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Optimizing Multivessel PCI with Limited Stents: Successful Revascularization Without Left Main Intervention

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Abstract

Background: Acute coronary syndrome (ACS) is a major cause of hospitalization and mortality. Patients with multivessel disease (MVD), especially with left main (LM) involvement, face higher risks of complications and adverse outcomes.

Objective: A 55-year-old male with uncontrolled hypertension and diabetes presented with 16-hour chest pain. The ECG showed T-wave inversion in leads I and aVL, with a high-sensitivity troponin level of 59,480 ng/dL. He was diagnosed with high-risk lateral NSTEMI.

Methods: This is a case report. Coronary angiography (CAG) revealed 70% distal LM stenosis, 80% ostial stenosis with chronic total occlusion (CTO) in the proximal left anterior descending (LAD) artery, and 80% subtotal occlusion in the left circumflex (LCx) artery. PCI was performed using drug-eluting stents in the LAD and LCx.

Results: TIMI 3 flow was achieved without major complications. LM PCI was deferred due to strategic stenting in the LAD and LCx, which improved perfusion and potentially reduced the functional significance of LM stenosis.

Conclusion: This case highlights the complexity of MVD PCI and demonstrates that targeted stenting can optimize revascularization while minimizing procedural risks. Careful post-PCI assessment is essential for long-term management.

Keywords: Acute Coronary Syndrome, Left Main Disease, Multivessel Coronary Artery Disease, Percutaneous Coronary Intervention, Chronic Total Occlusion

Introduction

Acute Coronary Syndrome (ACS) represents a critical cardiovascular emergency that remains a major contributor to morbidity and mortality worldwide.[1,2] In 2021, the World Health Organization (WHO) reported that approximately 20–25% of the global population, equivalent to around two million individuals, along with an additional six million people, were at increased risk of developing ACS. Data from the 2023 Indonesian Health Survey (SKI) further indicated that the nationwide prevalence of physician-diagnosed heart disease across all age groups was 0.85%, representing an estimated 877,531 individuals in Indonesia. These findings highlight that heart disease, including ACS, remains a substantial public health burden at the national level.[3] Among these patients, significant multivessel coronary artery disease (MVD) coexists in nearly 40–50% of those presenting with ST-elevation myocardial infarction (STEMI) and up to 70% of those with non-STEMI.[4] The cornerstone therapy for both STEMI and NSTEMI is percutaneous coronary intervention (PCI) directed at the culprit lesion to restore perfusion in the infarct-related artery (IRA). Nevertheless, individuals with MVD defined by ≥50% stenosis affecting at least two major epicardial coronary vessels tend to experience poorer clinical outcomes compared to those with isolated single-vessel involvement.[1]

Debate persists regarding the most appropriate management of non-culprit lesions (NCLs), particularly whether these lesions should undergo routine revascularization or be managed conservatively with optimal guideline-directed medical therapy. Determining the true benefit of additional interventions in preventing future adverse cardiac events remains complex. Despite this, data from several randomized controlled trials (RCTs) indicate that performing complete revascularization through multivessel PCI confers significant advantages over a culprit-only (CO) approach, demonstrating reductions in cardiovascular mortality, recurrent angina, repeat revascularization, and major adverse cardiovascular events (MACE).[1,4]

In practice, healthcare infrastructure constraints remain a challenge in some hospitals. Consequently, careful selection of target lesions, timing, and revascularization strategy becomes crucial to optimize outcomes, particularly in resource-limited settings. This report emphasizes the importance of individualized treatment planning and strategic decision-making in patients with multivessel coronary disease, highlighting that favorable results can still be achieved even when complete revascularization cannot be performed.

Methods

This case report was developed from the clinical assessment, diagnostic findings, and therapeutic management of a patient with multivessel coronary artery disease (MVD) who underwent percutaneous coronary intervention (PCI) at Siloam Heart Center in 2025. Relevant clinical information, including laboratory data, imaging results, and procedural documentation, was retrospectively retrieved from the patient's medical records after obtaining appropriate consent. The management followed contemporary guideline-directed medical therapy, with all diagnostic and interventional decisions individualized according to the patient's clinical status and the available institutional resources.

