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Original Article

Clinical Outcomes of Percutaneous Coronary Intervention for Left Main Coronary Artery Disease in Acute Coronary Syndrome Patients: A Hospital-Based Study

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Abstract

Objectives: This study aims to evaluate the in-hospital outcomes of patients with acute coronary syndrome (ACS) who have left main coronary artery disease (LMCAD) and are treated with percutaneous coronary intervention (PCI).

Methodology: A cross-sectional, hospital-based study was conducted at the Department of Interventional Cardiology, National Institute of Cardiovascular Diseases, Karachi, from May 2022 to December 2022. Using a convenient sampling technique, adult male and female patients presenting with ACS and angiographically confirmed LMCAD were enrolled.

Results: A total of 129 patients were included in the final analysis, with a mean age of 51.22±12.03 years. The majority were male (n = 101, 78.29%). Dyslipidemia was the most common comorbid condition (n = 34, 26.35%), followed by hypertension (n = 32, 24.80%) and type 2 diabetes mellitus (n = 22, 17.50%). The most frequent in-hospital complications following PCI were heart failure (n = 12, 9.8%) and arrhythmias (n = 5, 3.87%). The in-hospital mortality rate was 2.32% (n = 3).

Conclusion: The study demonstrates that PCI for LMCAD in ACS patients is associated with favorable prognostic outcomes. While cardiac arrhythmias were the most prevalent post-procedural complication, the overall in-hospital mortality rate was low.

Keywords: Percutaneous coronary intervention, left main coronary artery disease, acute coronary syndrome, in-hospital outcomes

INTRODUCTION

Acute coronary syndrome (ACS) encompasses a spectrum of conditions, including unstable angina (UA), non-ST segment elevation myocardial infarction (NSTEMI), and ST-segment elevation myocardial infarction (STEMI) [1]. Among these, acute myocardial infarction is a leading cause of morbidity, disability, and related complications worldwide. The prevalence of acute myocardial infarction is steadily increasing, with approximately 3.8% of the global population under 60 years of age being diagnosed with this condition [2].

In Pakistan, a national study that analyzed data from 14,601 patients diagnosed with ACS between 1988 and 2018 reported a higher prevalence of STEMI (52.4%) compared to NSTEMI (47.6%) [3]. Similar findings were observed in an international study, where the prevalence of STEMI was 51.87% versus 23.86% for NSTEMI [4].

Prompt diagnosis and treatment of STEMI are critical in preventing post-myocardial infarction complications such as arrhythmias, heart failure, and death. Early revascularization of the culprit vessel is particularly recommended in STEMI patients [5]. However, left main coronary artery disease (LMCAD), a severe and life-threatening condition, is more commonly encountered in patients with complicated STEMI rather than those with stable presentations. Revascularizing the culprit vessel in such cases presents significant challenges due to the heightened risk of sudden cardiac death, longer procedural times, and an increased likelihood of arrhythmias during PCI, especially when the left main coronary artery is involved [6].

Given the critical nature of LMCAD in the context of ACS and the challenges it presents during PCI, this study was designed to assess the clinical outcomes of ACS patients with LMCAD who undergo PCI in the interior Sindh region of Pakistan. This research aims to fill a significant gap in the existing literature and provide insights into the management and outcomes of this high-risk patient population.

METHODOLOGY

Study Design: This study was designed as a prospective observational study, aiming to evaluate the in-hospital outcomes of patients with angiographically proven left main (LM) coronary artery disease who underwent percutaneous coronary intervention (PCI). The study was conducted over eight months, from May 2022 to December 2022.

Setting: The research was conducted in the Department of Interventional Cardiology at the National Institute of Cardiovascular Diseases (NICVD), Hyderabad. This institution is a leading cardiovascular center equipped to handle complex coronary interventions, making it an ideal setting for this study.

