CATHALOGUE

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CASE REPORT

Role of imaging in complex PCI

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Abstract

Background: The left main stem (LMS) disease is of critical importance due to its significant impact on myocardial perfusion. While coronary artery bypass grafting has historically been favored, advancements in percutaneous interventions offer viable alternatives. The evolution of stent technology, imaging modalities, and pharmacotherapy has expanded the scope of percutaneous treatment for LMS disease.

Case Presentation: A 45-year-old male with a history of diabetes and hypertension presented with chest pain and was diagnosed with Anterior Wall Myocardial Infarction (AWMI). After thrombolysis at a secondary care facility, he was referred to a tertiary care hospital where diagnostic assessments revealed severe LMS ostial stenosis and subtotal LAD artery occlusion. Despite initial plans for PCI targeting the LMS, subsequent intravascular ultrasound (IVUS) imaging led to a revised treatment strategy focusing on PCI to the LAD.

Results: Initial angiography suggested significant LMS disease, but IVUS revealed a different scenario, prompting a shift in the treatment plan towards PCI of the LAD. The procedure was successfully performed, with post-dilation confirming optimal stent expansion. Follow-up assessments demonstrated stable clinical status and improved cardiac function, indicating the efficacy of the intervention.

Conclusion: The case underscores the dynamic nature of coronary artery disease management and the pivotal role of advanced imaging techniques such as IVUS in refining treatment strategies. By adapting interventions based on evolving diagnostic assessments, optimal outcomes can be achieved, even in complex cases.

Keywords

Intravascular ultrasound (IVUS), Guider, Complex PCI, Bifurcation stenting, left main stem (LMS) disease.

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Introduction

Left main stem (LMS) disease represents a critical subset of coronary artery pathology, with up to 5% of diagnostic angiography cases revealing its presence. This finding holds significant prognostic implications due to the substantial amount of myocardium at risk. Historically, the management of LMS disease has been informed by landmark studies such as the Coronary Artery Surgery Study registry, which demonstrated the superiority of coronary artery bypass grafting (CABG) over medical therapy. In symptomatic patients, CABG resulted in a remarkable reduction in 5-year mortality rates, dropping from 43% to 16%.

Despite the established efficacy of CABG, interventional cardiologists have long sought to explore the feasibility and effectiveness of percutaneous treatment modalities for LMS disease. The advent of coronary angioplasty marked a pivotal moment in this endeavor, providing a foundation for the development of percutaneous coronary interventions (PCI). Over the years, advances in stent technology, implantation techniques, adjunctive imaging modalities, and pharmaceutical therapy have propelled the field forward, making the percutaneous management of LMS disease an increasingly viable option[1].

The evolving landscape of interventional cardiology, coupled with the continuous refinement of PCI techniques, has led to a paradigm shift in the management of LMS disease. In this context, the role of imaging techniques such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT) has become increasingly prominent. These imaging modalities offer detailed insights into coronary artery anatomy, plaque characteristics, and stent deployment, thereby enhancing procedural planning and optimizing outcomes in LMS interventions[1,2]. This transition underscores the need for a detailed understanding of the pathophysiology, patient selection criteria, and procedural nuances associated with percutaneous LMS interventions. As such, this introduction sets the stage for a comprehensive exploration of the contemporary approaches to LMS disease management, emphasizing the pivotal role of PCI in this evolving landscape.

Case Presentation

A 45-year-old male, with a ten-year history of diabetes and three-year history of hypertension, presented with chest pain while at home. Initially, he attempted to alleviate the discomfort with over-the-counter medication for what he believed to be a gastric issue. However, as the pain persisted, he sought medical attention at a nearby facility. Following an electrocardiogram (ECG) at the District Headquarters (DHQ) hospital, he was diagnosed with a myocardial infarction (MI). Subsequently, he received thrombolysis with streptokinase injection and remained hospitalized for three days before being discharged. Upon discharge, he was referred to a tertiary care hospital for further evaluation with a diagnostic angiogram.

The patient's family history was unremarkable, and he had no prior history of cardiac interventions. A teacher by profession and a non-smoker, he experienced another episode of chest pain at home and promptly presented to the tertiary care center. Admitted to the emergency department with post-MI angina, he underwent baseline investigations and remained clinically stable throughout his admission.

Echocardiography revealed anterior wall hypokinesia with an ejection fraction (EF) of 35%, indicating compromised heart function but no mechanical complications. With informed consent, he was recommended to undergo coronary angiography to assess the extent and severity of coronary artery disease, a pivotal step in determining the optimal treatment approach for his condition.

Diagnostic Assessment

His coronary angiogram was done through femoral route. He had significant pressure damping on engagement of left sided catheter which was 6F catheter JL 4.0 catheter. He was given intracoronary nitrate then again catheter was engaged, pressure damping occurred. Again, intracoronary nitrate was given and catheter was changed with 5F diagnostic JL 4.0 catheter. Then check injection showed severe ostial disease of LMS. Left system angiogram was done with disengagement of catheter each time. It showed severe LMS ostial stenosis. LAD showed subtotal proximal stenosis with TIMI-II flow as shown Fig. 1.

