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Original Research Article

PERCUTANEOUS CORONARY INTERVENTION FOR UNPROTECTED LEFT MAIN CORONARY ARTERY DISEASE: A PROSPECTIVE OBSERVATIONAL STUDY FROM A TERTIARY CARE CENTRE IN INDIA

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ABSTRACT

Background: Unprotected left main coronary artery (ULMCA) disease is associated with substantial morbidity and mortality due to a large area of myocardial territory supplied. Coronary artery bypass grafting (CABG) has traditionally been the preferred revascularization strategy; however, advances in percutaneous coronary intervention (PCI), techniques have expanded the role of PCI in selected patients. Indian real-world data on ULMCA PCI are very few. The objective is to evaluate clinical outcomes and complications of PCI for ULMCA disease and to identify predictors of major adverse cardiac and cerebrovascular events (MACCE), with emphasis on anatomical complexity and stenting strategy. **Materials and Methods:** This prospective observational study included 104 consecutive patients undergoing PCI for angiographically significant mlULMCA disease at a tertiary care hospital between September 2023 and March 2025. Clinical, angiographic, and procedural data were collected. Lesion complexity was assessed using the SYNTAX score. PCI strategies included provisional single-stent and planned two-stents techniques. The primary endpoint was MACCE, defined as a composite of death, myocardial infarction, stroke, stent thrombosis, and repeat revascularization. **Result:** The mean age was 61.9 ± 11.4 years; 75% were male. Distal LMCA bifurcation lesions were present in 69% and 61.5% had intermediate or high SYNTAX scores. Simple stenting done in 31%, provisional single stenting was done in 45% and two-stents strategies in 24 % of cases. Procedural complications occurred in 13.5%. In two-stents group procedural complication was significantly high when compared to provisional single stent group. In-hospital MACCE occurred in 5.8%, and follow-up MACCE in 11% within 6 months. Higher SYNTAX score (≥33) was significantly associated with MACCE (p = 0.046). Although MACCE rates were numerically higher in the two-stents group, it was not statistically significant. **Conclusion:** PCI for ULMCA disease can be performed safely with acceptable short-term outcomes in selected Indian patients. Anatomical complexity remains the principal determinant of adverse events. Single stent strategy was found to be the safer option in distal LM bifurcation disease.

INTRODUCTION

Significant stenosis of the left main coronary artery (LMCA) represents one of the most critical forms of coronary artery disease, owing to the large myocardial territory supplied. Natural history studies have demonstrated poor survival with medical therapy alone, establishing coronary artery bypass grafting (CABG) as the standard of care for several decades.[1,2]

Over the past two decades, advances in PCI—including newer-generation drug-eluting stents, improved antiplatelet therapy, refined bifurcation techniques, and intravascular imaging— have challenged the exclusive role of surgery.[3-6] Randomized trials such as SYNTAX, EXCEL, and NOBLE have shown that PCI provides outcomes comparable to CABG in selected patients with low to intermediate anatomical complexity.[7-10] Consequently, contemporary guidelines now endorse

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PCI as an alternative revascularization strategy for ULMCA disease in appropriately selected patients, emphasizing Heart Team decision- making and SYNTAX-based risk stratification.[11,12]

Despite these advances, outcomes of LMCA PCI remain closely linked to lesion complexity, bifurcation anatomy, and institutional expertise. Indian patients often present late with diffuse disease, high prevalence of diabetes, and multivessel involvement.[13,14] Moreover, public sector hospitals manage patients under significant resource constraints, with limited access to intravascular imaging and delayed surgical availability. Data reflecting such real-world practice remain scarce.

The present study was designed to evaluate the safety and short-term outcomes of PCI for ULMCA disease in a tertiary care high volume government hospital in India and to identify predictors of adverse outcomes, with particular emphasis on anatomical complexity and stenting strategy.

MATERIALS AND METHODS

This was a single-centre prospective observational study conducted at a tertiary care government medical college hospital in South India. This hospital is a high volume centre. Consecutive adult patients undergoing PCI with DES for angiographically significant ULMCA disease were enrolled. Patients with protected LMCA, Cardiogenic shock, CTOs, Severe LV dysfunction and preferring CABG were excluded.