Participants

- **Inclusion criteria:** A total of 129 patients were included in this study, all of whom met the following inclusion criteria: they had angiographically proven left main coronary artery disease, were between the ages of 30 and 70 years, had never attempted percutaneous coronary intervention (PCI) for left main (LM) disease, and were not candidates for coronary artery bypass grafting (CABG). Both male and female patients were considered for the study.

- **Exclusion criteria:** The exclusion criteria were established to ensure the accuracy and relevance of the study's findings. Patients were excluded if they had a history of previous CABG, presented with multivessel coronary artery disease requiring CABG or non-stentable LM disease, had concomitant heart failure and/or valvular heart disease, or declined to participate in the study. All patients were thoroughly briefed on the potential benefits and risks associated with the study, and informed consent was obtained before their inclusion.

Variables: The primary outcome variables observed were in-hospital complications, including heart failure, cerebrovascular accident (CVA), renal failure requiring dialysis, cardiogenic shock, re-infarction, arrhythmias, and mortality. Secondary variables included baseline demographic and clinical data, such as age, gender, body mass index (BMI), smoking status, comorbid conditions, systolic and diastolic blood pressure, heart rate, and duration of hospitalization.

Data Sources/Measurement: Data was collected using a predesigned proforma that captured both baseline and clinical information. Baseline data included demographic details such as age, gender, area of residence, social class, marital status, BMI, smoking status, and comorbidities (hypertension,

diabetes mellitus, dyslipidemia). Clinical data collected included systolic and diastolic blood pressure, heart rate before the intervention, diagnosis at admission, anti-ischemic treatment, serum creatinine levels, random blood sugar, hemoglobin levels, duration of hospitalization, and in-hospital outcomes.

Coronary angiography and PCI were performed by an interventional cardiologist with a minimum of five years of experience. The severity of left main coronary artery disease was assessed via coronary angiography, performed either through femoral or radial access. A stenosis of ≥50% in the left main artery was classified as severe. Following the angiographic assessment, a joint decision was made by the patient and the interventionalist on whether to proceed with PCI or opt for CABG.

Bias: Selection bias was minimized by using a convenient sampling technique, including all patients who met the inclusion criteria during the study period. However, the lack of randomization could introduce potential bias, which was acknowledged as a limitation of this observational study.

Study Size: The study included a total of 129 patients, chosen based on the predefined inclusion and exclusion criteria. This sample size was deemed sufficient to observe the in-hospital outcomes of patients undergoing LM PCI at the NICVD, Hyderabad.

Quantitative Variables: Quantitative variables included continuous variables such as age, BMI, systolic and diastolic blood pressure, heart rate, serum creatinine levels, random blood sugar, and hemoglobin levels. Categorical variables included gender, area of residence, social class, marital status, smoking status, comorbid conditions, diagnosis at admission, and in-hospital outcomes.

Statistical Methods: All collected data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as means and standard deviations, while categorical data were presented as frequencies and percentages. The chi-square test or Fisher's exact test was used for comparing categorical variables, and Student's t-test was used for continuous variables where appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

Participants: The study included a total of 129 patients with angiographically proven left main (LM) coronary artery disease who underwent percutaneous coronary intervention (PCI). The participants were predominantly male, with 101 males (78.29%) and 28 females (21.70%). The mean age of the participants was 51.22±12.03 years, with an age range of 30 to 70 years. All patients were selected based on strict inclusion and exclusion criteria to ensure the study's relevance and accuracy.