Results

A 55-year-old male presented with acute chest pain that had persisted for 16 hours, accompanied by diaphoresis. His symptoms did not improve with sublingual isosorbide dinitrate (ISDN). The patient had a history of similar episodes and was on clopidogrel, aspirin, and atorvastatin (20 mg). His medical history included uncontrolled hypertension and type 2 diabetes mellitus. On physical examination, his vital signs were as follows: blood pressure 155/109 mmHg, heart rate 79 bpm, respiratory rate 20 breaths per minute, temperature 36.8°C, and oxygen saturation of 98% on room air. Cardiac and pulmonary examinations were unremarkable. Electrocardiography (ECG) revealed T-wave inversion in leads I and aVL, as shown in Figure 1.

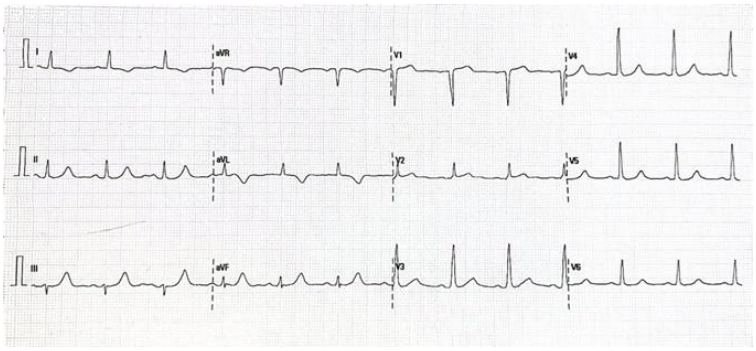


Figure 1. ECG On Arrival at the Emergency Department

Laboratory tests demonstrated elevated high-sensitivity troponin levels (64.55 ng/dL), random blood glucose of 197 mg/dL, and mild hyponatremia (133 mmol/L). Other laboratory results are presented in Table 1. The patient was diagnosed with high-risk lateral NSTEMI, with an onset of 16 hours, and classified as Killip class I. Transthoracic echocardiography revealed mild left ventricular systolic dysfunction with an ejection fraction of 45%, without significant valvular abnormalities.

