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LEFT VENTRICULAR DYSFUNCTION SEVERITY IN PATIENTS WITH AND WITHOUT LEFT MAIN CORONARY ARTERY DISEASE

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ABSTRACT

Objective: To determine the frequency of left main coronary artery (LMCA) disease in patients with acute coronary syndrome and to compare the severity of left ventricular (LV) dysfunction in patients with and without LMCA disease.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Cardiology, Punjab Institute of Cardiology, Lahore, from 1st May 2025 till 31st July 2025.

Methodology: A total of 83 patients aged 16–65 years presenting with acute coronary syndrome were enrolled through non-probability consecutive sampling. All patients underwent coronary angiography to assess LMCA disease and echocardiography to evaluate left ventricular ejection fraction (LVEF). LV dysfunction was categorized as hyperdynamic, normal, mild, moderate, or severe based on standard LVEF ranges. Data were analyzed using SPSS version 25.

Results: The mean age of patients was 40.00 ± 14.23 years, with male predominance (60.2%). LMCA disease was present in 35 (42.2%) patients. Normal LVEF was observed in 31 (37.3%) patients, while moderate and severe LV dysfunction were seen in 15 (18.1%) and 7 (8.4%) patients, respectively. A higher proportion of LMCA disease was observed in patients with moderate and severe LV dysfunction; however, the association was not statistically significant ($p = 0.281$). No significant association was found between LMCA disease and BMI ($p = 0.665$) or age ($p = 0.710$).

Conclusion: LMCA disease was observed in a considerable proportion of patients with acute coronary syndrome. Although no statistically significant association was found, a higher frequency of LMCA involvement was noted in patients with moderate to severe LV dysfunction, suggesting a clinically relevant relationship..

KEYWORDS: Left main coronary artery disease, left ventricular dysfunction, ejection fraction, acute coronary syndrome, echocardiography.

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INTRODUCTION

The left ventricle is the main driving force in circulating the blood in the body, and the proportion of blood that is pumped from it constitutes the left ventricular ejection fraction (LVEF) [1]. The most common causes of left ventricular ejection fraction (LVEF) dysfunction include hypertension and ischemic cardiomyopathies, both of which contribute significantly to impaired myocardial contractility and subsequent cardiac dysfunction. According to the American College of Cardiology (ACC), LVEF dysfunction is classified into five categories based on the degree of impairment. These include hyperdynamic function with an LVEF greater than 70%, normal function with LVEF ranging from 50% to 70%, mild dysfunction with LVEF between 40% and 49%, moderate dysfunction with LVEF between 30% and 39%, and severe dysfunction with LVEF less than 30% [2]. Left Main Stem (LMS) is the main artery of the left system of the heart from where Left Anterior Descending Artery (LAD) and Left Circumflex Artery (LCX) arise. LMS supplies a major portion of the myocardium and may cause serious cardiovascular events in case of its disease. The prevalence of LMS disease is 5–7% in diagnostic coronary angiographies. LMS disease also

indicates a high likelihood of disease in other coronary arteries and has a profound effect on LVEF [3]. Significant LMS disease is characterized by stenosis ≥50% and carries a high risk of morbidity and mortality. Because a large area of myocardium is jeopardized by LMCA disease, long-term manifestations include LV dysfunction and heart failure, leading to increased mortality [4]. However, it is not yet established whether long-term outcomes after CABG and PCI for LMCA disease are affected by the degree of LV dysfunction. Among the various forms of CAD, left main coronary artery (LMCA) disease is particularly clinically significant because it supplies a large portion of the myocardium, including the left anterior descending (LAD) and left circumflex (LCx) arteries [5]. Significant stenosis of the LMCA can lead to extensive myocardial ischemia, often resulting in more severe impairment of left ventricular function compared to non-LMCA coronary lesions. Consequently, patients with LMCA disease are frequently observed to have worse cardiac outcomes and a higher burden of ventricular dysfunction [6,7]. The relationship between LMCA disease and the severity of LVD has been a subject of ongoing investigation [8]. While some studies suggest that LMCA involvement is independently associated with reduced LVEF and more extensive myocardial damage, others indicate that the severity of ventricular dysfunction may also depend on factors such as collateral circulation, ischemia duration, and timely revascularization [9,10]. This variability underscores the need to further evaluate LVD severity in patients with and without LMCA disease. In a study by Park et al., long-term outcomes after PCI or CABG were analyzed according to LV dysfunction severity. Among patients, 2,641 (75.7%) had normal LVEF, while 403 (11.6%), 260 (7.5%), and 184 (5.3%) had mild, moderate, and severe dysfunction, respectively. Another study by Iqbal et al. reported significant LMCA disease in 68.03% patients with ACS having ST elevation [6].

