CATHALOGUE

OPEN ACCESS

CASE REPORT

The Critical Role of Imaging in Managing Complex PCI: A Case Report

Naeem Hameed, Shahid Abbas & Rehan Riaz

Faisalabad Institute of Cardiology, Faisalabad-Pakistan.

Citation:
Naeem H, Shahid A, Rehan R. The Critical Role of Imaging in Managing Complex PCI: A Case Report. Cathalogue. 2024; 2(3):110-115.

Corresponding Author Email:
dr_naeem80@hotmail.com

Funding:
The author(s) received no specific funding for this work.

Conflicts of Interests:
The authors have declared that no competing interests exist.

Received 10/01/2024
Accepted 25/04/2024
First Published 30/09/2024

Abstract

Background: Left Main Stem (LMS) disease presents significant challenges in interventional cardiology, particularly when the severity of lesions is ambiguous. Accurate assessment is crucial for determining appropriate treatment strategies.

Case Presentation: A 45-year-old male presented to a tertiary care hospital with post-myocardial infarction (MI) angina, five days after being thrombolyzed at a secondary care facility. At presentation, he was clinically stable, with normal baseline investigations. An echocardiogram revealed an ejection fraction (EF) of 35% and anterior wall hypokinesia. Coronary angiography demonstrated severe ostial stenosis of the left main stem (LMS) and subtotal occlusion of the left anterior descending (LAD) artery, persisting even after intracoronary nitrate administration.

Results: Initially planned for PCI of the LMS to the LAD or potential LMS bifurcation stenting, the patient underwent an intravascular ultrasound (IVUS) study three weeks later, which clarified the situation. Contrary to earlier expectations, the IVUS revealed no significant LMS disease. This unexpected finding suggested that the initial pressure damping during angiography was likely due to a thrombotic plaque and superimposed spasm at the LMS ostium. The procedure was performed using a 7F guiding catheter with planned intra-aortic balloon pump (IABP) support, but it ultimately resulted in a simpler PCI of the LAD with ostial coverage.

Conclusion: This case illustrates the critical role of IVUS in managing LMS disease and highlights how advanced imaging can alter treatment strategies. The ability to differentiate between significant and non-significant LMS lesions led to a less complex intervention than initially anticipated, contributing to an excellent post-procedural outcome for the patient.

Keywords

IVUS, IABP, Guider, Complex PCI, Bifurcation Stenting.

Published by Pakistan Society of Interventional Cardiology

Introduction

Up to 5% of diagnostic coronary angiography cases reveal left main stem (LMS) disease, a condition with significant prognostic implications due to the large area of myocardium at risk[1]. The Coronary Artery Surgery Study (CASS) registry, conducted decades ago, demonstrated that coronary artery bypass grafting (CABG) significantly reduced mortality in symptomatic patients with LMS disease, with 5-year mortality dropping from 43% to 16% compared to medical therapy alone[2]. These findings established CABG as the gold standard treatment for LMS disease for many years.

However, since the advent of coronary angioplasty, interventional cardiologists have been exploring percutaneous coronary intervention (PCI) as a less invasive alternative to CABG for managing LMS disease. The evolution of PCI techniques and advancements in stent technology, including drug-eluting stents and bioresorbable scaffolds, have significantly improved the success rates of these procedures[3]. Furthermore, enhanced implantation techniques and adjunctive imaging modalities like intravascular ultrasound (IVUS) have allowed for more accurate assessments of lesion morphology and improved procedural outcomes. The integration of these innovations into clinical practice has steadily increased the viability of PCI as a treatment option for LMS disease[4].

Recent studies have indicated that with proper patient selection and advanced procedural techniques, PCI can achieve outcomes comparable to CABG in selected populations, particularly in cases of less complex LMS disease[5-7]. The increasing experience of interventional cardiologists and ongoing research into optimal approaches for LMS lesions have contributed to a paradigm shift in the management of this challenging condition[8].

This case report presents a unique instance of successful PCI for LMS disease in a patient with a complex coronary anatomy. We aim to highlight the decision-making process, the techniques employed, and the patient's outcomes, emphasizing the evolving role of PCI as a viable alternative to surgical intervention in select cases of LMS disease. Through this case, we seek to illustrate the importance of individualized treatment strategies and the potential benefits of contemporary interventional approaches in managing patients with LMS disease.

Case Presentation

A 45-year-old male, with a 10-year history of diabetes mellitus and a 3-year history of hypertension, presented with chest pain at home while at rest. He reported no significant family history of cardiovascular disease and was a non-smoker. Professionally, he was a school teacher and led a relatively sedentary lifestyle. His diabetes and hypertension were controlled with oral medications. Initially suspecting gastric discomfort, he self-medicated at home before seeking help at a nearby clinic, where he was referred to a secondary care facility after minimal intervention.

