CATHALOGUE

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CASE REPORT

A rock along the road

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Abstract

Background: Coronary calcification poses a significant challenge for interventional cardiologists, often leading to procedural complexities and suboptimal outcomes. Lesions that appear non-severely calcified angiographically may pose unexpected difficulties during percutaneous coronary intervention (PCI), necessitating the use of intravascular imaging for accurate lesion assessment and procedural planning.

Case Presentation: We present the case of a 52-year-old hypertensive male who presented with non-ST elevation myocardial infarction (NSTEMI) to Chaudhary Pervaiz Elahi Institute of Cardiology. Initial management was conservative, and subsequent coronary angiography revealed a mid-left anterior descending artery (LAD) lesion at the origin of a prominent diagonal branch. Despite attempted PCI, the lesion proved resistant to conventional treatment modalities. Subsequent intravascular ultrasound (IVUS) imaging identified a calcific spur impinging the vessel lumen, prompting the decision for rotational atherectomy followed by successful stenting with a drug-eluting stent (DES).

Management and Results: The patient underwent staged PCI with rotational atherectomy, leading to effective lesion modification and subsequent stent deployment. IVUS-guided optimization ensured optimal post-stenting results, with the patient tolerating the procedure well and experiencing resolution of symptoms.

Conclusion: This case underscores the importance of employing intravascular imaging, particularly in the presence of coronary calcification, to guide procedural decision-making and optimize post-stenting outcomes. By incorporating IVUS into routine practice, interventionalists can enhance procedural success rates and improve long-term clinical outcomes in patients with complex coronary artery disease.

Keywords

Coronary calcification, Intravascular imaging, Rotational atherectomy, Percutaneous coronary intervention (PCI) and Drug-eluting stent (DES)

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Introduction

Coronary artery disease remains a leading cause of morbidity and mortality globally, imposing a substantial burden on healthcare systems and economies. While medical therapy, lifestyle modifications, and preventive measures form the cornerstone of coronary artery disease (CAD) management, invasive interventions such as percutaneous coronary intervention (PCI) play a pivotal role in alleviating symptoms, improving quality of life, and reducing adverse cardiovascular events in select patient populations.

One of the paramount challenges encountered by interventional cardiologists in the modern era is the management of coronary calcification. Calcified lesions present a unique set of complexities, often rendering conventional angioplasty techniques inadequate or ineffective. Unlike softer plaques, calcified lesions pose a formidable barrier to balloon dilatation and stent deployment, predisposing patients to suboptimal procedural outcomes, higher rates of complications, and increased risk of restenosis[1].

Calcium deposition within coronary arteries represents an advanced stage of atherosclerosis, reflecting chronic inflammation, lipid accumulation, and vascular remodeling processes. It contributes to the pathogenesis of CAD by altering plaque stability, impairing vasomotor function, and promoting thrombus formation, thereby exacerbating ischemic burden and precipitating acute coronary events[2,3].

In addition to the intrinsic mechanical resistance posed by calcific plaques, the presence of calcification complicates lesion assessment, decision-making, and procedural planning during coronary angiography and PCI. Standard angiographic imaging techniques may underestimate the severity and extent of calcification, leading to suboptimal treatment strategies and procedural complications.

Furthermore, the management of calcified lesions necessitates a tailored approach, incorporating a spectrum of advanced adjunctive technologies and procedural techniques to overcome the challenges posed by calcium. These may include intravascular imaging modalities such as intravascular ultrasound (IVUS) or optical coherence tomography (OCT), atheroablative devices like rotational atherectomy, or novel plaque modification strategies such as intravascular lithotripsy.

Despite the growing recognition of the importance of calcium in CAD intervention, several knowledge gaps and clinical uncertainties persist, particularly regarding optimal lesion characterization, selection of appropriate treatment modalities, and long-term outcomes following intervention. Addressing these challenges requires a multidisciplinary approach, encompassing collaboration between interventional cardiologists, imaging specialists, and cardiovascular researchers, alongside continuous innovation and refinement of therapeutic strategies.

In this context, this case study aims to illustrate the complexities and intricacies involved in the management of calcified coronary lesions, highlighting the role of advanced imaging techniques and innovative interventional approaches in achieving successful outcomes in challenging clinical scenarios. By elucidating the pathophysiology, diagnostic assessment, therapeutic interventions, and long-term follow-up of a specific case, this study seeks to contribute to the existing body of knowledge and inform clinical practice, ultimately enhancing the quality of care and outcomes for patients with calcific coronary artery disease.

