

Outcomes of Left Main Percutaneous Coronary Intervention

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ABSTRACT

Objective: To study the outcomes of left main percutaneous coronary artery (LMCA) revascularisation.

Study Design: A descriptive study.

Place and Duration of Study: The Aga Khan University Hospital (AKUH), Karachi, from February till July 2016.

Methodology: The study included all adult patients aged 18 years or more, who underwent percutaneous LMCA revascularisation at study centre from April 2006 till April 2015. In-hospital outcomes were ascertained of patients *via* charts along with telephonic follow-up for outcome ascertainment at 1-year and 5-year. Results were expressed in terms of means and standard deviation for quantitative variables and percentages for qualitative variables.

Results: Of the 86 patients, the mean age was 66.05 ± 12.6 years and 69% (59 cases, n=86) of them were males. Sixteen (18.6%) patients presented with cardiogenic shock and 17.4% (15 cases, n=86) required mechanical ventilation upon arrival. Among the 86 patients, 23.3% (20 patients, n=86) underwent PCI because of unstable condition for CABG and refusal by the surgeons. Mean follow up time for participants was 40.5 ± 25.7 months with mean length of hospital stay of 4.36 ± 2.4 days. In-hospital mortality was 12.8%, while mortality at 1-year and at mean follow-up was 7.3% and 6.9%, respectively.

Conclusion: LM percutaneous coronary intervention is a viable option for patients who are hemodynamically unstable and require urgent revascularisation or for patients denying bypass surgery due to other reasons in Pakistan. Prospective studies in future may be required to evaluate the role of PCI for LM lesions in elective setting in contrast to existing treatment options.

Key Words: *Coronary artery disease, Percutaneous coronary Intervention, Coronary artery bypass grafting, Intravascular ultrasound, Left main coronary artery.*

INTRODUCTION

Left main (LM) stenosis is visualised in around 3-5% of all coronary angiograms.¹ A stenosis of more than 50% of the LM is associated with significant mortality as a critical LM lesion jeopardises at least 75% of the myocardium.² The mainstay of treatment of left main stenosis has been coronary artery bypass grafting (CABG) with favourable outcomes reported in various studies.³⁻⁶

Since the inception of percutaneous coronary intervention (PCI), multiple attempts have been made over the years to prove the equivalence of PCI to bypass surgery for treating left main interventions. Early attempts at LM PCI with plain old balloon angioplasty (POBA) and bare metal stents showed appalling results.^{7,8}

Recently, data regarding LM PCI with newer generation drug eluting stents (DES) has emerged from all parts of the world and reviews suggest that in patients with severe LM disease, PCI with newer generation DES is comparable to CABG, and it offers an effective method of revascularisation with comparable long-term rates of

major adverse outcomes.⁹⁻¹² However, there is a dearth of data on clinical outcomes of left main PCI in Pakistan. This study is an effort to bridge this gap and put forward our experience of LM-PCI practice at a tertiary health care centre in Pakistan.

The primary objective of this study was to determine the outcomes of LM PCI, both in hospital and post-discharge, in terms of mortality. The secondary objective of the study was to document angina, myocardial Infarction, repeat revascularisation, stroke and heart failure in patients who underwent LM PCI over an extended period of follow-up.

METHODOLOGY

The study was conducted at the Aga Khan University Hospital (AKUH), Karachi, from February till July 2016 after approval from the hospital Ethics Review Committee. The study included all adult patients aged 18 years or more who underwent percutaneous LMCA revascularisation at The Aga Khan University Hospital (AKUH), Karachi in the last decade from April 2006 till April 2015.

For the purpose of study, patients who had undergone left main coronary artery (LMCA) revascularisation percutaneously were identified using records from the AKUH cardiology catheterisation laboratory records. Information relevant to study objectives were collected using a predesigned proforma. Information regarding procedural details, mortality and morbidity were collected from review of charts or *via* phone follow-up after seeking informed consent from the patients.

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The data were analysed using SPSS version 20.0 and results were expressed in terms of means and standard deviation for quantitative variables and frequency along with percentages for qualitative variables.

RESULTS

A total of 86 patients underwent LM PCI at the study centre during the studied period. Amongst patients undergoing LM PCI, 62 (72%) had unprotected LM. The most common presentation of patients undergoing LM PCI was unstable angina [40 patients (46.5%)], 82 (95.3%) had native LM disease requiring PCI of LM, whereas 4.7% cases (4 patients) underwent LM PCI as a bailout procedure. Mean follow-up duration was 40.5 ±25.7 months.

