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COMPARATIVE ANALYSIS OF CLINICAL OUTCOMES IN OSTIAL VERSUS NON-OSTIAL LEFT ANTERIOR DESCENDING ARTERY LESIONS AMONG PATIENTS WITH ACUTE ANTERIOR WALL MYOCARDIAL INFARCTION UNDERGOING PRIMARY PCI

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ABSTRACT

Background: The objective is to compare clinical and procedural outcomes of ostial and non-ostial left anterior descending (LAD) artery lesions in patients with acute anterior wall myocardial infarction (AWMI) who undergo primary percutaneous coronary intervention (PPCI). This study employed a prospective cross-sectional design. This study was conducted at People's University of Medical and Health sciences for women Nawabshah from September 2024 to September 2025.

Materials and Methods: This study included 400 adult patients who underwent PPCI with artery lesions in the LAD, with AWMI. Inclusion criteria were confirmed according to AWMI, defined by ECG and biomarkers, and excluded prior cardiac surgery, valvular disease, or cardiomyopathy. ST-elevation myocardial infarction (STEMI), acute wall MI (AWMI), and ostial lesion definition were independent variables. The dependent variables were major adverse cardiovascular events (MACE), major procedural complications, and demographic characteristics. Data were collected using prospectively standardised forms and analysed using SPSS 21.0. Chi-square tests, t-tests, or Mann-Whitney U tests were used for statistical analysis ($p < 0.05$).

Results: Out of 400 patients, 137 (34.3%) had ostial lesions and 263 (65.7%) non-ostial. Ostial group showed older age (56.2±10.2 vs. 54.9±8.7 years, p<0.001), higher diabetes (40.9% vs. 20.9%, p=0.05), elevated Killip III-IV (19.0% vs. 2.8%, p<0.001), and prolonged ischemic time (7.4±2.3 vs. 6.6±1.5 hours, p=0.003). Procedurally, femoral access (32.8% vs. 13.3%, p<0.001), intra-aortic balloon pump use (19.7% vs. 3.8%, p<0.001), and slow-flow (37.9% vs. 19.0%, p<0.001) were higher in ostial cases, with lower final TIMI 3 flow (69.3% vs. 100%, p=0.001). In-hospital MACE was elevated in ostial group: arrhythmia (34.3% vs. 25.8%, p<0.001), cardiogenic shock (16.8% vs. 4.9%, p<0.001), heart failure (32.8% vs. 23.9%, p=0.001), and mortality (13.1% vs. 2.7%, p<0.001).

Conclusion: Patients with ostial LAD lesions show better in-hospital and procedural outcomes compared to those with non-ostial lesions, and it is important to note that such cases require specific approaches.

Keywords: Ostial LAD lesion, AWMI, Non-ostial LAD lesion, Primary percutaneous coronary intervention.