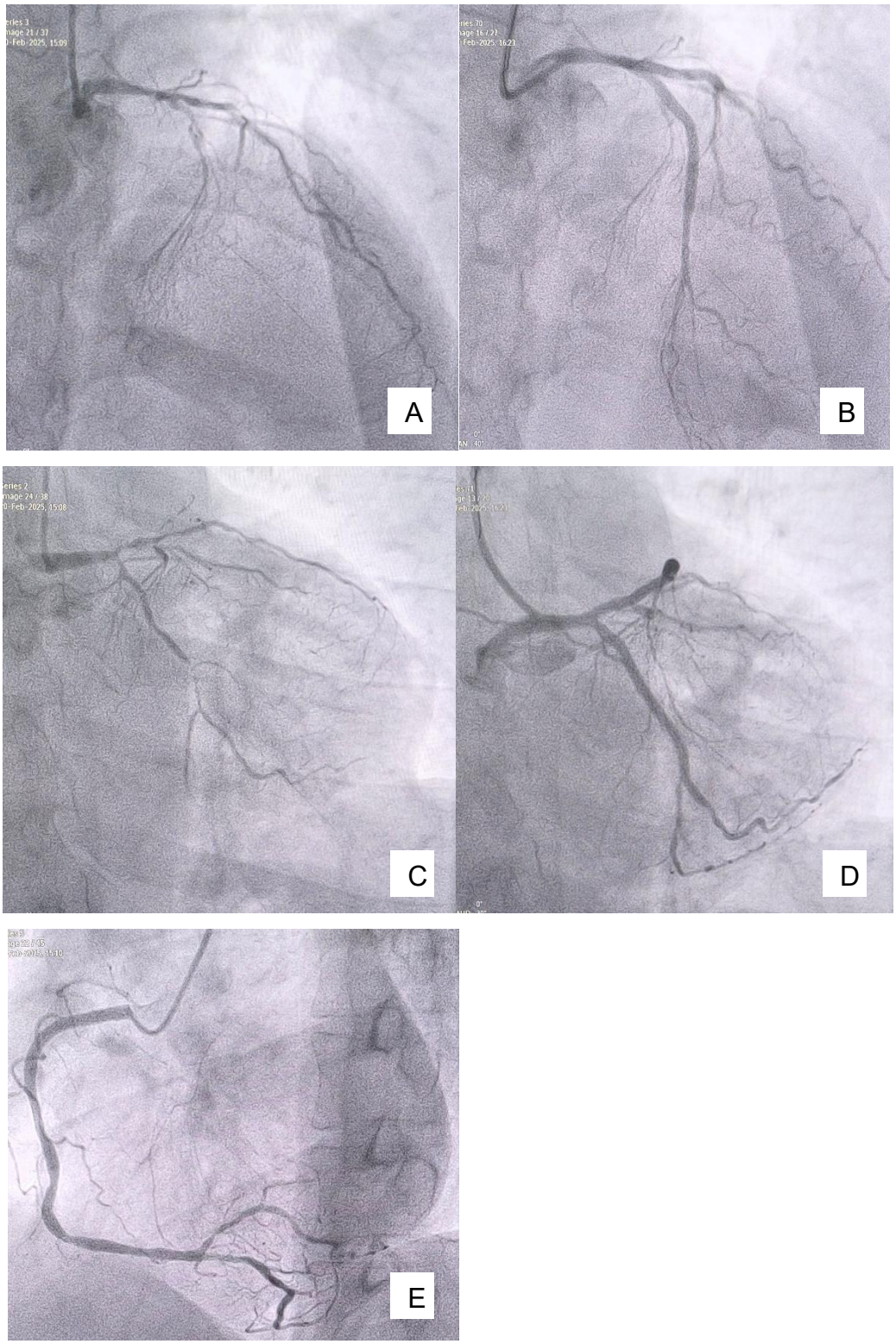


Figure 2. Results of Coronary Angiography and Percutaneous Coronary Intervention. (A) LAD Pre-Stent – 80% stenosis at the ostial LAD, CTO in the proximal segment, with collateral filling from the RCA. (B) LAD Post-Stent – Supraflex Cruz 2.75 x 48 mm DES placed from distal LM to distal LAD; TIMI 3 flow achieved. (C) LCx Pre-Stent – 80% stenosis in the ostial LCx, subtotal occlusion in the distal segment. (D) LCx Post-Stent – Supraflex Cruz 2.5 x 48 mm DES placed from proximal LCx to OM branch; TIMI 3 flow achieved. (E) RCA – Collateral filling to the distal LAD; no significant stenosis in RCA.

Coronary angiography (CAG), as shown in Figure 2, revealed 70% stenosis in the distal left main (LM) artery. The left anterior descending (LAD) artery showed 80% tubular stenosis at the ostial segment, chronic total occlusion (CTO) in the proximal segment, and collateral filling from the right coronary artery (RCA) to the distal segment. The left circumflex (LCx) artery showed 80% tubular stenosis in the ostial segment and subtotal occlusion in the distal segment. The patient underwent PCI targeting the LCx and LAD using an XB 3.0/6F guiding catheter.

After successfully crossing the lesion with a BMW guidewire, pre-dilatation was performed in the distal LCx with a Sapphire II Pro 1.5 x 15 mm balloon inflated up to 12 atm. A Supraflex Cruz 2.5 x 48 mm drug-eluting stent (DES) was then deployed at 12 atm from the proximal LCx to the obtuse marginal (OM) branch. A similar procedure was performed on the LAD. Pre-dilatation was done with a Sapphire II Pro 1.5 x 15 mm balloon inflated up to 20 atm in the proximal LAD, followed by balloon dilatation with a 2.5 x 48 mm balloon at 18 atm from the distal LM to the distal LAD. A Supraflex Cruz 2.75 x 48 mm DES was then placed at 18 atm from the distal LM to the ostial distal LAD. Both vessels showed good angiographic results with TIMI 3 flow achieved. The patient received additional medical therapy, including aspirin 80 mg, atorvastatin 20 mg, clopidogrel 75 mg, diazepam 2 x 2 mg, insulin detemir (Levemir) 14 IU once daily, enoxaparin (Lovenox) 0.6 cc twice daily, metformin 500 mg three times daily, ramipril 2.5 mg once daily, and Laxadine syrup 15 cc once daily. The post-PCI ECG is shown in Figure 3. The patient was hospitalized for five days with regular monitoring of vital signs and clinical status. No major adverse cardiovascular events (MACE) occurred during hospitalization.