Table 1: baseline and clinical variables of study participants

Continuous variables	(N = 129)
Age (Mean ± SD) – years	51.22 ± 12.03
Weight – kg	79.88 ± 10.08
Height – cm	168.04 ± 5.67
BMI - kg/m2	25.36 ± 4.81
Systolic blood pressure – mmHg	143.58 ± 50.74
Diastolic blood pressure – mmHg	72.33 ± 12.57
Heart rate – bpm	88.45 ± 20.58
Random blood sugar - mg/dl	168.42 ± 70.40
Serum creatinine	0.89 ± 0.89
Hemoglobin level - gm/dl	12.84 ± 3.51
Duration of hospitalization – days	02.04 ± 3.55
Gender	
Male	101 (78.29%)
Female	28 (21.7%)
Area of residence	
Urban	105 (81.39%)
Rural	24 (18.6%)
Marital status	
Unmarried	4 (3.1%)
Married	122 (91.57%)
Widowed	3 (2.32%)
Comorbid	
Hypertension	32 (24.8%)
Diabetes mellitus	22 (17.5%)
Dyslipidemia	34 (26.35%)
Current smoker	15 (11.62%)
Family history of CAD	8 (6.2%)
Anti-ischemic therapy	5 (3.87%)

CAD = coronary artery disease, BMI = body mass index, NSTEMI = non-ST segment elevation myocardial infarction, STEMI = ST segment elevation myocardial infarction

Descriptive Data: The baseline characteristics of the study participants revealed that the majority were overweight, with a mean body mass index (BMI) of 25.36±4.81 kg/m². Most patients presented with elevated systolic blood pressure prior to the PCI procedure, with a mean systolic blood pressure of 143.58±50.74 mmHg, while the mean diastolic blood pressure was 72.33±12.57 mmHg. The average heart rate of the participants was 88.45±20.58 beats per minute.

The study also evaluated various comorbid conditions among the participants. Dyslipidemia was the most common comorbidity, observed in 34 patients (26.35%), followed by hypertension in 32 patients (24.80%) and type 2 diabetes mellitus in 22 patients (17.50%). A small percentage of patients had a family history of premature ischemic heart disease (6.2%) or were current smokers (11.62%). Additionally, only 3.87% of the participants were already receiving anti-ischemic therapy at the time of their hospital admission.

The mean duration of hospitalization for patients who underwent PCI was 2.04±3.55 days. Most of the participants (81.39%) resided in urban areas, while 18.60% were from rural areas. Regarding marital status, the majority of patients were married (94.57%), with a small percentage being unmarried (3.10%) or widowed (2.32%).

Outcome Data: The primary outcome of interest was the in-hospital complications observed in patients who underwent PCI for LM disease. Heart failure was the most common complication, occurring in 12 patients (9.8%) during hospitalization. Arrhythmias were noted in 5 patients (3.87%), while 3 patients (2.32%) experienced in-hospital mortality following the procedure.

The data also indicated that the majority of patients (95.34%) presented with acute ST-segment elevation myocardial infarction (STEMI) as the indication for coronary angiography, while unstable angina was the least common indication, observed in only one patient (0.77%).

Main Results: The study successfully identified key in-hospital outcomes for patients with left main coronary artery disease who underwent PCI. The findings revealed that heart failure and arrhythmias were the most frequently observed complications. Despite the severity of the condition, in-hospital mortality was relatively low at 2.32%, suggesting that PCI for LM disease, when performed under appropriate conditions and patient selection, can have favorable outcomes.

DISCUSSION

Acute coronary syndrome (ACS) is one of the leading causes of admission in cardiovascular emergencies, with patients diagnosed with STEMI (ST-segment elevation myocardial infarction) and NSTEMI (non-ST-segment elevation myocardial infarction) being prioritized for emergency or elective coronary angiography and/or angioplasty, respectively [7]. Left main (LM) coronary artery disease or multivessel disease is often associated with poorer in-hospital outcomes compared to single-vessel disease [8-10]. Given the complexity and severity of LM disease, the decision to proceed with percutaneous coronary intervention (PCI) versus coronary artery bypass grafting (CABG) should be made carefully, considering the risks, benefits, and the expertise available.

