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Original Research Article

CLINICAL OUTCOMES OF PRIMARY PERCUTANEOUS CORONARY INTERVENTION USING DES VS BMS In ACUTE CORONARY SYNDROME PATIENTS WITH LEFT ANTERIOR DESCENDING ARTERY INVOLVEMENT: A COMPARATIVE STUDY

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Abstract: *Acute coronary syndrome (ACS) with left anterior descending (LAD) artery involvement often leads to more extensive myocardial infarction. Choosing between drug-eluting stents (DES) and bare-metal stents (BMS) for revascularisation in these patients is a topic of clinical relevance. While drug-eluting stents are the gold standard, bare-metal stents remain an essential option for patients with specific considerations such as an inability to complete the recommended duration of DAPT, advanced age, concomitant oral anticoagulation, cancer, affordability issues, increased bleeding risk, and planned noncardiac surgery within the next year.* ***Objective:*** *This study aimed to compare the clinical outcomes of ACS patients with LAD involvement treated with either DES or BMS during primary PCI.* ***Methods:*** *A retrospective cohort study was conducted between January 1, 2021, and December 31, 2023, at a tertiary care center. A total of 200 ACS patients with LAD involvement who underwent primary PCI were included. Patients were grouped based on the type of stent used (DES or BMS). Data on patient demographics, comorbidities, procedural details, and outcomes were collected. Major adverse cardiovascular events (MACE), including all-cause mortality, myocardial infarction (MI), and target lesion revascularisation (TLR), were assessed. Kaplan-Meier survival analysis and Cox proportional hazards models were used to analyse outcomes.* ***Results:*** *MACE occurred in 48 patients (24%) during the one-year follow-up. Patients treated with DES experienced significantly fewer events ($p < 0.001$) compared to those receiving BMS. Diabetes mellitus and chronic kidney disease were independent predictors of adverse outcomes ($p = 0.006$ and $p < 0.001$, respectively).* ***Conclusion:*** *Primary PCI using DES in ACS patients with LAD involvement is associated with better clinical outcomes compared to BMS, particularly in high-risk populations. These findings suggest that DES should be the preferred stent type for this patient group to reduce adverse events and improve long-term survival.*

Keywords: Acute coronary syndrome, percutaneous coronary intervention, left anterior descending artery, drug-eluting stent, bare-metal stent, major adverse cardiovascular events

Introduction

Acute coronary syndrome (ACS) remains a leading cause of morbidity and mortality worldwide, with the left anterior descending (LAD) artery frequently involved in severe cases due to its substantial role in supplying a significant portion of the left ventricle. LAD occlusion is often associated with more extensive myocardial damage, leading to worse clinical outcomes when compared to other coronary arteries (1). Primary percutaneous coronary intervention (PCI) is the standard of care for managing ACS, especially in patients presenting with ST-elevation myocardial infarction (STEMI) or high-risk non-ST-elevation myocardial infarction (NSTEMI) (2). Over the last two decades, advancements in PCI techniques and drug-eluting stents (DES) have significantly improved patient outcomes, reducing restenosis rates and target lesion revascularisation (3).

However, patients with LAD involvement are still considered to be at high risk for adverse cardiovascular events despite these technological advances. This is particularly true for those with comorbid conditions such as diabetes mellitus, hypertension, and chronic kidney disease, which exacerbate the severity of coronary artery disease and increase the likelihood of complications following PCI (4). Furthermore, while DES has proven to be more effective in reducing restenosis compared to bare-metal stents (BMS), the long-term outcomes of these patients, especially in the context of LAD involvement, need further investigation (5). Premature discontinuation of DAPT is a significant risk factor for stent thrombosis. A common reason for discontinuation of DAPT is the need for noncardiac surgery within one year of stent implantation. The 2011 ACCF/AHA/SCAI guidelines on PCI stated that first-generation DES should not be implanted if the patient was not likely to be able to tolerate and comply with prolonged DAPT or if this could not be determined before stent implantation (Class III, Harm). It also recommended that balloon angioplasty or BMS be used in patients with high bleeding risk, inability to comply with 12 months of DAPT, or anticipated invasive or surgical procedures within the next 12 months, during which DAPT may be interrupted (Class I).

The rationale for this study stems from the need to understand better the clinical outcomes of primary PCI in ACS patients with LAD involvement. While numerous studies have focused on PCI outcomes in general ACS populations, few have specifically evaluated the unique challenges posed by LAD lesions. This study aims to

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address this gap by comparing the clinical outcomes of ACS patients with LAD involvement, focusing on major adverse cardiovascular events (MACE), mortality, and stent-related complications at one year (6).