Surgical opinion by cardiothoracic surgeon for CABG was sought for all patients prior to PCI. 23.3% (20 cases) patients were considered unfit for CABG because of hemodynamic instability, coexisting comorbidities, extremes of age or due to very high surgical risks. LM PCI was opted over CABG by patient or family in (76.7% cases, 66 patients). LM PCI was primarily performed by the femoral route in 94% patients (80 cases). 79% (68 cases) had distal LM PCI done and 81% (70 cases) required PCI to other vessels in addition to LM. The Baseline characteristics of patients are given in Table I and procedural details of PCI are given in Table II.

The mortality at mean follow-up was 29% (25 patients), with the mean time to death of 20.12 ±27.9 months. As autopsy was not performed in any case, all mortalities were presumed to be due to cardiovascular cause.

The in-hospital mortality was 12.8% (11 patients) with a mean hospital stay of 4.36 ±2.4 days. All these patients

Table I: Baseline characteristics of the LM PCI patients.

Baseline characteristics	N (%)
No. of patients	86
Age (years)	66.05 ±12.6
Male	59 (68.6)
Unprotected LM	62 (72.1)
Risk factors	
Hypertension	79 (91.8)
Dyslipidemia	42 (48.8)
Diabetes	53 (61.3)
Smoking	28 (32.6)
CKD	14 (16.3)
On Hemodialysis	6 (7.0)
LV Dysfunction	42 (48.8)
Presentation	
STEMI	16 (18.6)
NSTEMI	30 (34.9)
Angina	40 (46.5)
Cardiogenic shock	16 (18.6)
Intubated patients	15 (17.4)
Cardiac arrest	8 (9.3)

CKD: Chronic kidney disease; LV dysfunction: EF <40% at the time of PCI; STEMI: ST elevation myocardial infarction; NSTEMI: Non ST elevation myocardial infarction.

Table II: Procedure details of LM-PCI.

Procedure details	N (%)
Emergent PCI	22 (25.6)
PCI of other vessels along with LM	70 (81.4)
Type of stent in LM	
Drug eluting stents	71 (82.6)
Bare metal stents	13 (15.1)
Covered stent	1 (1.2)
Drug eluting balloon	1 (1.2)
Complications during PCI	
Dissection	15 (17.4)
No reflow	3 (3.5)
Distal LM PCI	68 (79.1)
Ostial LM PCI	18 (20.9)
PCI Technique	
LM to LAD crossover	42 (48.8)
SKS	8 (9.4)
CULOTTE	4 (4.7)
LM to LCX crossover	8 (9.4)
LM Stenting only	23 (26.7)
IVUS	30 (34.9)
IABP placement	20 (23.3)
TPM placed	14 (16.3)
Inotropic support	19 (22.1)

LM: Left main; LAD: Left anterior descending artery; LCX: Left circumflex artery; PCI: Percutaneous coronary intervention; IVUS: Intravascular ultrasound; IABP: Intra aortic balloon pump; TPM: Temporary pacemaker; SKS: Simultaneous kissing stenting; TPM: Temporary pacemaker.

had unprotected LM PCI. The mean age was 69.7 ±11.3 years. Nine patients had been deemed unfit for CABG due to hemodynamic instability as they were in cardiogenic shock requiring intubation, inotropic support and counter pulsation therapy with intra-aortic balloon pump. The major cause of in-hospital mortality was refractory cardiogenic shock (5 patients), other causes included overwhelming sepsis and GI bleeding. Among the 75 patients that were discharged from the hospital, the mortality at one year was 6.6% (5 patients).

Distal LM stenting poses a unique challenge as it is equivalent to bifurcation stenting. In this study, 68 patients (79.1%) underwent PCI to distal LM. The total mortality for distal LM PCI at mean follow-up was 23.2% (20 patients). The in-hospital mortality of patients undergoing distal LM PCI was 10.4% (09 patients). 4.6% (04 patients) undergoing distal LM PCI required target lesion revascularisation, whereas no patient undergoing PCI to LM ostium or shaft required TLR.