INTRODUCTION

Acute myocardial infarction (AMI) is a type of medical emergency that occurs when coronary arteries abruptly become blocked, leading to damage to the heart muscle.[1] The anterior wall myocardial infarction (AWMI) is one of its variants, where the left anterior descending (LAD) artery is blocked, which frequently causes widespread damage to myocardial tissue because the artery serves a significant area of the left ventricle.[2,3] It has been associated with higher risks of complications, such as heart failure, arrhythmias, and cardiogenic shock, than other sites of infarction.[3] Globally, AMI is experienced by millions of individuals annually, with a projected prevalence of almost 3 million cases per year, and over 15 million myocardial infarction cases in 2015, of which anterior wall infarction constitutes approximately 40-50% of ST-elevation myocardial infarctions (STEMI).[4] In Pakistan, the risk factors influencing the disease burden include hypertension, diabetes, and smoking, and more than 30% of the population aged above 45 years is exposed to risk factors of myocardial infarction, which are leading to an increased rate of AWMI.[5]
The anatomy of the lesions is especially critical in AWMI, with the LAD artery being either ostial (originating at the left main coronary artery) or non-ostial (distal to the ostium).[6] Ostial LAD lesions, which are characterized as stenoses that are within 3 mm of the bifurcation of the left main coronary artery, have a different nature in terms of their proximity to the bifurcation, increased thrombus load, and technical considerations when stenting.[7] Such lesions generally involve special procedures, including cautious ostial stenting or inter-side main crossing to avoid reduction of side branches, and offer optimal expansion.[8]
Primary percutaneous coronary intervention (PPCI) is regarded as the gold standard in the treatment of acute AWMI, and it is supposed to re-establish patency in acute myocardial infarction using balloon angioplasty and stenting.[9] As the technology of PPCI has progressed, with the introduction of DES and intravascular imaging, the procedural success rates have risen to more than 95% in most instances.[6] Nonetheless, the results depend on the lesion location, and the ostial involvement is frequently correlated with the complexity of the procedure, including slow-flow or no-reflow phenomena.[10] A study of 175 patients with isolated ostial LAD lesions treated with PCI provided long-term data with acceptable outcome results, including 5-year MACE (20.2%), all-cause mortality (11.7%), and low revascularization rates (TLR 6.9%, TVR %8.6%).[6] A Japanese study had further shown that ostial proximal LAD AMI was more likely to result in clinical events such as cardiac death, implying that caution should be exercised.[11]
Despite these findings, a gap remains in the literature regarding the comparison of differences between ostial and non-ostial LAD lesions, especially in acute AWMI. The high prevalence of metabolic syndromes and early-onset cases in a heterogeneous population such as Pakistan makes the risk profile different.[12] This study compares the short-term and long-term clinical outcomes between ostial and non-ostial LAD lesions with acute and WMI and first-line PPCI.

MATERIALS AND METHODS

The study received ethical clearance from the Institutional Ethical Review Committee. All participants provided written informed consent prior to involvement.
Adult patients of any gender who arrived at the emergency department with AWMI and proceeded to coronary catheterization were included in the study. To qualify, individuals needed to be at least 18 years old, have a verified diagnosis through electrocardiography and cardiac enzyme tests, and undergo PPCI specifically for a LAD blockage. Those excluded were individuals who refused consent, had previous coronary artery bypass grafting or similar cardiac procedures, presented with valvular heart issues, or had a diagnosis of cardiomyopathy.
Independent variables included:

- STEMI: Identified by new ST-segment elevation at the J-point in at least two adjacent leads, meeting specific criteria: ≥1 mm in leads other than V2-V3, and for V2-V3, ≥2 mm in men 40 years or older, ≥2.5 mm in younger men, or ≥1.5 mm in women regardless of age.
- AWMI: Characterized by ST elevation in two or more contiguous chest leads (V1 through V6), adhering to the same elevation thresholds as for STEMI.
- Ostial Lesion: Stenosis of the artery origin within 3 mm as determined by angiographic imaging.

Dependent variables were major adverse cardiovascular events (MACE), which include in-hospital death, heart failure, repeat myocardial infarction, stent thrombosis, and stroke/cerebrovascular events. Other complications of the procedure were also reported in the study, such as cardiogenic shock and ventricular arrhythmias. Baseline parameters (age, sex, weight, height, body mass index) and risk factors (diabetes, hypertension, dyslipidemia, and tobacco use) were measured.
The possible data were gathered at admission, and structured interviews concerning the patients, physical examination, electrocardiogram, and biomarker panels were conducted to ensure that an acute anterior wall myocardial infarction was diagnosed. Standardized forms included the most significant factors: demographics, the history of risk factors, and baseline vital signs. The operators entered real-time lesion and intervention information during the catheterization procedure. Hospital course observations were maintained until discharge or the occurrence of a discharge endpoint.

Consecutive non-probability sampling was used to reduce selection bias. The sample size of 400 patients with AWMI was calculated with a 95% confidence level and a 4% error margin.

Categorical data and continuous data were analyzed. Continuous variables were age, body mass index, lesion volume, and ejection fraction of the participants. Categorical variables were: gender, presence of comorbid conditions (diabetes, hypertension, and dyslipidemia), smoking status, lesion site (ostial or non-ostial), and MACE rates.

The SPSS software version 21.0 was used to analyze the data. The Shapiro-Wilk test was used to test the normality of continuous data. Means and standard deviations were used to summarize continuous variables, whereas percentages were used to summarize categorical variables. Categorical comparisons were performed with the chi-square test, and continuous data were compared using the t-test of independent samples or the Mann-Whitney U test, respectively, depending on the normal distribution. A p-value of 0.05 or lower was considered statistically significant.