Upon arrival at the District Headquarters (DHQ) Hospital, the patient underwent an electrocardiogram (ECG) and was diagnosed with an acute myocardial infarction (MI). He was thrombolyzed with streptokinase and admitted for monitoring. After three days, he was discharged and referred to a tertiary care center for a diagnostic coronary angiogram.

Several days later, the patient experienced recurrent chest pain and returned to the emergency department of the tertiary care hospital. He was diagnosed with post-MI angina and admitted for further evaluation. Echocardiography revealed anterior wall hypokinesia with an ejection fraction (EF) of 35%, but there were no mechanical complications. After stabilization and counseling, the patient consented to undergo coronary angiography for further assessment. He had no history of previous coronary interventions.

Diagnostic Assessment

Coronary angiography was performed via the femoral route. On engaging the left coronary artery with a 6F Judkins Left (JL) 4.0 catheter, significant

pressure damping was observed. The patient was administered intracoronary nitrates to relieve potential vasospasm, and the catheter was re-engaged, but pressure damping persisted. To mitigate the risk of arterial injury, the catheter was downsized to a 5F JL 4.0 diagnostic catheter, and the procedure was repeated with the same outcome (Figure 1).

Coronary angiography revealed severe ostial stenosis of the LMS and subtotal proximal stenosis of the left anterior descending (LAD) artery with Thrombolysis in Myocardial Infarction (TIMI)-II flow as shown fig. I. At this point, it was concluded that the patient had significant LMS and LAD disease requiring revascularization.

Therapeutic Intervention

The patient was counseled regarding revascularization options, including coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) for the LAD. After an informed discussion, the patient opted for PCI. The intervention was scheduled two weeks later with the support of an intra-aortic balloon pump (IABP) and adjunctive cardiac imaging, such as IVUS, to optimize stent placement and outcomes.

On the day of the procedure, a 7F guiding catheter was used to engage the left coronary system. Initial non-selective contrast injection showed a better appearance of the LMS ostium. However, selective engagement again revealed no significant LMS ostial disease. To confirm the angiographic findings, IVUS was employed, which demonstrated severe stenosis of the proximal LAD involving the ostium but no significant LMS involvement. The minimal lumen area (MLA) of the LAD was calculated to be 6.2 mm^2, confirming the need for PCI to the LAD.

The intervention plan was therefore revised from LMS PCI to LAD PCI. The LAD lesion was successfully stented with a 3.5 mm × 24 mm drug-eluting stent (DES). Post-dilation was performed, and final IVUS imaging confirmed good stent expansion without complications (Figure 2).

Follow-Up and Outcomes

The patient was discharged the following day on dual antiplatelet therapy (aspirin 75 mg and clopidogrel 75 mg), along with atorvastatin 40 mg, bisoprolol 5 mg, and lisinopril 5 mg. At a 1-week follow-up, the patient was clinically stable with no recurrence of chest pain or bleeding complications. At the 1-month follow-up, his functional capacity was significantly improved, and he remained free of chest pain on exertion.

A repeat echocardiogram performed six weeks post-procedure showed an improvement in EF from 35% to 50%, although anterior wall hypokinesia persisted. The patient was well-informed about the importance of adherence to medical therapy and follow-up appointments. He expressed satisfaction with the outcome and reported significant improvement in his quality of life.

Discussion

Left main stem (LMS) disease is clinically significant due to its role in supplying a large portion of the myocardium. In cases of right coronary artery dominance, the LMS supplies approximately 70% of the myocardium, while in left dominance, it can supply up to 90%. This makes revascularization of the LMS particularly crucial, yet also challenging. Historically, both ostial and distal LMS disease were regarded as absolute indications for coronary artery bypass grafting (CABG), as percutaneous coronary intervention (PCI) was associated with poorer outcomes in this high-risk subset. However, advancements in interventional techniques, stent technology, and imaging modalities have revolutionized the treatment of LMS disease, making PCI a viable and effective alternative to CABG in selected cases.

Ostial LMS PCI has been shown to yield similar outcomes to CABG in terms of both safety and efficacy, with a growing body of evidence supporting its long-term benefits. Distal LMS bifurcation, once a technical challenge, is now performed with increasing frequency and success, thanks to the development of bifurcation-specific stents and techniques. In isolated LMS disease with

a low SYNTAX score, PCI is often preferred, particularly when patients are at higher surgical risk or prefer a less invasive option.