OBJECTIVES

- To find the frequency of left main coronary artery disease in patients with acute coronary syndrome.
- To compare the severity of LV dysfunction in patients with and without LMCA disease.

METHODOLOGY

This was a cross-sectional study conducted at Department of Cardiology, Punjab Institute of Cardiology, Lahore, Pakistan, from 1st May 2025 till 31st July 2025. The sample size was calculated using the WHO sample size calculator, taking a confidence level of 95%, margin of error of 0.10, and an assumed proportion of 68.8%, resulting in a total of 83 patients. A non-probability consecutive sampling technique was used to recruit participants who met the predefined inclusion and exclusion criteria. Patients aged 16–65 years of either gender presenting with acute coronary syndrome, including unstable angina, stable angina, NSTEMI, STEMI, and those with documented coronary artery disease involving single, double, or triple vessel disease were included in the study. Patients with a history of previous angioplasty, coronary artery bypass grafting (CABG), or chronic kidney disease were excluded.

The study was initiated after obtaining ethical approval from the institutional review board, and informed consent was obtained from all participants. Detailed clinical history and physical examination were performed for each patient. All participants underwent coronary angiography to assess the presence of left main coronary artery (LMCA) disease, and based on angiographic findings, patients were categorized into two groups: those with LMCA disease and those without LMCA disease. Echocardiography was performed in all patients to evaluate left ventricular function. Left ventricular ejection fraction (LVEF) was measured, and the severity of left ventricular dysfunction was categorized into mild, moderate, and severe according to standard clinical guidelines. Relevant demographic and clinical data, including age, gender, body mass index (BMI), type of acute coronary syndrome, and angiographic findings, were recorded using a structured proforma.

Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 20. Numerical variables such as age and duration of disease were presented as mean ± standard deviation, while categorical variables including gender, LMCA disease status, type of acute coronary syndrome, and severity of left ventricular dysfunction were expressed as frequencies and percentages. Data were stratified with respect to age, gender, BMI, and type of acute coronary syndrome to control for potential effect modifiers. The comparison of severity of left ventricular dysfunction between patients with and without LMCA disease was carried out using the chi-square test, and a p-value of ≤0.05 was considered statistically significant.