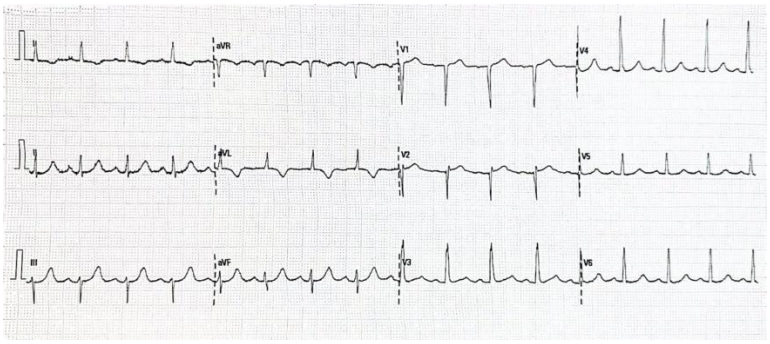


Figure 3. Post-PCI ECG

Discussion

The left main (LM) coronary artery originates from the aortic root and typically divides into the left anterior descending (LAD) and left circumflex (LCx) branches.[5] Similar to obstructions in other coronary territories, lesions in the left main coronary artery (LMCAD) can compromise perfusion to a broad myocardial region, frequently manifesting as angina or other ischemic symptoms.[6] In the present case, the patient experienced chest pain persisting for more than 20 minutes, attributed to vascular occlusion that caused myocardial hypoxia and necrosis.[7] The obstruction was likely secondary to thrombus formation following endothelial injury, precipitated by long-standing hypertension and diabetes mellitus.

Because the LM artery provides blood flow to approximately 75%–100% of the left ventricular (LV) myocardium, any significant stenosis places a substantial burden on ventricular function.[5] Acute myocardial infarction (AMI) results in the loss of viable myocytes, leading to both diastolic relaxation impairment and systolic dysfunction. Initially, fibrosis within the infarcted area limits contraction locally, but progressive ventricular remodeling may occur even in non-infarcted regions. This remodeling distorts the geometry and elasticity of the left ventricle, thereby worsening overall cardiac performance.[8] In this case, echocardiography confirmed these consequences through a reduction in ejection fraction.

Coronary angiography (CAG) demonstrated 70% narrowing at the distal LM segment, classified as Medina 1:1:1. Roughly 15% of LM lesions occur within the mid-shaft portion. The LAD exhibited 80% tubular narrowing at its ostium with chronic total occlusion (CTO) proximally and collateral filling from the right coronary artery (RCA) distally. Meanwhile, the LCx presented with 80% ostial stenosis and subtotal distal obstruction. LMCA narrowing exerts a hemodynamic influence on both the LAD and LCx, increasing turbulence and lowering wall shear stress (WSS) near the bifurcation. Such changes promote endothelial dysfunction, stimulate adhesion molecule expression, and accelerate foam cell and smooth muscle proliferation, factors that intensify atherosclerotic plaque progression, particularly around bifurcation zones. Moreover, LM disease is often accompanied by downstream atherosclerosis in the LAD and LCx, where disturbed flow and pressure gradients contribute to plaque expansion and complicate physiologic assessment using fractional flow reserve (FFR). Collectively, these mechanisms demonstrate how LMCA pathology can accelerate disease in its daughter vessels through both biomechanical and biological interactions.[9]