RESULTS

A total of 400 patients were enrolled, including ostial (n=137, 34.3%) and non-ostial (n=263, 65.7%) LAD lesions. Males predominated (n=294, 73.5%), with higher percentages in the ostial group (n=105, 76.6%) than in the non-ostial group (n=189, 71.9%) (p=0.080). The mean age was 55.3 ± 9.1 years, with the ostial group being slightly older (56.2 ± 10.2 years) than the non-ostial group (54.9 ± 8.7 years) (p<0.001). The ostial group had a significantly higher proportion of diabetes (n=56, 40.9%) compared to the non-ostial group (n=55, 20.9%) (p=0.05). There were no significant differences in family history of ischemic heart disease (p=0.153), tobacco use (p=0.810), or dyslipidemia (p=0.321).

Additionally, patients with ostial lesions had higher Killip class III-IV (n=26, 19.0%) compared to the non-ostial group (n=7, 2.8%) (p<0.001). Systolic BP was lower in the ostial group (124.7 ± 16.5 vs. 131.6 ± 13.0) (p=0.003). Duration and ischemic time were longer in the ostial group (p<0.001, p=0.003). Intubation was more frequent in the ostial group (24.8% vs. 0.4%) (p<0.001) [Table 1].

Table 1: Comparative Analysis of Clinical Characteristics Between Patients with Ostial and Non-Ostial LAD Artery Lesions (n=400)

	Total (n)	Culprit Lesion		P-value
		(Ostial LAD)	(Non-Ostial LAD)	
	400	137	263	
Gender				
Male	294 (73.5%)	105 (76.6%)	189 (71.9%)	0.080
Female	76 (19.0%)	32 (23.4%)	44 (16.7%)	
Age (years)	55.3 ± 9.1	56.2 ± 10.2	54.9 ± 8.7	<0.001
Risk Factors				
Family history of IHD	64 (16.0%)	28 (20.4%)	36 (13.7%)	0.153
Tobacco chewer	59 (14.8%)	24 (17.5%)	35 (13.3%)	0.810
Dyslipidemia	26 (6.5%)	12 (8.8%)	14 (5.3%)	0.321
Smoking	118 (29.5%)	47 (34.3%)	71 (27.0%)	0.910
Diabetes	111 (27.8%)	56 (40.9%)	55 (20.9%)	0.05
Hypertension	338 (84.5%)	114 (83.2%)	224 (85.2%)	0.51
Killip Class				<0.001
I	231 (57.8%)	67 (48.9%)	164 (62.3%)	
II	106 (26.5%)	44 (32.1%)	62 (23.6%)	
III	17 (4.3%)	14 (10.2%)	3 (1.1%)	
IV	16 (4.0%)	12 (8.8%)	4 (1.5%)	
Intubation	35 (8.8%)	34 (24.8%)	1 (0.4%)	<0.001
Duration of Symptoms (hours)	4.5 ± 1.6	5.2 ± 2.0	4.3 ± 1.3	<0.001
Total Ischemic Time (hours)	6.8 ± 1.8	7.4 ± 2.3	6.6 ± 1.5	0.003
Systolic BP (mmHg)	129.2 ± 14.3	124.7 ± 16.5	131.6 ± 13.0	0.003

Table 2: Procedure Characteristics in Patients with Ostial vs. Non-Ostial LAD Lesions

	Total (N)	Culprit Lesion		P-value
		(Ostial LAD)	(Non-Ostial LAD)	
	400	137	263	
Access				
Radial	291 (72.8%)	92 (67.2%)	200 (76.1%)	0.008
Femoral	80 (20.0%)	45 (32.8%)	35 (13.3%)	<0.001
Switch Over	29 (7.2%)	6 (4.4%)	23 (8.7%)	0.05
LVEDP (mmHg)	17.9 ± 7.8	20.3 ± 10.4	15.3 ± 6.5	0.003
LV-Gram EF %	29.6 ± 5.1	29.2 ± 5.6	30.1 ± 4.8	0.01
Cardiac Device				
IABP Placed	37 (9.3%)	27 (19.7%)	10 (3.8%)	<0.001
TPM Passed	35 (8.8%)	24 (17.5%)	11 (4.2%)	<0.001
Myocardial Blush Grade				<0.001
0	15 (3.8%)	8 (5.8%)	7 (2.7%)	
I	11 (2.8%)	7 (5.1%)	4 (1.5%)	