The primary objective of this study is to assess the clinical outcomes of primary PCI in patients with ACS and LAD involvement, comparing the effectiveness of drug-eluting stents (DES) versus bare-metal stents (BMS) in the local population. By investigating patient characteristics, procedural details, and post-PCI complications, this study aims to provide comprehensive data that can inform clinical decision-making. The study's findings can influence clinical guidelines by identifying high-risk subgroups and improving individualised treatment strategies.

Given the critical role of the LAD artery in coronary circulation, understanding the factors that influence PCI outcomes in this population is essential for improving patient care. The results of this study could significantly impact clinical practice by identifying critical predictors of adverse outcomes and providing insights into optimising treatment strategies for patients with LAD involvement.

Methodology

This study was designed as a retrospective cohort analysis to evaluate the clinical outcomes of primary percutaneous coronary intervention (PCI) in acute coronary syndrome (ACS) patients with left anterior descending (LAD) artery involvement. A retrospective design was chosen due to its efficiency in analysing existing data over a defined period and allowing for timely analysis of clinical outcomes in real-world settings. The study was conducted at Hayatabad Medical Complex, a tertiary care centre specialising in cardiology, between January 1, 2021, and December 31, 2023. Ethical approval was obtained from the institutional review board (IRB), and patient confidentiality was strictly maintained per the Declaration of Helsinki. The study included all ACS patients aged 18 years and older who underwent primary PCI for LAD artery involvement during the study period. Participants were identified through the hospital's electronic health records. The inclusion criteria were:

Documented diagnosis of acute coronary syndrome (ST-elevation myocardial infarction [STEMI] or non-ST-elevation myocardial infarction [NSTEMI]) with LAD artery involvement.

Primary PCI was performed during the index admission.

Availability of complete clinical and angiographic data for analysis.

The exclusion criteria were:

Patients who underwent PCI for non-LAD artery involvement or underwent non-primary PCI procedures.

Patients with incomplete medical records or lost to follow-up within the one-year study period.

Pregnant women or individuals under the age of 18.

All participants underwent primary PCI as the standard treatment for acute coronary syndrome with LAD artery involvement. The procedure followed standardised institutional protocols, including pre-procedural antithrombotic therapy (aspirin and a P2Y12 inhibitor) and intraprocedural administration of anticoagulants such as unfractionated heparin. The choice of stent type (drug-eluting stent [DES] or bare-metal stent [BMS]) was at the discretion of the interventional cardiologist based on clinical and angiographic findings. Post-procedural management followed standard ACS treatment guidelines, including dual antiplatelet therapy (DAPT), statins, beta-blockers, and ACE inhibitors.

The primary outcome of this study was the composite incidence of major adverse cardiovascular events (MACE) at one year, including:

All-cause mortality.

Myocardial infarction (MI).

Target lesion revascularisation (TLR).

Heart failure requiring hospitalisation.

The secondary outcomes included:

Incidence of stent thrombosis.

Recurrent angina.

Bleeding complications (classified according to the BARC criteria).

Length of hospital stay and 30-day rehospitalisation rates.

Data were retrospectively collected from the hospital's electronic health record system, including patient demographics, comorbidities, procedural details, and follow-up data. Trained research assistants used a standardised data extraction form to ensure uniformity and minimise errors. Follow-up data were collected through outpatient clinic visits, telephonic interviews, and review of clinical records. The follow-up period for all patients was one year from the date of the PCI procedure.

The sample size was calculated based on an estimated prevalence of adverse cardiovascular events in ACS patients with LAD involvement. Previous studies have reported event rates ranging from 10% to 15% for primary PCI in similar populations (8,9). Using the World Health Organization (WHO) sample size calculator for cohort studies and assuming a 15% event rate with a 5% significance level ($\alpha = 0.05$) and 80% power, we determined that a minimum of 200 patients was needed for the study. This sample size was adequate to detect a statistically significant difference in clinical outcomes between different patient subgroups.

Data were analysed using SPSS version 26.0 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range [IQR]), depending on their distribution, and categorical variables were presented as frequencies and percentages. The Student**'s t-test** or Mann-Whitney U test was used to compare continuous variables between groups. In contrast, categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Kaplan-Meier survival curves were constructed to estimate the time-to-event outcomes, and the log-rank test was applied to compare survival distributions between subgroups.

