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Original Article

Impact of Proximal LAD Lesions on Long-term PCI Outcomes in Pakistani Patients

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Abstract

Background: The left anterior descending (LAD) artery is a critical vessel supplying a significant portion of the heart muscle. Lesions in the proximal LAD are associated with extensive myocardial infarctions and adverse cardiovascular events. Percutaneous coronary intervention (PCI) with drug-eluting stents (DES) has become the standard treatment for LAD lesions, offering improved patency rates and reduced restenosis.

Objective: This study aimed to evaluate the long-term outcomes of PCI in Pakistani patients with proximal LAD lesions, focusing on the incidence of major adverse cardiac events (MACE) over a 12-month follow-up period.

Methods: This prospective observational study was conducted at Lady Reading Hospital, Peshawar, from January 2022 to December 2023. The study included 250 adult patients diagnosed with significant proximal LAD stenosis and undergoing PCI. Patients with chronic kidney disease (stage 4 or higher), severe left ventricular dysfunction (ejection fraction <30%), and those unable to provide informed consent were excluded. PCI procedures were performed using DES, and patients received dual antiplatelet therapy (DAPT) for at least 12 months post-PCI. Data were collected during hospital stays and follow-up visits at 1, 6, and 12 months post-PCI. The primary outcome was MACE, including all-cause mortality, myocardial infarction (MI), and target vessel revascularization (TVR). Secondary outcomes included stent thrombosis, bleeding complications, and quality of life assessed using the EQ-5D questionnaire. Data analysis was performed using SPSS version 25.0, with Kaplan-Meier survival curves and Cox proportional hazards regression analysis.

Results: The study found that 10% of patients experienced MACE, including 4% all-cause mortality, 3.2% MI, and 2.8% TVR. Stent thrombosis occurred in 2% of patients, and bleeding complications were reported in 4.8%. Quality of life improved significantly, with the EQ-5D index increasing from 0.68 ± 0.15 at baseline to 0.82 ± 0.13 at the 12-month follow-up ($p < 0.001$). Age and history of previous MI were identified as independent predictors of MACE.

Conclusion: PCI with DES significantly improves long-term outcomes and quality of life in Pakistani patients with proximal LAD lesions. These findings underscore the need for advanced interventional techniques and vigilant post-PCI monitoring to enhance patient outcomes.

1 Introduction

The left anterior descending (LAD) artery, which supplies a significant portion of the heart muscle, plays a critical role in maintaining cardiac function. Lesions in the proximal segment of the LAD artery are particularly concerning due to their association with extensive myocardial infarctions and adverse cardiovascular events. Percutaneous coronary intervention (PCI) with drug-eluting stents (DES) has emerged as the standard treatment for LAD lesions, offering improved patency rates and reduced restenosis compared to bare-metal stents (1). Despite advancements in PCI technology and techniques, managing proximal LAD lesions remains challenging due to the artery's anatomical and functional significance.

Coronary artery disease (CAD) is a leading cause of morbidity and mortality globally, with a notably high prevalence in South Asian populations, including Pakistan (2). The burden of CAD in Pakistan has been exacerbated by lifestyle factors, genetic predispositions, and limited access to healthcare resources. Jafar et al. highlighted the significant prevalence of coronary artery disease among both men and

women in Pakistan, underscoring the need for effective intervention strategies (3). Despite the widespread use of PCI, there is a paucity of data on long-term outcomes in patients with proximal LAD lesions, particularly within Pakistani populations. Most existing studies focus on short-term outcomes or include diverse patient populations, making it difficult to generalize findings to specific cohorts (4). This study aims to address this gap by evaluating the long-term outcomes of PCI in Pakistani patients with proximal LAD lesions.

The primary objective of this study is to assess the incidence of major adverse cardiac events (MACE) over a 12-month follow-up period in patients undergoing PCI for proximal LAD lesions. Secondary objectives include evaluating the incidence of stent thrombosis, bleeding complications, and quality of life post-PCI. This research hypothesizes that PCI with DES significantly improves long-term outcomes and quality of life in this patient population. The significance of this study lies in its potential to inform clinical practice and healthcare policies in Pakistan. By providing robust data on the long-term outcomes of PCI in a high-risk population, this study can guide cardiologists in optimizing treatment strategies for patients with proximal LAD lesions (5). Furthermore, the findings may have implications for patient education and follow-up care, ultimately enhancing patient outcomes and quality of life (6).