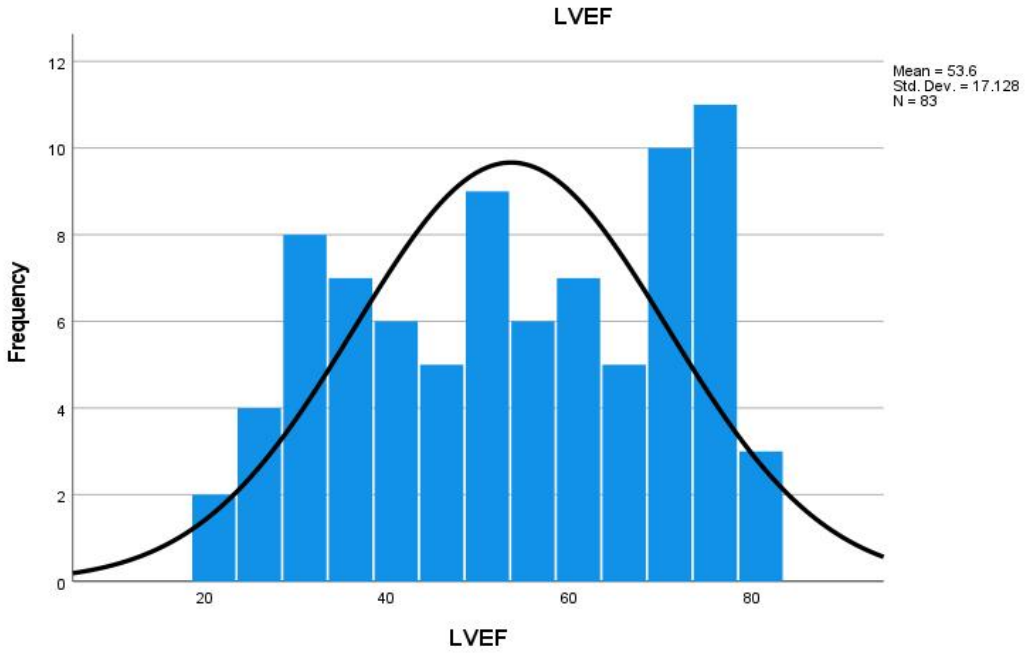
RESULTS

Data were collected from 83 patients, with a mean age of 40.00 ± 14.23 years, indicating a relatively younger study population. Males constituted the majority with 50 (60.2%) patients, while females accounted for 33 (39.8%). When stratified by age groups, most patients were above 45 years (34, 41.0%), followed by those aged 30–45 years (28, 33.7%), and less than 30 years (21, 25.3%). Regarding echocardiographic and structural findings, left ventricular dilatation was observed in 41 (49.4%) patients, while 42 (50.6%) had no dilatation. Wall motion abnormalities were present in 39 (47.0%) patients, whereas 44 (53.0%) showed no abnormalities.

Table 1: Detailed Baseline Demographic Characteristics (n = 83)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	40.00 ± 14.23
Gender	Male	50 (60.2%)

	Female	33 (39.8%)
Age Groups (years)	<30	21 (25.3%)
	30–45	28 (33.7%)
	>45	34 (41.0%)
LV Dilatation	Yes	41 (49.4%)
	No	42 (50.6%)
Wall Motion Abnormality	Yes	39 (47.0%)
	No	44 (53.0%)
LV Hypertrophy	Yes	36 (43.4%)
	No	47 (56.6%)
Diastolic Dysfunction	Grade I–III	58 (69.9%)
	None	25 (30.1%)



The distribution of body mass index (BMI) categories showed that 38 (45.8%) patients had a healthy BMI, 17 (20.5%) were overweight, and 28 (33.7%) were obese. Among patients with LMCA disease, 14 (36.8%) had a healthy BMI, 8 (47.1%) were overweight, and 13 (46.4%) were obese. In comparison, among those without LMCA disease, 24 (63.2%) had a healthy BMI, 9 (52.9%) were overweight, and 15 (53.6%) were obese.

Table 2: Anthropometric Characteristics and Association with LMCA Disease

Variable	Category	LMCA Yes (n=35)	LMCA No (n=48)	Total (n=83)	p-value
BMI Category	Healthy	14 (36.8%)	24 (63.2%)	38 (45.8%)	
	Overweight	8 (47.1%)	9 (52.9%)	17 (20.5%)	
	Obese	13 (46.4%)	15 (53.6%)	28 (33.7%)	**0.665**

Chi-square test applied

Assessment of left ventricular ejection fraction (LVEF) revealed that 19 (22.9%) patients had hyperdynamic function, 31 (37.3%) had normal function, 11 (13.3%) had mild dysfunction, 15 (18.1%) had moderate dysfunction, and 7 (8.4%) had severe dysfunction. Among patients with LMCA disease, moderate dysfunction was relatively more frequent, observed in 9 (60.0%) patients, and severe dysfunction in 4 (57.1%). In contrast, patients without LMCA disease more commonly had normal LVEF

(21, 67.7%) and mild dysfunction (8, 72.7%).

Table 3: Echocardiographic Findings (LVEF Classification) and LMCA Disease

LVEF Category	LMCA Yes (n=35)	LMCA No (n=48)	Total (n=83)	p-value
Hyperdynamic (>70%)	9 (47.4%)	10 (52.6%)	19 (22.9%)	
Normal (50–70%)	10 (32.3%)	21 (67.7%)	31 (37.3%)	
Mild Dysfunction (40–49%)	3 (27.3%)	8 (72.7%)	11 (13.3%)	
Moderate Dysfunction (30–39%)	9 (60.0%)	6 (40.0%)	15 (18.1%)	
Severe Dysfunction (<30%)	4 (57.1%)	3 (42.9%)	7 (8.4%)	**0.281**

Regarding lifestyle and comorbid risk factors, smoking was present in 40 (48.2%) patients, with 18 (51.4%) in the LMCA group and 22 (45.8%) in the non-LMCA group. Hypertension was observed in 36 (43.4%) patients, including 16 (45.7%) with LMCA disease and 20 (41.7%) without. Diabetes mellitus was present in 33 (39.8%) patients, with 15 (42.9%) in the LMCA group and 18 (37.5%) in the non-LMCA group.