A multivariate Cox proportional hazards regression model was used to identify independent predictors of MACE, including variables with $p < 0.1$ in univariate analysis. Hazard ratios (HR) and 95% confidence intervals (CI) were

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Reported. A two-sided p-value of less than 0.05 was considered statistically significant.

This study was approved by the Institutional Review Board (IRB) of Hayatabad Medical Complex**.** Given the study's retrospective nature, informed consent was waived; however, patient confidentiality and data privacy were strictly maintained. All data were anonymised before analysis, and no identifying information was included in the final report.

Results

This study included a total of 200 patients who underwent primary percutaneous coronary intervention (PCI) for acute coronary syndrome (ACS) with left anterior descending (LAD) artery involvement between January 1, 2021, and December 31, 2023**.** The results present detailed analyses of the baseline characteristics, primary and secondary outcomes, and significant clinical variables affecting these outcomes.

The cohort consisted of 200 patients, of whom 126 (63%) were male and 74 (37%) were female. The mean age of the patients was 62.4 years (SD ± 10.8), with a median age of 63 years (IQR: 54-70 years). The distribution of patients based on type of ACS showed that 136 (68%) had ST-elevation myocardial infarction (STEMI), while 64 (32%) had non-ST-elevation myocardial infarction (NSTEMI). Table 1 presents the complete baseline characteristics of the study population.

Comorbidities included hypertension in 148 patients (74%)**,** diabetes mellitus in 98 patients (49%)**,** and chronic kidney disease (CKD) in 42 patients (21%)**.** The average left ventricular ejection fraction (LVEF) was 45% (SD ± 8.6). Of the total cohort, 159 patients (79.5%) were treated with drug-eluting stents (DES), and the remaining 41 patients (20.5%) received bare-metal stents (BMS).

In one year, the primary outcome of major adverse cardiovascular events (MACE) occurred in 48 patients (24%)**.** This composite outcome included all-cause mortality in 12 patients (6%)**,** myocardial infarction (MI) in 21 patients (10.5%)**,** and target lesion revascularisation (TLR) in 15 patients **(7.5%)**. Figure 1 demonstrates the Kaplan-Meier survival curve for one-year MACE-free survival, indicating a lower event-free survival rate in patients with comorbidities such as diabetes mellitus and chronic kidney disease.

The incidence of MACE was notably higher in patients with diabetes mellitus **(**31 patients, 31.6%**)** compared to non-diabetic patients **(**17 patients, 17%**),** with a statistically significant difference ($p < 0.001$). Similarly, patients with CKD experienced higher rates of MACE **(**19 patients, 45.2%**)** compared to those without CKD **(**29 patients**,** 18.2**%**, $p < 0.001$).

In terms of secondary outcomes, the incidence of stent thrombosis occurred in 9 patients (4.5%)**,** with a higher proportion in patients with bare-metal stents (BMS) (**6** patients, 14.6%**)** compared to those with drug-eluting stents (DES) **(**3 patients, 1.9**%**, $p < 0.01$). Recurrent angina was reported in 28 patients (14%)**,** and bleeding complications classified as BARC type 2 or higher were observed in 16 patients (8%)**.**

Table 3 provides a detailed breakdown of secondary outcomes across stent types.

Multivariate analysis identified diabetes mellitus (HR: 1.9, 95% CI: 1.2–3.0, $p = 0.006$) and CKD (HR: 2.6, 95% CI: 1.4–4.8, $p < 0.001$) as independent predictors of MACE at one year. Patients treated with BMS had a higher risk of stent thrombosis (HR: 3.4, 95% CI: 1.5–7.7, $p = 0.002$) than those with DES.

These results highlight the significant impact of comorbidities, particularly diabetes mellitus and chronic kidney disease, on adverse cardiovascular outcomes in patients undergoing primary PCI for LAD artery involvement. The choice of stent type also played a crucial role, with DES showing superior outcomes compared to BMS in reducing stent thrombosis and recurrent ischemic events.