Although coronary artery bypass grafting (CABG) has historically been considered the definitive treatment for LMCA stenosis in the setting of multivessel disease (MVD), recent evidence has increasingly validated percutaneous coronary intervention (PCI) as a safe and effective alternative in selected complex cases. The emergence of refined procedural techniques, second-generation drug-eluting stents (DES), and robust real-world data has driven broader acceptance of PCI as a viable revascularization option.[10] Randomized clinical trials (RCTs) have demonstrated that complete revascularization via multivessel PCI is superior to culprit-only (CO) PCI in reducing cardiovascular mortality, recurrent angina, repeat revascularization, and major adverse cardiovascular events (MACE). In this case, because of financial constraints affecting treatment affordability, only two stents were implanted. A Supraflex Cruz 2.5 × 48 mm DES in the LCx from the proximal segment to the obtuse marginal (OM) branch at 12 atm, and a Supraflex Cruz 2.75 × 48 mm DES extending from the distal LM into the ostial LAD at 18 atm.

Intervention on the LM bifurcation typically requires a dual-stent approach, especially when both LAD and LCx ostia are diseased. However, in this patient, stent selection was prioritized for the LAD and LCx due to the severity and hemodynamic significance of their lesions. Isolated stenting of the LM alone was considered suboptimal, as it could have risked occluding the LCx and worsening lateral wall ischemia. By restoring distal flow through long-segment stenting of the LAD and LCx, distal pressure was improved, potentially decreasing the functional impact of the LM stenosis.[11] Prior studies have reported that revascularizing distal vessels such as the LAD and LCx can enhance overall coronary perfusion, indirectly lessening the

hemodynamic stress on the LM lesion as indicated by higher post-procedure FFR values. This selective revascularization approach also minimizes the risk of side-branch compromise, particularly at the LCx ostium, a frequent complication associated with LM-to-LAD crossover stenting. Thus, under resource-limited conditions, this technique represents a pragmatic and effective alternative.[12] Nevertheless, distal LM bifurcation stenting, especially via LM-to-LAD crossover, carries a recognized risk of LCx ostial lumen loss due to carina shift. This occurs when post-stent expansion alters the bifurcation geometry, displacing the carina toward the LCx and narrowing its ostium. Anatomical configurations significantly influence this process. A narrow LAD–LCx distal angle combined with a wider LM–LCx proximal angle increases the likelihood of carina displacement and subsequent LCx compromise. Additionally, plaque redistribution during stent deployment can further constrict the LCx ostium as atheromatous material shifts laterally. These factors together contribute to lateral wall ischemia and highlight the technical complexity of treating distal LM bifurcation lesions.[13-15]

In this case, LMCA stenting was deferred to address the most critical, flow-limiting lesions first, those in the LAD and LCx, given anatomical considerations and the constraint of stent availability. Enhancing distal perfusion may also help attenuate the physiological significance of residual LM stenosis. Ultimately, careful evaluation of lesion priority, timing, and technique selection is essential for optimizing procedural outcomes and long-term prognosis. Successful revascularization depends not only on technical execution but also on sound clinical judgment, individualized to each patient's circumstances. In this report, the patient remained free from major adverse cardiovascular events (MACE) throughout follow-up. Continued outpatient monitoring is warranted to evaluate potential future interventions for the LMCA as part of comprehensive long-term care.

Conclusion

Left main coronary artery disease (LMCAD), accompanied by multivessel involvement, represents a major therapeutic and procedural challenge, given its extensive myocardial impact and the complex decision-making required for revascularization. In this case, the intervention strategy prioritized treatment of the most hemodynamically significant lesions in the LAD and LCx to reestablish adequate myocardial perfusion, while deferring direct revascularization of the LMCA. This management plan was guided by anatomical feasibility, procedural safety, and institutional resource considerations. Comprehensive lesion evaluation, judicious stent selection, and patient-centered management remain critical to achieving favorable outcomes in complex coronary disease. Although no major adverse cardiovascular events (MACE) occurred during follow-up, continued surveillance and potential future LMCA intervention should be considered to maintain long-term stability and prevent recurrent ischemia.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

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