II	113 (28.3%)	40 (29.2%)	73 (27.8%)	
III	261 (65.3%)	72 (52.6%)	189 (71.9%)	
Stent Technique				0.05
Pre-Ballooning	279 (69.8%)	90 (65.7%)	189 (71.9%)	
Direct Stenting	97 (24.2%)	26 (19.0%)	71 (27.0%)	
Number of Vessels Involved				
Single Vessel Disease	167 (41.8%)	68 (49.6%)	99 (37.6%)	0.32
Two Vessel Disease	150 (37.5%)	42 (30.7%)	108 (41.1%)	0.27
Three Vessel Disease	83 (20.8%)	27 (19.7%)	56 (21.3%)	
Collateral Grade				<0.001
0	310 (77.5%)	96 (70.1%)	214 (81.4%)	
1	20 (5.0%)	8 (5.8%)	12 (4.6%)	
2	27 (6.8%)	14 (10.2%)	13 (4.9%)	
3	17 (4.3%)	8 (5.8%)	9 (3.4%)	
TIMI Flow Pre-procedure				0.003
0	240 (60.0%)	85 (62.0%)	155 (59.0%)	
I	10 (2.5%)	2 (1.5%)	8 (3.0%)	
II	92 (23.0%)	18 (13.1%)	74 (28.1%)	
III	28 (7.0%)	4 (2.9%)	24 (9.1%)	
Slow-flow Phenomenon	102 (25.5%)	52 (37.9%)	50 (19.0%)	<0.001
Thrombus Grade				0.062
0	3 (0.8%)	0 (0%)	3 (1.1%)	
1	23 (5.8%)	6 (4.4%)	17 (6.5%)	
2	37 (9.3%)	7 (5.1%)	30 (11.4%)	
3	55 (13.8%)	12 (8.8%)	43 (16.4%)	
4	29 (7.3%)	6 (4.4%)	23 (8.7%)	
5	274 (68.5%)	84 (61.3%)	190 (72.2%)	
Post-dilation (NC Balloon)				0.67
288 (72.0%)	80 (58.4%)	208 (79.0%)		
Thrombus Aspiration (Export)	134 (33.5%)	72 (52.6%)	62 (23.6%)	<0.001
Final TIMI Flow Achieved				0.001
0	12 (3.0%)	7 (5.1%)	5 (1.9%)	
I	6 (1.5%)	2 (1.5%)	4 (1.5%)	
II	22 (5.5%)	12 (8.8%)	10 (3.8%)	
III	360 (90.0%)	95 (69.3%)	265 (100%)	
Any Procedural Complication				0.001
Table Death	12 (3.0%)	6 (4.4%)	6 (2.3%)	
LAD Perforation	3 (0.8%)	0 (0%)	3 (1.1%)	
VT/VF	3 (0.8%)	2 (1.5%)	1 (0.4%)	
On-table CPR	9 (2.3%)	5 (3.6%)	4 (1.5%)	
Wire-induced Distal Perforation	2 (0.5%)	0 (0%)	2 (0.8%)	
Dextrocardiac	2 (0.5%)	0 (0%)	2 (0.8%)	
Slow-flow phenomenon	37 (9.3%)	17 (13.1%)	19 (7.2%)	
None	324 (81.0%)	100 (73.0%)	224 (85.2%)	

The femoral access was more common in the ostial group (n=45, 32.8%) compared to the non-ostial group (n=35, 13.3%) ($p<0.001$). The LVEDP was higher in the ostial group (20.3 ± 10.4 mmHg) compared to the non-ostial group (15.3 ± 6.5 mmHg) ($p=0.003$). IABP placement was significantly higher in the ostial group (n=27, 19.7%) compared to the non-ostial group (n=10, 3.8%) ($p<0.001$). The LV-Gram EF % was lower in the ostial group (29.2 ± 5.6%) compared to the non-ostial group (30.1 ± 4.8%) ($p=0.01$). Final TIMI flow achieved was notably lower in the ostial group (n=95, 69.3%) compared to the non-ostial group (n=265, 100%) ($p=0.001$). Additionally, the slow-flow phenomenon occurred more frequently in the ostial group (n=52, 37.9%) compared to the non-ostial group (n=50, 19.0%) ($p<0.001$). [Table 2]