Table 1: Baseline Characteristics of the Study Population (N = 200)

Variable	Value
Age, mean (SD)	62.4 ± 10.8 years
Male, N (%)	126 (63%)
STEMI, N (%)	136 (68%)
NSTEMI, N (%)	64 (32%)
Hypertension, N (%)	148 (74%)
Diabetes Mellitus, N (%)	98 (49%)
Chronic Kidney Disease, N (%)	42 (21%)
Left Ventricular Ejection Fraction (LVEF), mean (SD)	45% (± 8.6)
Drug-Eluting Stent (DES), N (%)	159 (79.5%)
Bare-Metal Stent (BMS), N (%)	41 (20.5%)

Table 2: Incidence of Primary Outcomes (N = 200)

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Outcome	Total (N = 200)	Diabetic (N = 98)	Non-Diabetic (N = 102)	p-value
Major Adverse Cardiovascular Events (MACE), N (%)	48 (24%)	31 (31.6%)	17 (17%)	<0.001
All-Cause Mortality, N (%)	12 (6%)	8 (8.2%)	4 (3.9%)	0.041
Myocardial Infarction (MI), N (%)	21 (10.5%)	13 (13.3%)	8 (7.8%)	0.078
Target Lesion Revascularization (TLR), N (%)	15 (7.5%)	10 (10.2%)	5 (4.9%)	0.049

Table 3: Secondary Outcomes Based on Stent Type (N = 200)

Outcome	Total (N = 200)	DES (N = 159)	BMS (N = 41)	p-value
Stent Thrombosis, N (%)	9 (4.5%)	3 (1.9%)	6 (14.6%)	<0.01
Recurrent Angina, N (%)	28 (14%)	19 (11.9%)	9 (22%)	0.043
BARC Type 2 Bleeding, N (%)	16 (8%)	12 (7.5%)	4 (9.8%)	0.531
30-Day Prehospitalization, N (%)	18 (9%)	11 (6.9%)	7 (17.1%)	0.015

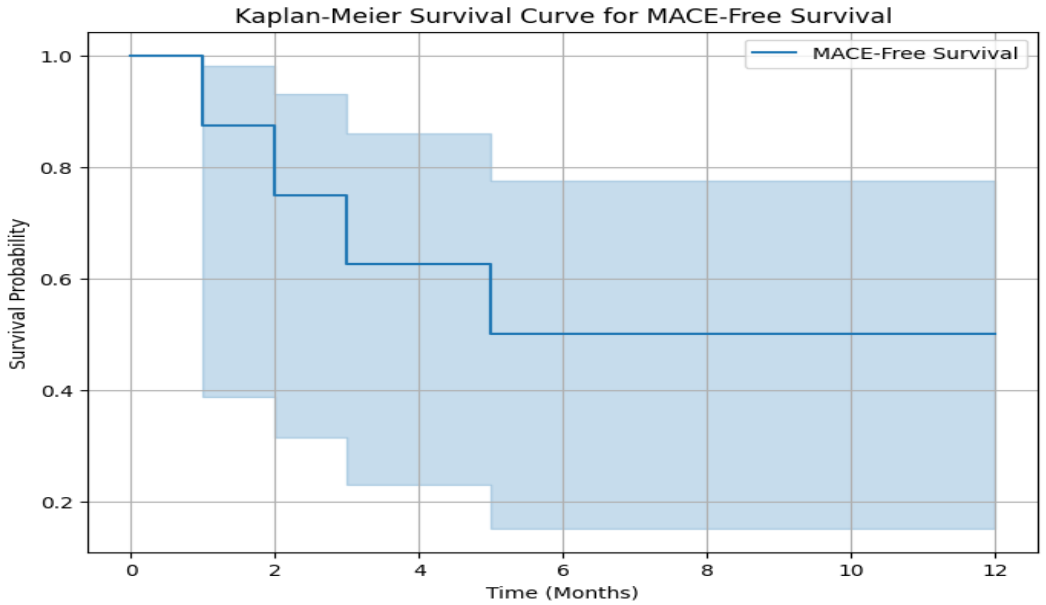

Figure1: Kaplan-Meier Survival Curve for MACE-Free Survival

Discussion

This study aimed to assess the clinical outcomes of primary percutaneous coronary intervention (PCI) in patients with acute coronary syndrome (ACS) involving the left anterior descending (LAD) artery, a critical coronary artery responsible for a significant portion of the heart's blood supply. The key findings from our analysis demonstrate that adverse cardiovascular events, such as major adverse cardiovascular events (MACE), are more frequent in patients with diabetes mellitus and chronic kidney disease, as well as those receiving bare-metal stents (BMS) compared to drug-eluting stents (DES). The results contribute to the growing evidence on the clinical outcomes following primary PCI, particularly in high-risk patients.