Table 4: Lifestyle and Risk Factors (if included from dataset)

Variable	Category	LMCA Yes (n=35)	LMCA No (n=48)	Total	p-value
Smoking	Yes	18 (51.4%)	22 (45.8%)	40 (48.2%)	
	No	17 (48.6%)	26 (54.2%)	43 (51.8%)	
Hypertension	Yes	16 (45.7%)	20 (41.7%)	36 (43.4%)	
	No	19 (54.3%)	28 (58.3%)	47 (56.6%)	
Diabetes	Yes	15 (42.9%)	18 (37.5%)	33 (39.8%)	
	No	20 (57.1%)	30 (62.5%)	50 (60.2%)	**>0.05**

Chi-square test applied

DISCUSSION

Left main coronary artery (LMCA) disease represents a high-risk subset of coronary artery disease due to the large myocardial territory it supplies. The present study aimed to evaluate the relationship between LMCA disease, and the severity of left ventricular (LV) dysfunction as assessed by left ventricular ejection fraction (LVEF). In this study, the mean age of participants was 40.00 ± 14.23 years, with a male predominance (60.2%). This demographic pattern is consistent with previous research, which has shown that coronary artery disease, particularly LMCA involvement, is more prevalent in males and tends to present earlier in South Asian populations compared to Western cohorts. Previous research has similarly reported a higher burden of cardiovascular disease in middle-aged individuals, reflecting early onset risk factors in this population [11].

The frequency of LMCA disease in our study was 42.2%, which appears higher than that reported in earlier studies where LMCA disease prevalence ranges between 5–7% in general angiographic populations. However, this difference may be explained by the selective inclusion of patients presenting with acute coronary syndrome in our study, which inherently represents a higher-risk group. Previous research has demonstrated increased LMCA involvement among patients with high-risk electrocardiographic findings and advanced coronary disease. Regarding LV function, most patients in our study had normal (37.3%) or hyperdynamic (22.9%) LVEF [12]. However, a substantial proportion demonstrated LV dysfunction, with moderate dysfunction observed in 18.1% and severe dysfunction in 8.4% of patients. These findings are clinically important, as reduced LVEF is a well-established predictor of adverse cardiovascular outcomes, including heart failure and mortality [13].

When comparing LVEF categories with LMCA disease, a higher proportion of patients with moderate (60.0%) and severe (57.1%) LV dysfunction had LMCA involvement compared to those with normal or mildly reduced LVEF. Although this association did not reach statistical significance ($p = 0.281$), the observed trend suggests a potential relationship between worsening LV function and LMCA disease [14]. Previous research has reported similar findings, indicating that extensive coronary involvement, particularly LMCA disease, is associated with impaired myocardial function due to ischemia of a large myocardial territory. Anthropometric analysis showed that a significant proportion of patients were either overweight or obese; however, no statistically significant association was found between BMI categories and LMCA disease ($p = 0.665$) [15,16]. This is in line with previous research suggesting that while obesity is a risk factor for coronary artery disease overall, its direct association with specific anatomical patterns, such as LMCA involvement, may not be significant [17]. Similarly, no significant difference in age was observed between patients with and without LMCA disease ($p = 0.710$). Risk factors such as smoking, hypertension, and diabetes were prevalent in the study population but did not show a statistically significant

association with LMCA disease. These findings may be attributed to the relatively small sample size and the cross-sectional design, which limits the ability to detect subtle associations [18-20].

LIMITATIONS

This study has several limitations. First, it was a single-center cross-sectional study with a relatively small sample size, which may limit the generalizability of the findings to broader populations. Second, the use of non-probability consecutive sampling may introduce selection bias. Third, due to the cross-sectional design, causal relationships between LMCA disease and left ventricular dysfunction could not be established. Additionally, although echocardiographic parameters such as LVEF were assessed, inter-observer variability and differences in measurement techniques may have influenced the results. Detailed quantitative assessment of coronary artery disease severity beyond LMCA involvement was not included, which may limit the comprehensive evaluation of disease burden. Furthermore, subgroup analyses may have been underpowered due to smaller numbers within categories, potentially affecting the detection of statistically significant associations. Despite these limitations, the study provides valuable local data regarding the relationship between LMCA disease and LV dysfunction in patients with acute coronary syndrome.

CONCLUSION

It is concluded that left main coronary artery disease was present in a substantial proportion of patients with acute coronary syndrome. Although no statistically significant association was observed between LMCA disease and demographic or lifestyle factors, a higher frequency of LMCA involvement was noted in patients with moderate to severe left ventricular dysfunction. This suggests a clinically important relationship between LMCA disease and impaired ventricular function.

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