Therapeutic Intervention

Patient was counselled about need of revascularization either with coronary artery bypass grafting or with PCI to LAD. Patient opted for PCI. It was planned to go for PCI after 2 weeks with the backup of IABP and using cardiac imaging as a tool for optimal PCI. We used 7F guider to engage left system. Initial non selective injection showed somewhat better appearance of LMS ostium. Then after engaging left system again angiogram was taken which showed non significant left main ostium. We decided to go for IVUS imaging to confirm LMS findings on angiogram done 2 weeks back and again this check injection. IVUS study done from mid LAD to LMS ostium. It showed significant stenosis of LAD involving ostium but LMS disease was not significant. We calculated MLA which came out to be 6.2. So it was decided to go for PCI to LAD with ostial nailing. So our initial plan and patient counselling turned into a different entity which was from LMS PCI to LAD PCI now. So LAD PCI done with 3.5*24mm stent. Post dilated and final IVUS check showed good expansion of stent without any complication.

Follow-Up and Outcomes

Patient was discharged next day on dual antiplatelet therapy including aspirin and Clopidogrel 75mg, Atorvastatin 40mg, Bisoprolol 5mg, Lisinopril 5mg. Follow up after 1 week showed stable clinical condition with no chest pain or bleeding complication. Follow up after 1 month show good functional capacity with no chest pain on exertion. Follow up echocardiogram after 6 weeks showed EF 50% with anterior wall hypokinesia. Patient was well satisfied with the treatment and fully aware of the need of medications.

Discussion

Left mainstem (LMS) disease holds paramount significance in cardiovascular medicine, as it supplies a substantial portion of the myocardium, ranging from 70% in cases of right dominance to 90% in cases of left dominance. Historically, revascularization of LMS lesions has posed considerable challenges, with both ostial and distal LMS disease traditionally regarded as absolute indications for surgical intervention[3]. However, advancements in interventional techniques and expertise have revolutionized the management of LMS disease, offering alternatives to surgical revascularization.

The emergence of percutaneous coronary intervention (PCI) as a viable option for LMS disease has been particularly noteworthy. Ostial LMS PCI has been demonstrated to confer similar benefits to coronary artery bypass grafting (CABG), with improved procedural outcomes and comparable long-term results. Furthermore, the increasing frequency of distal LMS bifurcation interventions has yielded favorable clinical outcomes in both the short and long term.

The selection of patients with isolated LMS disease and low Syntax scores for PCI has become increasingly common, reflecting the growing confidence in the efficacy of percutaneous approaches[4]. However, the intricacies of LMS PCI demand meticulous procedural planning, with considerations akin to those for bifurcation PCI and the provision of circulatory support.

Imaging modalities, particularly intravascular ultrasound (IVUS), play a pivotal role in guiding LMS interventions. IVUS serves as the gold standard for evaluating LMS lesions, providing detailed insights into lesion morphology, plaque composition, and calcific burden. Notably, data from large registries have underscored the mortality benefit associated with the use of IVUS in LMS PCI.

In the context of our case, IVUS played a transformative role, leading to a significant deviation from the initially planned complex LMS PCI to a simpler PCI approach[5]. The frequent utilization of IVUS in LMS interventions is paramount for optimizing both short-term procedural outcomes and long-term clinical results. Moreover, IVUS aids in identifying and mitigating stent-related complications, such as malposition, under-expansion, and stent-edge dissection, thereby reducing the risk of stent thrombosis and adverse events.

Conclusion

The management of LMS disease demands meticulous planning and consideration of all possible outcomes. It is imperative to thoroughly assess and address every aspect before proceeding with stenting of any lesion. The integration of advanced imaging modalities, particularly in IVUS, plays a pivotal role in guiding complex PCI and optimizing procedural outcomes.

Learning points

- **Comprehensive Planning:** Complex PCI procedures, especially those involving LMS disease, should be meticulously planned with consideration of all potential scenarios. Thorough assessment and anticipation of complications are essential for achieving optimal results.
- **Bifurcation Stenting Strategy:** LMS disease, particularly when extending into branches, warrants careful planning with the intent of bifurcation stenting. Utilizing appropriate sheath and guiding catheter sizes can facilitate successful intervention in these challenging cases.
- **Role of Imaging:** IVUS emerges as the preferred modality for evaluating the severity of LMS disease. Its utilization is crucial, especially in situations where angiography results are equivocal or difficult to interpret. IVUS guidance provides invaluable insights that can inform decision-making and streamline complex PCI procedures.
- **Transformative Potential of IVUS:** IVUS guidance has the transformative potential to convert a complex PCI procedure into a relatively simple one. By providing detailed insights into lesion morphology and characteristics, IVUS facilitates accurate lesion assessment and stent placement, thereby optimizing procedural success.
- **Underlying Pathophysiology:** In cases of ostial changes, such as spasm or thrombotic disease, a thorough understanding of the underlying pathophysiology is essential. Recognizing these factors allows for appropriate intervention strategies and ensures optimal patient outcomes..