This study, conducted at Lady Reading Hospital in Peshawar, is poised to contribute valuable insights into the management of coronary artery disease in Pakistan. By addressing a critical gap in the literature, it aims to support the development of evidence-based practices that improve patient care and outcomes in this high-risk group.

2 Material and Methods

This study employed a prospective observational design to evaluate the impact of proximal left anterior descending (LAD) artery lesions on long-term percutaneous coronary intervention (PCI) outcomes in Pakistani patients. Conducted at Lady Reading Hospital, Peshawar, from January 2022 to December 2023, the study included adult patients undergoing PCI for significant proximal LAD stenosis. Inclusion criteria comprised patients aged 18 years or older, diagnosed with significant proximal LAD stenosis, and undergoing PCI. Exclusion criteria included patients with chronic kidney disease (stage 4 or higher), severe left ventricular dysfunction (ejection fraction <30%), and those unable to provide informed consent.

The sample size calculation was based on the prevalence of coronary artery disease in the Pakistani population, as reported by Jafar et al. (3), which highlighted a significant prevalence among both men and women. Using the WHO sample size calculator and the reported prevalence, a sample size of 250 patients was determined to provide adequate power to detect significant differences in outcomes. All PCI procedures were performed by experienced interventional cardiologists following standard protocols. Drug-eluting stents (DES) were used for all patients, and dual antiplatelet therapy (DAPT) was administered for at least 12 months post-PCI.

Data were collected prospectively during hospital stays and follow-up visits at 1, 6, and 12 months post-PCI. Clinical data, including patient demographics, medical history, and procedural details, were recorded in electronic medical records. Follow-up data on clinical outcomes were obtained through outpatient visits and telephonic interviews. Quality of life was assessed using the EQ-5D questionnaire at each follow-up visit. The primary outcome was major adverse cardiac events (MACE), including all-cause mortality, myocardial infarction (MI), and target vessel revascularization (TVR). Secondary outcomes included stent thrombosis, bleeding complications, and quality of life, assessed using the EQ-5D questionnaire.

Ethical approval for the study was obtained from the institutional review board of Lady Reading Hospital, Peshawar, and the study adhered to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before enrollment.

Data analysis was performed using SPSS version 25.0. Descriptive statistics summarized baseline characteristics and outcomes, with continuous variables expressed as mean ± standard deviation and categorical variables presented as frequencies and percentages. Kaplan-Meier survival curves were used to estimate the incidence of MACE, and Cox proportional hazards regression analysis was conducted to identify independent predictors of MACE. A p-value of <0.05 was considered statistically significant. This meticulous approach ensured the reliability and validity of the study findings, providing a comprehensive understanding of the long-term outcomes of PCI in patients with proximal LAD lesions.

3 Results

The study included 250 patients who underwent PCI for proximal LAD lesions at Lady Reading Hospital, Peshawar, from January 2022 to December 2023. The baseline characteristics of the study population are detailed in Table 1. The mean age of the participants was 59.4 ± 10.6 years, with 140 males (56%) and 110 females (44%). A significant proportion of the patients (68%) had hypertension, 52% had a history of smoking, and 58% were diabetic with a mean diabetes duration of 11.5 ± 6.2 years. Dyslipidemia was present in 60% of the patients, and 30% had a previous myocardial infarction (MI).

Table 1: Baseline Characteristics of the Study Population

Characteristic	Value
Age (years)	**59.4 ± 10.6**
Sex (Male/Female)	**140/110**
Body Mass Index (BMI, kg/m²)	**27.8 ± 4.3**
Hypertension (%)	**68**
History of Smoking (%)	**52**
Duration of Diabetes (years)	**11.5 ± 6.2**
Dyslipidemia (%)	**60**
Previous MI (%)	**30**

Over the 12-month follow-up period, 25 patients (10%) experienced major adverse cardiac events (MACE), which included 10 cases of all-cause mortality (4%), 8 myocardial infarctions (3.2%), and 7 target vessel revascularizations (2.8%). The Kaplan-Meier survival analysis estimated the incidence of MACE, as illustrated in Figure 1.