Baseline Evaluation: Baseline evaluation included clinical history, electrocardiography, transthoracic echocardiography, and routine laboratory investigations. Coronary angiography was performed using standard techniques. Lesion location (ostial, shaft, distal bifurcation) and extent of coronary artery disease were documented. SYNTAX score was used to assess the anatomical complexity of lesion.

PCI Procedure: The procedure was performed mostly through femoral route. Unfractionated heparin was used as the anticoagulant agent. The stenting strategy is decided with the lesion anatomy and operator judgement. Newer generation drug eluting stent was used in all cases. Intravascular imaging was used in very few cases due to financial and logistic issues.

End points and Follow-up: The primary end point was occurrence of MACCE. Which is defines as all cause mortality, myocardial infarction, CVA, stent thrombosis and repeated revascularization.

Statistical Analysis: The categorical variables are expressed as frequencies and percentages. Associations were analyzed using chi-square test and Fisher's exact test. A p-value of < 0.05 was considered statistically significant.

RESULTS

Baseline Clinical Characteristics: A total of 104 patients were included. Mean age was 61.9 ± 11.4 years, and 75% were male. Mean LVEF was 51.9%. Diabetes mellitus, Dyslipidemia, and Hypertension were highly prevalent, reflecting a high- risk population. The most common clinical presentation was chronic stable angina (41.3%) followed by NSTEMI (28.8%), and Unstable angina (23.1%). STEMI constituted 6.7% only. Distal LMCA bifurcation involvement was present in 69% of patients. Intermediate (23–32) and high (≥33) SYNTAX scores were observed in 61.5%, highlighting substantial anatomical complexity. [Table 1]

Simple stenting is done in 30.8% cases it is done mainly in ostial LMCA and shaft lesion. Provisional single-stent strategy was used in 45.2%, while 24% underwent planned two- stents strategy. Two-stents techniques were employed in distal true bifurcation lesions and higher SYNTAX categories. Intracoronary imaging was used in very few patients due to financial constrains. [Table 1]

Overall procedural complications occurred in 14 patients (13.5%). The most common complications were transient arrhythmias (3.8%) and contrast-induced nephropathy (2.9%). Life-threatening complications such as cardiac arrest (1.9%) and cardiac tamponade (1.9%) were rare. 3 patients had mixture of procedural complications [Table 2]. On subgroup analysis the complication rate was significantly higher in two stents group when compared to single stent group. ([Table 3]; Fisher's exact test p value 0.036). Patients with CKD had a higher complication rate (25%) than non-CKD patients (12.5%), but this was not significant. Apart from this no baseline characteristics had any meaningful association with procedural complication.

Clinical Outcomes: In-hospital MACCE occurred in 6 patients (5.8%); 2 cardiac arrest and 4 peri-procedural MI. During follow-up, MACCE [Table 4] occurred in 10.6%, predominantly driven by repeat revascularization (4.9%). During short-term follow-up period of six months, 89% of patients remained free of MACCE. The most frequent event was revascularization (45%), followed by MI (4%), cardiac death (3%), non-cardiac death (2%), CVA (1%), and combinations of these events in a few individuals.

A clear increase in MACCE was observed with rising SYNTAX scores (24.1%) which was statistically significant also. [Table 5] There was a trend towards slightly higher MACCE reported in patients with STEMI presentation (28.6%), CKD (25%), previous MI with LV dysfunction (25.9%) and in those with Diabetes Mellitus (18.9%) but was not statistically significant. No reasonable relationship was seen when compared to other baseline characteristics.

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Patients undergoing two-stent strategies had higher anatomical complexity and more frequent distal bifurcation disease. MACCE rates were numerically higher in the two-stent group; [Table 6&7] however; it nearing to approach significance statistically. Higher SYNTAX score remained the dominant determinant.