When considering LMS PCI, procedural planning is crucial. It is typically approached with the mindset that a bifurcation PCI may be required, and the availability of circulatory support, such as intra-aortic balloon pump (IABP) or mechanical circulatory support devices, is often necessary to mitigate hemodynamic risks. Intravascular imaging, especially intravascular ultrasound (IVUS), plays an indispensable role in optimizing LMS interventions. IVUS is considered the gold standard for LMS evaluation as it provides critical information about plaque morphology, lesion length, and vessel sizing, all of which guide stent selection and positioning. Data from large registries have demonstrated that the use of IVUS in LMS PCI is associated with improved short- and long-term clinical outcomes, including a reduction in mortality[1,2].

Optical coherence tomography (OCT), while useful in other coronary interventions, does not offer the same depth of visualization for LMS assessment as IVUS, particularly when dealing with large-caliber vessels and extensive calcifications. In our case, the use of IVUS proved transformative. Initially, the patient was planned for a complex LMS PCI; however, IVUS revealed that the LMS disease was not as severe as angiographically perceived, shifting the focus to the left anterior descending (LAD) artery. This led to a much simpler intervention that avoided unnecessary LMS stenting, underscoring the importance of intravascular imaging in clarifying ambiguous angiographic findings.

Calcium burden is another critical consideration in LMS PCI, as extensive coronary calcification is a negative predictor of successful PCI outcomes. IVUS allows for detailed visualization of coronary calcification, particularly in the LMS, aiding in the selection of appropriate adjunctive therapies such as atherectomy or high-pressure balloon inflation to optimize stent deployment[3]. Furthermore, IVUS has the ability to identify and address stent-related complications, such as stent malposition, under-expansion, geographic miss, and stent-edge dissections[4].

Stent under-expansion is a particularly important predictor of stent thrombosis, a serious complication that can lead to poor long-term outcomes. IVUS can detect suboptimal stent expansion and facilitate post-dilation to ensure optimal stent apposition, thus reducing the risk of thrombosis and restenosis[5]. In our case, the use of IVUS not only guided decision-making regarding lesion severity but also ensured optimal stent expansion, contributing to a successful PCI and a favorable patient outcome.

Conclusion

When planning complex PCI, it is essential to anticipate all possible outcomes and thoroughly evaluate every aspect of the lesion before proceeding with stenting. The use of advanced imaging techniques, such as IVUS, can significantly simplify even the most challenging procedures by providing critical insights that may not be apparent through angiography alone. This case demonstrates how careful planning and the strategic use of imaging can transform a potentially complex intervention into a more straightforward and successful procedure, ultimately improving patient outcomes and reducing procedural risks.

Learning points

- In cases of LMS disease, particularly distal LMS or when extending into branches, planning should include the possibility of bifurcation stenting, ideally using a 7F sheath and guiding catheter.
- Intravascular ultrasound (IVUS) is the gold standard for evaluating LMS disease severity and should be employed when angiographic findings are ambiguous or difficult to interpret.
- IVUS-guided interventions can simplify complex PCI, optimizing outcomes and minimizing procedural risk.
- Ostial spasm or thrombotic disease are the most common causes of changes in ostial

appearance during angiography and should be carefully assessed before intervention.

References

1) Park SJ, Kim YH, Park DW et al. MAIN-COMPARE Investigators. Impact of intravascular ultrasound guidance on long-term mortality in stenting for unprotected left main coronary artery stenosis. Circ Cardiovasc Interv. 2009;2:167–77. doi: 10.1161/CIRCINTERVENTIONS.108.799494. DOI. PMID.
2) de la Torre Hernandez JM, Baz Alonso JA, Gómez Hospital JA et al. IVUS-TRONCO-ICP Spanish Study. Clinical impact of intravascular ultrasound guidance in drug-eluting stent implantation for unprotected left main coronary disease: pooled analysis at the patient-level of 4 registries. JACC Cardiovasc Interv. 2014;7:244–54. doi: 10.1016/j.jcin.2013.09.014. DOI. PMID.
3) Tuzcu EM, Berkalp B, De Franco AC et al. The dilemma of diagnosing coronary calcification: angiography versus intravascular ultrasound. J Am Coll Cardiol. 1996;27:832–8. PMID.
4) Bing R, Yong AS, Lowe HC. Percutaneous transcatheter assessment of the left main coronary artery: current status and future directions. JACC Cardiovasc Interv. 2015;8:1529–39. doi: 10.1016/j.jcin.2015.07.017. DOI. PMID
5) Nerlekar N, Cheshire CJ, Verma KP et al. Intravascular ultrasound guidance improves clinical outcomes during implantation of both first- and second-generation drug-eluting stents: a meta-analysis. EuroIntervention. 2017;12:1632–42. doi: 10.4244/EIJ-D-16-00769. DOI. PMID.
6) Predescu LM, Zarma L, Platon P, Postu M, Bucsa A, Croitoru M, Deleanu DE, Ginghina C. Current treatment of left main coronary artery disease. Cor et Vasa. 2016 Jun 1;58(3):e328-39.
7) Ramadan R, Boden WE, Kinlay S. Management of left main coronary artery disease. Journal of the American Heart Association. 2018 Mar 31;7(7):e008151.
8) Jones DA, Mathur A, Baumbach A. PCI Should Be the First Option for All Left Main Disease? An Interventional Cardiologist's Perspective. InLeft Main Coronary Revascularization 2022 Nov 18 (pp. 47-63). Cham: Springer International Publishing.