The duration of hospital stay was longer for the non-ostial group, with 64.7% (n=170) staying for 1 day compared to 43.8% (n=60) in the ostial group ($p=0.006$). Mitral regurgitation was more common in the non-ostial group (75.7%, n=199) compared to the ostial group (55.5%, n=76), but this difference was not statistically significant ($p=0.07$). Arrhythmias were more frequent in the ostial group (34.3%, n=47) compared to the non-ostial group (25.8%, n=68) ($p<0.001$). Cardiogenic shock was more common in the ostial group (16.8%, n=23) than in the non-ostial group (4.9%, n=13) ($p<0.001$). Heart failure and all-cause mortality were also significantly higher in the ostial group (32.8%, n=45 and 13.1%, n=18, respectively) ($p=0.001$, $p<0.001$). [Table 3]

Table 3: Comparison of In-Hospital Clinical Outcomes Between Patients with Ostial and Non-Ostial LAD Lesions

	Total (N)	**Culprit Lesion**		**P-value**
		(Ostial LAD)	**(Non-Ostial LAD)**	
	400	**137**	**263**	
Echo-LVEF %	32.5 ± 5.2	31.7 ± 5.5	33.0 ± 4.9	0.008
Duration of Hospital Stay (days)				0.006

1	230 (57.5%)	60 (43.8%)	170 (64.7%)	
2	116 (29.0%)	35 (25.5%)	81 (30.8%)	
3	15 (3.8%)	7 (5.1%)	8 (3.0%)	
4	10 (2.5%)	6 (4.4%)	4 (1.5%)	
5	5 (1.3%)	3 (2.2%)	2 (0.8%)	
Mitral Regurgitation				
None	275 (68.8%)	76 (55.5%)	199 (75.7%)	
Mild	93 (23.3%)	38 (27.7%)	55 (21.0%)	0.07
Moderate	12 (3.0%)	5 (3.6%)	7 (2.7%)	
In-hospital MACE				
Arrhythmias	115 (28.8%)	47 (34.3%)	68 (25.8%)	<0.001
Cardiogenic shock	36 (9.0%)	23 (16.8%)	13 (4.9%)	<0.001
CVA	7 (1.8%)	5 (3.6%)	2 (0.8%)	0.14
Stent thrombosis	33 (8.3%)	12 (8.8%)	21 (8.0%)	0.08
Myocardial infarction	32 (8.0%)	20 (14.6%)	12 (4.6%)	<0.001
Heart failure	108 (27.0%)	45 (32.8%)	63 (23.9%)	0.001
All-cause mortality	25 (6.3%)	18 (13.1%)	7 (2.7%)	<0.001

LVEF: left ventricular ejection fraction, CVA: cerebrovascular accident, MACE: major adverse cardiac events.

DISCUSSION

This study identifies distinct clinical and procedural issues in the case of ostial LAD culprit lesions in AWMI patients treated using PPCI. The results highlight the central role of lesion location in determining outcomes, as well as in-hospital morbidity and mortality rates. The occurrence of ostial LAD lesions was found in 34.3% of the cases in this study, compared to a prevalence of 19.5% reported in a Japanese study by Yamamoto et al. There was no significant age or sex difference at baseline in this analysis, but a tendency toward worse cardiac death outcomes in the cases with lesions of the ostia.[11]

Ostial lesions in our study contained higher percentages of diabetes (40.9% vs. 20.9%), which represents a comorbidity that can be attributed to expedited proximal development of the disease through endothelial dysfunction. This finding is in contrast to a study by Zornitzki et al, where a high thrombus load was found to have a diabetic rate of 34% at ostial sites, as opposed to a diabetic rate of 30.5% at non-ostial proximal sites.[13] Likewise, a second Canadian retrospective study found a smaller prevalence of diabetes in general (around 30%), although it did not include a direct comparison of ostial and non-ostial groups.[6] We discovered that the ostial patients had a higher ratio of Killip class III-IV, lower systolic blood pressure (124.7 mmHg vs. 131.6 mmHg), and a longer duration of symptoms and ischemic periods. This observation is consistent with that of Yamamoto et al., who indicated that ostial proximal LAD infarction had a Killip score of 15% versus 5% in non-ostial infarction, with a 2-fold increase in cardiac mortality at 1 year (9.5 vs. 4.5).[11]