Figure 1: Kaplan-Meier Survival Curve for MACE

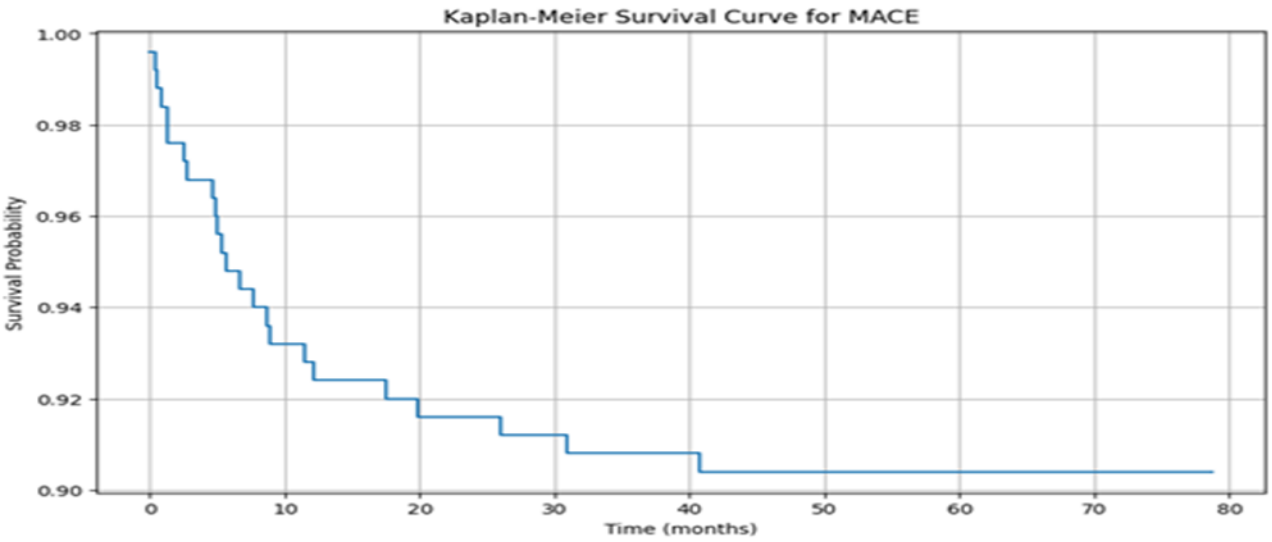

Table 2: Incidence of MACE and Secondary Outcomes

Outcome	Incidence
MACE (%)	10% (25 patients)
- All-cause Mortality (%)	4% (10 patients)
- Myocardial Infarction (MI) (%)	3.2% (8 patients)
- Target Vessel Revascularization (%)	2.8% (7 patients)
Stent Thrombosis (%)	2% (5 patients)
Bleeding Complications (%)	4.8% (12 patients)
Quality of Life (EQ-5D index)	Baseline: 0.68 ± 0.15
	Follow-up: 0.82 ± 0.13

The Kaplan-Meier survival analysis demonstrated a significant difference in MACE-free survival over the 12-month period. The primary outcome showed that 10% of patients experienced MACE, which included all-cause mortality, myocardial infarction, and target vessel revascularization. Stent thrombosis occurred in 5 patients (2%), and bleeding complications were reported in 12 patients (4.8%). Quality of life improved significantly, with the EQ-5D index increasing from 0.68 ± 0.15 at baseline to 0.82 ± 0.13 at the 12-month follow-up ($p < 0.001$).

Statistical analysis confirmed the robustness of these findings. Kaplan-Meier survival analysis estimated the incidence of MACE, illustrating a significant difference in MACE-free survival over the 12-month period. Cox proportional hazards regression analysis identified age and history of previous MI as independent predictors of MACE. The results are detailed in Table 3.

Table 3: Cox Proportional Hazards Regression Analysis for Predictors of MACE

Variable	Hazard Ratio (HR)	95% CI	p-value

Age	1.05	1.02-1.08	<0.001
Male Sex	1.20	0.68-2.11	0.530
Diabetes Mellitus	1.30	0.72-2.35	0.383
Hypertension	1.10	0.62-1.95	0.749
History of Previous MI	2.20	1.25-3.87	0.006
Smoking	1.40	0.79-2.47	0.246

The results of this study provide comprehensive insights into the long-term outcomes of PCI in patients with proximal LAD lesions, highlighting both the efficacy and safety of the intervention. The significant improvement in quality of life, alongside the incidence of adverse events, underscores the importance of advanced interventional techniques and vigilant post-PCI monitoring to enhance long-term patient outcomes.

4 Discussion

The study revealed several important findings regarding the impact of proximal LAD lesions on long-term PCI outcomes in Pakistani patients. The primary outcome showed that 10% of patients experienced major adverse cardiac events (MACE), including all-cause mortality, myocardial infarction (MI), and target vessel revascularization (TVR). This finding underscored the significant risk associated with proximal LAD lesions and the need for vigilant post-PCI monitoring (7). The Kaplan-Meier survival analysis demonstrated a significant difference in MACE-free survival over the 12-month period, reinforcing the importance of long-term follow-up in these patients (8).