Figure/Video

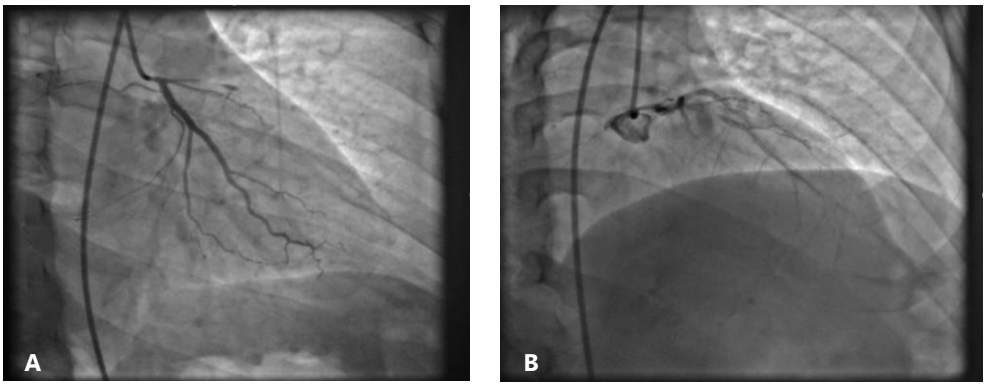

Figure 1(A): Caudal angulation demonstrating severe ostial stenosis of the left main stem (LMS). (B): Cranial angulation illustrating the extent of the lesion and its impact on the surrounding coronary anatomy.

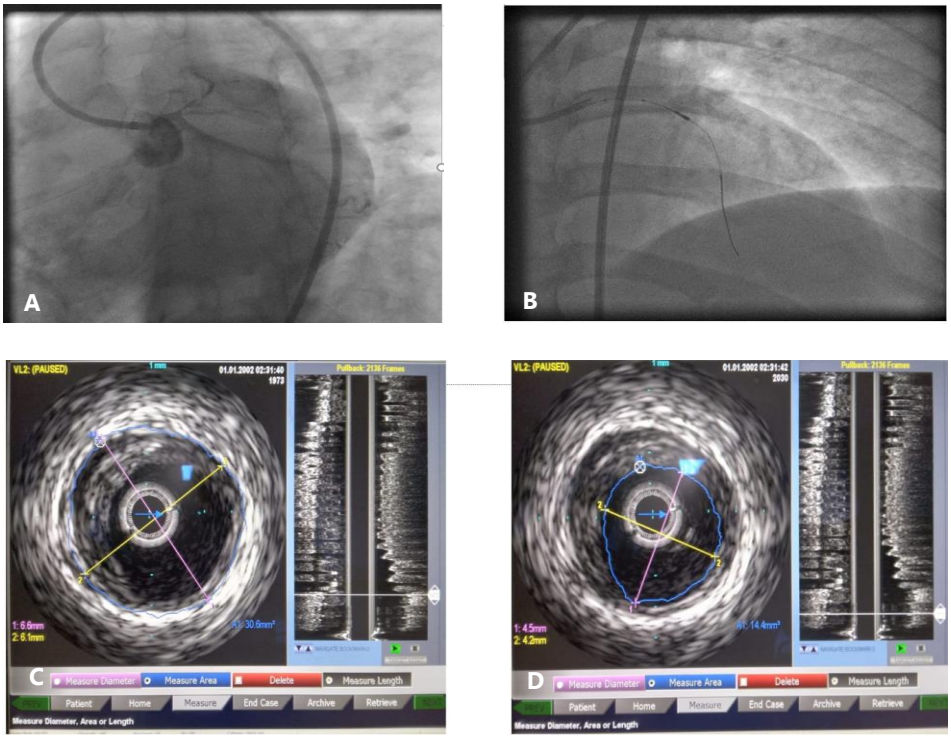

Figure 2(A): Check injection at the time of PCI, showing no apparent disease. (B): Intravascular ultrasound (IVUS) run assessing the significance of the left main stem (LMS) starting from the left anterior descending (LAD) artery. (C): IVUS image highlighting the LMS anatomy. (D): IVUS image detailing the LAD, demonstrating the absence of significant disease.