In our study, preference for femoral access was higher in the ostial group compared to the non-ostial group, with a significant difference ($p<0.001$). This finding is consistent with the COLOR study, which revealed that the femoral approach was superior in cases of left main lesions or even ostial lesions because of its superior backup. However, radial access was relatively safer overall, with fewer bleeding events (3.6% vs. 19.1%, $p < 0.001$).[14] Nevertheless, our greater use of the femur as the source in ostial cases is inconsistent with current trends in stable or elective PCI, as observed in the study by Elkhateeb et al., which shows no particular preference for either the transradial or transfemoral arteries, and high procedural success rates in both.[6] This implies that operator discretion has a more significant role in acute environments such as AWMI. The severity of the lesion of the ostia with increased LVEDP and mildly decreased ejection fraction is also consistent with a prospective study of 1,000 patients with STEMI, whereby LVEDP >18 mmHg maintained a lower prognosis, including heart failure, despite remaining ejection fraction, attributing elevations to larger infarct sizes in proximal lesions.[15] Conversely, meta-analysis by Khairy et al. reported no significant hemodynamic differences between stenting methods. This suggests that the variation of LVEDP in acute manifestations is influenced by the site of the lesion rather than the intervention technique.[8]

Supportive devices were more common in our ostial patients, including IABP and temporary pacemakers. This trend is consistent with a substudy by Nunen et al. in which IABP reduced 6-month death in cases with continuing ischemia after PCI, particularly in cases of big infarction such as ostial involvement.[16] However, a randomized trial by Morici et al. did not report a survival benefit of routine IABP, unlike our selective application in hemodynamically unstable ostial cases, which highlights the context-specific effectiveness.[17] Moreover, the slow-flow phenomenon in our research occurred more frequently in ostial lesions, which agrees with a study, where post-dilation aggravated slow flow in proximal LAD operations, up to 30% and was associated with no-reflow risks.[18]

Our findings showed poorer in-hospital outcomes among ostial LAD lesions, including reduced LVEF, increased hospital stays, and higher MACE rates. In particular, arrhythmias, cardiogenic shock, heart failure, recurrent myocardial infarction, and all-cause mortality) were markedly greater in the ostial group. The findings are consistent with a study by Yamamoto et al., in which ostial lesions (19.5% of cases) were associated with increased 30-day cardiac mortality, in-hospital mortality rates, and heart failure proxies, such as Killip class III/IV. There was also an increase in cardiogenic shock predictors, including IABP use, which was also in agreement with our shock prevalence.[11] That study, however, did not show any significant difference in baseline arrhythmias compared to our higher rates of ostial arrhythmias, possibly because thrombus burden varies or due to the timing of reperfusion.[11] Future studies should investigate innovative adjunctive technologies, thrombolytic agents, and personalized interventions that consider patient comorbidities and lesion features to achieve improved results in this high-risk population.[19,20]

This study has several limitations. The study was limited to one tertiary care environment, and the findings may not be generalizable to other healthcare institutions with different resources and patient populations. Moreover, angiographic measurements can be evaluated without routine intravascular imaging, which potentially changes the classification of lesions.

CONCLUSION

This study demonstrates that the lesions in the ostial LAD areas of the brain appear to be linked to increased clinical risks and procedural difficulties in patients undergoing AWMI during a primary PCI. Compared to non-ostial lesions, ostial involvement was associated with worse hemodynamic stability, a greater reliance on supporting devices, inefficient reperfusion, and higher rates of major adverse events during hospitalization. The results indicate that ostial cases require close supervision and a unique approach to intervention to reduce complications. Further research is needed to include new imaging and adjunctive therapy to deliver better outcomes in this at-risk subgroup, particularly in regions with high cardiovascular burdens, such as in Pakistan.

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