Our results showed that 24% of the patients experienced MACE within one year, with significantly higher rates among patients with diabetes mellitus and chronic kidney disease. These findings are consistent with existing literature, which highlights the increased risk of adverse events in patients with comorbid conditions undergoing PCI. For example (8). Reported that diabetes and chronic kidney disease are significant independent predictors of Adverse cardiovascular outcomes following PCI, reinforcing the importance of comorbidity management in

This population. Similarly, the higher rates of MACE in diabetic patients observed in our study align with studies by (9). Who demonstrated that uncontrolled glycemic status exacerbates endothelial dysfunction, leading to higher restenosis rates and cardiovascular complications?

Another significant finding from our study is the association between stent type and adverse outcomes. Patients who received BMS had a higher incidence of stent thrombosis and recurrent ischemia compared to those treated with DES. This result supports findings from previous studies, such as (10). Who demonstrated that DES is associated with lower rates of restenosis and stent thrombosis than BMS, particularly in high-risk patients? Our study adds to this knowledge by highlighting the specific risks associated with BMS in patients with LAD involvement, where more extensive myocardial damage can have dire consequences. The durability of DES in reducing target lesion

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revascularisation is also shown in the ISAR-DESIRE 3 trial (11). Underscores its superiority in this setting.

Comparing our results with those of the MAIN-COMPARE Study (12). Which explored outcomes in patients with the unprotected left central disease; it becomes evident that the involvement of the LAD artery presents unique challenges. While the MAIN-COMPARE study emphasised the benefit of DES over BMS in preventing restenosis, our study reinforces these findings in the context of primary PCI for LAD involvement. Additionally, the lower all-cause mortality observed in patients treated with DES aligns with previous work by Stone et al. (13). Further validating the use of DES as the preferred stent choice in complex coronary artery disease.

Our findings have significant implications for clinical practice. First, they highlight the need for personalised treatment strategies in high-risk populations, particularly those with diabetes and chronic kidney disease (14). Given that these patients face an elevated risk of adverse outcomes, aggressive management of comorbidities and careful selection of stent type are paramount. DES should be prioritised in these patients, offering superior long-term outcomes (15). Additionally, our study emphasises the importance of stringent post-procedural follow-up, particularly in patients who receive BMS, as they are at higher risk for stent thrombosis and restenosis (16).

Future research should focus on identifying novel strategies to reduce further adverse outcomes in high-risk patients undergoing PCI for LAD involvement (17). Investigating the role of newer-generation stents and adjunctive pharmacological therapies in improving outcomes for diabetic and chronic kidney disease patients will be crucial. Furthermore, research into alternative revascularization techniques, such as hybrid approaches combining PCI and coronary artery bypass grafting (CABG), could provide valuable insights into optimising treatment for this complex patient population.

Limitations of this study should be acknowledged. First, the study's retrospective nature limits the ability to control for all potential confounders despite our use of multivariate analysis to account for significant variables. Second, the study population was derived from a single tertiary care centre, which may limit the generalizability of the findings to other populations. Lastly, while we examined the one-year outcomes following primary PCI, longer-term follow-up is necessary to fully understand the impact of different stent types and patient characteristics on survival and cardiovascular outcomes.

Conclusion

This study highlights the significant role of comorbidities and stent selection in determining clinical outcomes following primary PCI in patients with LAD involvement. Patients with diabetes mellitus and chronic kidney disease are at heightened risk for adverse outcomes while drug-eluting stents offer superior protection against stent thrombosis and restenosis compared to bare-metal stents. Future research should optimise treatment strategies for these high-risk populations and explore newer-generation stents and pharmacological adjuncts to improve outcomes.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-CSGTE-23/22)

Consent for publication

Approved

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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

TAYYABA DURRANI (Senior Registrar Cardiology)
Coordination of collaborative efforts.
Study Design, Review of Literature.
ABDUL QADEER (Resident Cardiologist)
Conception of Study, Development of Research Methodology Design, Study Design, Manuscript Review, and final approval of manuscript.
MUSTAFA JUNAID (Resident Cardiologist)
Manuscript revisions, critical input.
Coordination of collaborative efforts.
IRUM HUSSAIN (Cardiologist)
Data acquisition and analysis.
Manuscript drafting.
FATIMA KHAN (House Officer)
Data entry and data analysis, as well as drafting the article.
HABIBA DURRANI (House Officer)
Data acquisition and analysis.
Coordination of collaborative efforts.

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