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Figure/Video

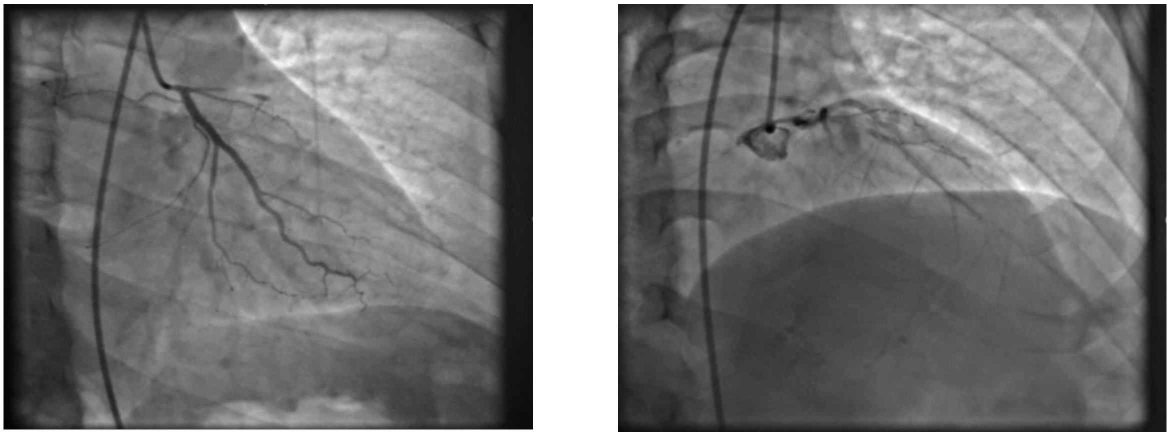

Fig 1: A) Caudal angulation showing severe ostial stenosis of LMS, B) Cranial

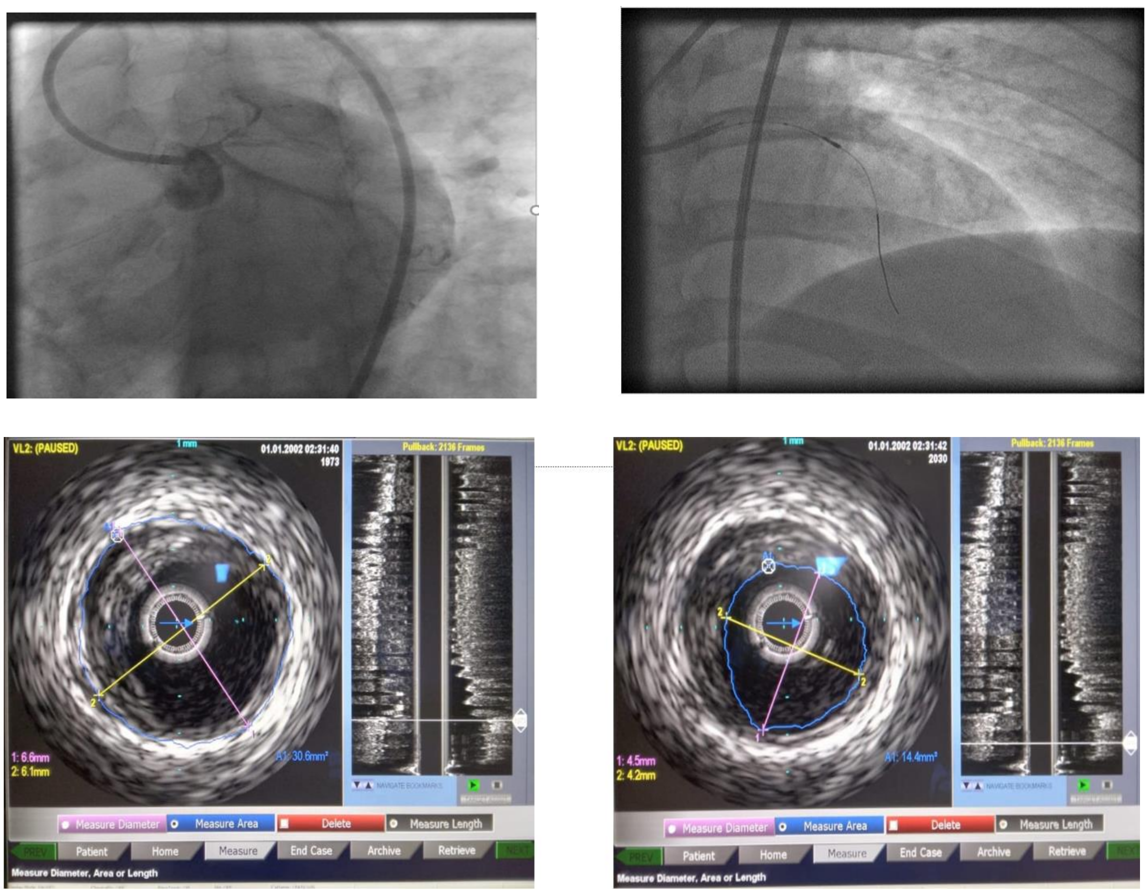

Fig 2: A) Check injection at the time of PCI, No disease apparently B) IVUS run to see significance of LMS starting from LAD (C,D) IVUS images in LMS and LAD respectively