IVUS was performed in 30 patients (34.9% cases) undergoing LM PCI, on follow-up 7 (8.13%) mortalities were identified. Nineteen (22.09%) cases, who underwent IVUS at the time of LM PCI, were alive at follow-up, whereas 4 cases were lost to follow-up.

At mean follow-up from index procedure, 10 (11.6%) patients had MI, 4 (4.6%) patients required repeat target lesion revascularisation, and 7 (8.13%) patients had congestive heart failure. No patient had stroke. All patients alive at mean follow-up were compliant to dual antiplatelet therapy with aspirin and clopidogrel.

Amongst the 10 patients who had MI, distal LM PCI was performed in 9 (10.4%) patients with bifurcation stenting of distal LM done in 4 (4.6%) patients and left main to LAD crossover was done in 5 (5.8%) patients. Four (4.6%) patients showed in-stent restenosis (ISR) in left main stent on subsequent angiograms. All patients developing ISR had distal LM stenting with LM-LAD crossover technique applied in two patients and bifurcation stenting done in two patients. All patients developing ISR had DES implanted with a mean diameter of 3.13 ± 0.47 mm with post-dilatation performed with a mean balloon size of 3.0 ± 0.40 mm.

DISCUSSION

The treatment of choice for critical left main disease is CABG. The current guidelines, in light of published literature, also endorse CABG for LM disease as a class I recommendation. However, the guidelines also take into consideration the option of LM PCI an alternative therapeutic option for left main disease in patients who are either not suitable for surgical re-vascularisation,¹³ or decline CABG.

Recent literature shows that PCI is non-inferior to CABG for the treatment of left main disease.¹⁰⁻¹⁵ This success of PCI to LM is attributed primarily to the introduction of newer generation DES and the use of dual anti-platelet therapy. The advent of drug eluting stents has a significant impact on the outcomes of left main stenting, as several registries regarding LM stenting with DES have shown positive results in terms of efficacy and safety profile.

The present study reported a mortality of 29% at mean follow-up. This inflated figure could be explained by the fact that among the cases undergoing LM PCI at our centre, most of the patients were elderly (mean age 66 ± 12.5 years), in cardiogenic shock at the time of PCI (18.6%) and deemed unfit for CABG (23.3%).

Unprotected left main PCI (UPLM PCI) is an option employed mostly in emergency situations that preclude an invasive option. Therefore, outcomes are also affected by the adverse clinical presentation rather than the procedure itself. Unprotected LM (UPLM) has been identified as an important predictor of mortality in previous studies.¹⁶⁻¹⁸ In this study, mortality in UPLM was 23.2%. An explanation for this high rate MACE is the fact that 81.25% of patients who had UPLM PCI also had significant disease of a non-LM vessel requiring intervention. The high occurrence of adverse events in this group can be attributed to the inherent heavy atherosclerotic burden.

The mortality of distal LM PCI was 23.2% (20 patients) with ISR seen in 4.5% of patients undergoing repeat angiograms. This experience of distal LM PCI was comparable to the reported literature that suggests that PCI of lesions involving the ostium or shaft of LM are

associated with better outcomes.^{19,20} Similarly, studies have reflected that PCI for distal LM lesions is the most significant predictor of repeat revascularisation and overall MACE.²¹ The high mortality among distal LM PCI patients can be attributed to the complex anatomy of distal LM.

The usage of smaller size stents in the left main may be attributed to diffuse disease in left main system. However, as there exists no reference values from our population on minimal surface area (MSA) and minimal luminal diameter of left main, subjective assessment of the operators emerges as the plausible rationale for this discrepancy. Although it has been recognised in the EXCEL trial that a small final MSA measured by IVUS after LM-PCI has a strong association with adverse events during long-term follow-up.²²

The main limitation of this study is its retrospective design. As all the patients did not have angiographic follow-up, the true rate of restenosis of LM could not be determined. Thirteen patients were lost to follow-up and no data could be retrieved for these patients.

CONCLUSION

Though CABG is the preferred choice of treatment for LM lesions, PCI of left main coronary artery is an option primarily reserved for those patients who require urgent revascularisation due to hemodynamic instability. Due to the anatomical location of LM lesions and the complexity of PCI in left main, there is a significant chance of restenosis. Planned, and elective PCI of LM lesions performed under IVUS guidance have better outcomes, with reduced rates of restenosis and MACE. Further prospective studies are required to evaluate the role of PCI for LM lesions in elective setting.

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