Figure 1: In-hospital outcome of patients intervened for left main disease
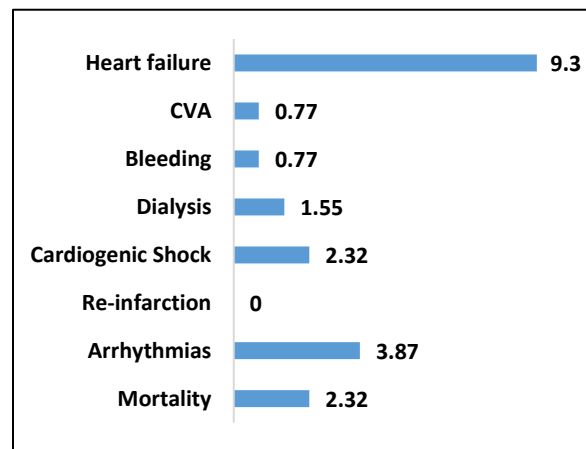
Numerous risk factors contribute to the development of LM disease. Previous studies by Sinha SK [11] and Caracciolo EA [12] identified smoking, a family history of premature ischemic heart disease, a sedentary lifestyle, stress, and obesity as significant risk factors for LM disease. In our study, we found that male gender, smoking, urban residency, and dyslipidemia were more frequently associated with LM disease. Although the precise pathology underlying these associations remains unclear, it is hypothesized that the accumulation of risk factors increases the likelihood of developing LM or multivessel disease.

Patients with LM disease typically belong to the middle-aged demographic, reflecting the severity of the condition and the resultant compromised myocardial blood flow. Our findings, with a mean patient age of 51.22±12.03 years, align with previous research indicating a mean age of 50.46±13.2 years in patients with LM disease [13]. However, a study conducted at Aga Khan University in Karachi reported a significantly higher mean age of 66.05±12.6 years

[14]. This discrepancy may be attributed to differences in the study populations; our research included all patients with ACS, which may have lowered the mean age.

The prognosis for patients with LM disease undergoing PCI is influenced by various factors, including vessel anatomy, disease severity and location, comorbid conditions, and myocardial function. In our study, heart failure was the most common complication observed post-PCI, occurring in 9.30% of patients. This contrasts with a national study that identified cardiogenic shock as the most prevalent clinical presentation [15]. Notably, the in-hospital mortality rate in our cohort was relatively low at 2.32%, which is considerably lower than the rates reported in studies from the United States (12.8%) and Japan (18.9%) [16].

A study conducted in Romania reported no major adverse cardiovascular events during hospitalization following PCI for LM disease, although there was one case of death eight months post-PCI [17]. The variation in outcomes across studies can be attributed to differences in patient populations (e.g., the inclusion of patients with acute myocardial infarction versus those undergoing elective procedures), clinical presentation, ethnicity, hospital resources, time to treatment, and operator expertise.

Our study underscores the importance of personalized treatment strategies for LM disease, taking into account the unique risk profiles and clinical presentations of patients. Further research is needed to better understand the factors influencing outcomes in this high-risk population and to optimize treatment approaches accordingly.

Limitations

While this study provides valuable insights, several limitations must be acknowledged and addressed in future research. Firstly, the single-center design of our study inherently limits the generalizability of the findings due to the relatively small sample size. A more extensive, multi-center study would provide a more comprehensive understanding of left main (LM) disease. Additionally, while we identified key risk factors associated with LM disease, a more detailed evaluation of all potential risk factors is necessary to develop a complete risk profile. Moreover, our study focused exclusively on short-term, in-hospital outcomes; long-term follow-up studies are essential

to assess the durability and extended prognosis of patients treated with percutaneous coronary intervention (PCI) for LM disease.

CONCLUSION

This study demonstrated that PCI for LM disease yielded favorable prognostic outcomes in patients admitted with ACS. Cardiac arrhythmias emerged as the most common complication, while the post-procedural mortality rate was notably lower than in other studies. These findings underscore the potential of PCI as an effective treatment strategy for LM disease, although further research, particularly in diverse and larger populations with long-term follow-up, is necessary to confirm these outcomes and refine treatment approaches.

AUTHORS' CONTRIBUTION

AHG, MZB, MRB, AFS, SHM, and ZIA: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work. AHG, MZB, MRB, AFS, SHM, and ZIA: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

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