with findings from a study, who proposed a mortality continuum across STEMI, NSTEMI with occluded arteries, and NSTEMI with non-occluded arteries (17,18). Furthermore, a study demonstrated that LMCA and total occlusion profiles in NSTEMI closely mimic those seen in STEMI, but with delayed presentation and inferior PCI outcomes (19). The implications of these results are significant. Traditionally, STEMI is prioritized for emergent intervention under the assumption of complete arterial occlusion, while NSTEMI is often managed with delayed angiography. However, the observed high rate of LMCA involvement in NSTEMI patients calls into question this dichotomous approach. Studies have repeatedly shown that LMCA disease portends a worse prognosis regardless of ECG changes, emphasizing the need for early identification and aggressive intervention (20,21). The strength of this study lies in its standardized operational definitions, systematic angiographic verification, and real-world hospital setting, enhancing its clinical relevance. The inclusion of confidence intervals further supports the reliability of the frequency estimates. However, several limitations must be acknowledged. The study design was cross-sectional and observational, thus limiting causal inference. Additionally, the sample was drawn from a single tertiary care center, possibly limiting generalizability to broader populations with different risk profiles. Another limitation is the lack of multivariate analysis to adjust for potential confounders such as age, gender, diabetes, and hypertension, which may influence both the type of MI and the likelihood of LMCA disease. Furthermore, clinical severity markers like Killip class and biochemical profiles were not analyzed in relation to LMCA involvement, which could have added predictive value. Also, the presence of multi-vessel coronary artery disease, which often coexists with LMCA lesions, was not reported in the current dataset but remains a significant determinant of treatment strategy and prognosis.

Future research should focus on multicenter longitudinal studies incorporating advanced imaging and biochemical markers to improve the risk stratification of LMCA disease. Further exploration into the prognostic utility of ECG features such as lead aVR elevation, as well as integration of risk scoring systems, may help in early detection (22). Additionally, comparative effectiveness research evaluating outcomes of early versus delayed revascularization in LMCA-involved NSTEMI could provide practice-changing insights. In conclusion, LMCA involvement is prevalent and clinically significant in both STEMI and NSTEMI patients. The findings underscore the importance of comprehensive angiographic evaluation and may warrant reconsideration of current treatment timelines, particularly in high-risk NSTEMI patients. Integrating these insights into guidelines may lead to more equitable and outcome-driven care for patients with acute coronary syndromes.

CONCLUSION

This study found a considerable and comparable frequency of left main coronary artery (LMCA) involvement in both STEMI and NSTEMI patients, underscoring its critical role in acute myocardial infarction regardless of ECG presentation. These findings highlight the need for early angiographic evaluation in all MI subtypes to enable timely risk stratification and guide revascularization decisions, ultimately improving patient outcomes.

AUTHOR CONTRIBUTION

Author	Contribution
Nasir Yaqoob*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Nauman Khan	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
Khalid Naseeb	Substantial Contribution to acquisition and interpretation of Data

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Author	Contribution
	Has given Final Approval of the version to be published
Muhammad Owais Shahid	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Abdul Samad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Haad Usmani	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Neelam Anees	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Aroona Kataria	Writing - Review & Editing, Assistance with Data Curation
Ahsan Ali Gaad	Writing - Review & Editing, Assistance with Data Curation

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