Table 1: Baseline Characteristics

Variables	Frequency
Mean Age	61.9±11.4
Mean BMI	24.6 ±4.4
Male: Female	78:26
Type II DM	37(35.8%)
SHTN	34(32.8%)
DLP	46(43%)
CKD	8(7.5%)
PrevMI	27(26.1%)
CVA	4(4%)
Smoking	28(27.1%)
Clinical Presentation	
CSA	43(41.3%)
UA	24(23.1%)
NSTEMI	30(28.8%)
STEMI	7(6.7%)
SYNTAX Score	
≤ 22	40(38.5%)
23-32	42(40.4%)
≥33	22(21.1%)
Angio Findings	
ISOLATED LMCA	9(8.7%)
LM+SVD	42(40.4%)
LM+2VD	36(34.6%)
LM+3VD	17(16.3%)
LM Lesion	
DISTAL	72(69%)
NON DISTAL	32(31%)
Stenting Technique	
Simple stenting	32(31%)
Provisional single stenting	47(45%)
Two stents strategy	25(24%)

Table 2: Procedural Complication

Complications	Frequency	Percent
Arrythmias	4	3.8
CardiacArrest	2	1.9
Dissection	3	2.9
Tamponade	2	1.9
CIN	3	2.9
PulmonaryEdema	3	2.9

Table 3: Stenting technique and Complication rate

Stenting Technique	Complication		Fisher's exact test P value
	N	%	
Provisional single stenting (47)	4	8.5	0.036
Two stents strategy (25)	7	28	

Table 4: MACCE in follow up

MACCE in follow up	Frequency
Non-Cardiac Death	2 (1.9%)
Cardiac Death	3 (2.9%)
MI	4 (3.9%)
Revascularisation	5 (4.9%)
CVA	1 (1%)
Total	11 (10.6%)

Table 5: SYNTAX Score and MACCE

SYNTAX	MACCE		$\chi 2$	df	p
	N	%			
<22	3	9.1	6.16	2	0.046
22-32	7	16.7			
>32	7	24.1			

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Table 6: Stenting Techniques and MACCE

Stenting Technique	MACCE		$\chi 2$	df	p
	N	%			
Simple stenting (32)	4	12.5	3.27	2	0.195
Provisional single stenting (47)	6	12.8			
Two stents strategy(25)	7	28			

Table 7: Stenting Techniques and MACCE subgroup analysis

Stenting Technique	MACCE		Fisher's exact test
	N	%	P value
Provisional single stenting (47)	6	12.8	0.123
Two stents strategy (25)	7	28	

DISCUSSION

This prospective study provides contemporary real-world data on PCI for ULMCA disease from a public sector tertiary care centre in India. The principal findings are that LMCA PCI can be performed with acceptable procedural safety and short-term outcomes in selected patients, who have low, intermediate SYNTAX score. Two stents strategy should be avoided as far as possible. The procedural risk and follow up MACCE were high in two stents group, whether its upfront two stents or bailout provisional stent strategy with two stents. The anatomical complexity as assessed by the SYNTAX score remains the most important predictor of adverse events. Associated CKD, LV dysfunction, STEMI presentation and Diabetes mellitus tends to have adverse outcome in this study even though statistically not proved. A relatively short follow up period and case load might have contributed to this weak association.

The MACCE rates observed in this study are comparable to those reported in major randomized trials and registries.[7-10] The predominance of distal bifurcation lesions and intermediate-to-high SYNTAX scores reflects the complex anatomy frequently encountered in Indian practice. The higher MACCE and procedural complication rates in two stents strategy highlights the importance of intracoronary imaging in complex bifurcation lesions involving ULMCA. Image guided PCI is better as it guaranties optimal stent apposition and maximum luminal gain thereby contributing in low MACCE. In this study the provisional stenting was the preferred strategy. Which is consistent with current evidence.[15-17] The anatomical characteristics of the disease was seen to be the reliable predictor of outcome.[18-20]

Limitations: The key limitation in this study is the unavailability of intravascular imaging in the LMCA stenting as which is the standard of care in contemporary guidelines.[11,12,21-23] But in our setting routine use of IVUS or OCT is limited by financial and logistic constrains. In addition small sample size, single centre design, short follow up period and absence of a CABG comparator cohort are other limitations of the study. However the study reflects an important real world scenario in a high volume tertiary care centre form government sector and provides valuable Indian data from where evidence remains sparse.

CONCLUSION

Unprotected LMCA-PCI can be performed with newer drug eluting stents in Low or intermediate SYNTAX score Indian patients with experienced operators with acceptable short term outcomes, particularly in resource constrained settings. As far as possible provisional single stent strategy is to be adopted.

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