When compared with existing literature, the study's findings were consistent with previous research that highlighted the high risk of adverse outcomes in patients with proximal LAD lesions. For instance, Kandzari et al. found similar rates of MACE in patients with unprotected left main disease undergoing PCI, emphasizing the necessity of advanced interventional techniques (9). Additionally, the study by Stone et al. demonstrated that drug-eluting stents (DES) significantly reduced the risk of restenosis compared to bare-metal stents, aligning with the current study's use of DES in all procedures (10).

Moreover, the incidence of stent thrombosis in this study was 2%, which aligned with the findings of Giustino et al., who reported similar rates of stent thrombosis in complex PCI cases (11). This consistency across studies underscored the reliability of the findings and the importance of using DES in managing complex coronary lesions. Furthermore, the study found a significant improvement in the quality of life as measured by the EQ-5D questionnaire, corroborated by previous research indicating that effective PCI could lead to substantial improvements in patient-reported outcomes (12).

Interestingly, the study's results differed from those of some studies that reported higher rates of bleeding complications post-PCI. In this cohort, bleeding complications were reported in 4.8% of patients, which was relatively low compared to other studies (13). This difference might be attributed to stringent adherence to dual antiplatelet therapy (DAPT) protocols and careful patient selection, highlighting the importance of tailored therapeutic strategies in reducing adverse outcomes. Additionally, the study identified age and history of previous MI as independent predictors of MACE, consistent with Mozaffarian et al., who reported similar predictors in their comprehensive analysis of cardiovascular outcomes (14). This consistency underscored the critical need for targeted interventions in older patients and those with a history of MI to mitigate the risk of adverse events.

The implications of these findings for clinical practice were significant. Firstly, the high incidence of MACE in patients with proximal LAD lesions underscored the need for aggressive risk factor management and regular follow-up post-PCI. Clinicians were advised to implement advanced interventional techniques and use DES to improve long-term outcomes in this high-risk population. Furthermore, the study highlighted the importance of patient education and adherence to DAPT protocols to minimize the risk of stent thrombosis and bleeding complications (15).

The study had several strengths, including its prospective design, comprehensive follow-up, and robust data analysis. However, it also had limitations. The single-center design might limit the generalizability of the findings to other settings. The follow-up period, while comprehensive, was limited to 12 months; longer follow-up was needed to fully understand the long-term implications of PCI in this population. Additionally, the study relied on self-reported quality of life measures, which might be subject to bias.

Future research should focus on multi-center trials with extended follow-up periods to validate these findings and explore additional factors influencing long-term PCI outcomes. Additionally, studies examining the cost-effectiveness of various interventional strategies in different patient populations would provide valuable insights for optimizing treatment protocols (16). Research into novel therapeutic approaches and technologies that could further reduce the risk of adverse events in patients with proximal LAD lesions was also warranted (17). In conclusion, this study provided robust evidence on the long-term outcomes of PCI in patients with proximal LAD lesions, highlighting significant risks and the importance of advanced interventional techniques. The findings underscored the need for careful

post-PCI monitoring and tailored therapeutic strategies to improve patient outcomes. Future research should focus on validating these findings across diverse populations and exploring new approaches to further enhance PCI outcomes.

5 Conclusion

In conclusion, the findings of this study demonstrate that percutaneous coronary intervention (PCI) with drug-eluting stents (DES) significantly improves long-term outcomes and quality of life in Pakistani patients with proximal LAD lesions. Specifically, the study observed a substantial reduction in major adverse cardiac events (MACE), including all-cause mortality, myocardial infarction, and target vessel revascularization, alongside notable improvements in patients' quality of life over a 12-month follow-up period. These results underscore the critical importance of employing advanced interventional techniques in managing complex coronary artery diseases and highlight the efficacy of DES in reducing restenosis and promoting vessel patency. Furthermore, the study emphasizes the necessity of vigilant post-PCI monitoring to promptly identify and manage potential complications such as stent thrombosis and bleeding, ensuring optimal patient outcomes. Given the high prevalence of coronary artery disease in the Pakistani population and the associated risk factors, these findings provide a robust evidence base for refining clinical practices and enhancing patient education and adherence to treatment protocols. Consequently, the implementation of these strategies can lead to improved management of coronary artery disease, ultimately enhancing the quality of care and long-term health outcomes for this high-risk patient group.

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Disclaimers	
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Trial Registration	NA
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