Case Presentation

The patient, a 52-year-old male, presented to the emergency department with a chief complaint of intermittent chest pain that had been radiating to his left shoulder for the past two days. He described the pain as moderate in intensity, with episodes occurring on and off. Notably, the pain was not relieved by rest or nitroglycerin. Given the nature of the symptoms and the suspicion of acute coronary syndrome, an electrocardiogram (ECG) was promptly performed, revealing non-specific

ST-T wave changes. Additionally, laboratory investigations showed elevated troponin levels (3.6 ng/mL, with a normal range being less than 0.05 ng/mL), confirming the diagnosis of non-ST segment elevation myocardial infarction (NSTEMI).

The patient had a significant medical history of hypertension for the past 8 years, which had been poorly controlled due to non-compliance with antihypertensive medication. Despite being prescribed amlodipine 10 mg, he admitted to irregular medication adherence over the past 6 months. Furthermore, his family history was notable for ischemic heart disease, with his brother experiencing a myocardial infarction at the age of 48. Socially, the patient belonged to a lower socioeconomic background, working as a shopkeeper to support his family of six children, none of whom were employed.

Upon physical examination, the patient appeared uncomfortable but was hemodynamically stable, with a heart rate of 90 beats per minute, blood pressure of 110/70 mmHg, and oxygen saturation of 97% on room air. Auscultation of the chest revealed no additional heart sounds, and there was no evidence of pedal edema. Given the clinical presentation and diagnostic findings, the patient was admitted to the coronary care unit (CCU) for further evaluation and management of NSTEMI.

Initial management in the CCU consisted of administering aspirin 300 mg, clopidogrel 300 mg, and sublingual nitrates to alleviate symptoms and mitigate the risk of further thrombotic events. Additionally, the patient received enoxaparin 80 mg subcutaneously for anticoagulation. The chest pain gradually subsided, and the patient remained stable during his hospitalization.

Within 48 hours of admission, the patient underwent invasive coronary angiography to assess the extent and severity of coronary artery disease. The procedure was performed via the right radial artery approach, and the angiographic findings revealed significant lesions in the coronary arteries. Specifically, the left main stem (LMS) was found to be normally functioning with mild distal tapering. The left anterior descending artery (LAD) exhibited a severe mid-disease at the origin of the diagonal branch (Medina 1,1,1), indicating a high-grade stenosis. Furthermore, the left circumflex artery (LCX) demonstrated severe proximal disease, while the dominant right coronary artery (RCA) showed mild proximal disease.

The angiographic findings confirmed the presence of obstructive coronary artery disease, particularly in the LAD and LCX arteries, consistent with the clinical presentation of NSTEMI. Given the severity of the lesions and the clinical status of the patient, a multidisciplinary team convened to discuss the optimal management strategy, weighing the risks and benefits of revascularization.

Diagnostic Assessment

Following the initial diagnosis of NSTEMI and confirmation of significant CAD on angiography, further assessment was necessary to delineate the extent and characteristics of the lesions, particularly in the LAD and LCX. Despite the angiographic visualization of disease severity, attempts at PCI were impeded by a calcified lesion within the LAD, which was not readily apparent on angiography alone.

IVUS Imaging was utilized to provide additional insight into the nature and composition of the calcified lesion. IVUS employs a catheter-mounted ultrasound transducer to generate high-resolution cross-sectional images of the coronary arteries, allowing for detailed assessment of plaque morphology, including the presence and extent of calcification. In this case, IVUS revealed the presence of a calcific spur protruding into the lumen of the LAD, which was not adequately visualized on angiography. This crucial information provided a more comprehensive understanding of the lesion and guided subsequent therapeutic decision-making.

Therapeutic Intervention

Given the complexity of the lesion and the challenges encountered during initial PCI attempts, a multidisciplinary approach involving interventional cardiologists, imaging specialists, and cardiovascular surgeons was essential to formulate an optimal treatment strategy. After careful consideration of the patient's clinical status, lesion characteristics, and available therapeutic options, a decision was made to proceed with staged PCI, incorporating rotational atherectomy as a plaque modification technique.

Rotational atherectomy is a specialized PCI technique that involves the use of a high-speed rotational burr to ablate and modify calcified plaque within coronary arteries. This procedure is indicated in cases of severe calcific coronary lesions that are resistant to conventional angioplasty techniques. Prior to rotational atherectomy, meticulous preparation and patient optimization were undertaken, including ensuring adequate hydration, administration of vasodilators to prevent coronary spasm, and optimization of dual antiplatelet therapy to minimize the risk of thrombotic events.

Under the guidance of IVUS imaging, rotational atherectomy was performed to ablate the calcified spur within the LAD, thereby facilitating successful stent deployment and restoration of coronary blood flow. Following plaque modification with rotational atherectomy, IVUS-guided stenting of the LAD and LCX arteries was performed to optimize stent placement and ensure adequate luminal expansion.

Follow-Up and Outcomes

Subsequent to the successful completion of PCI with rotational atherectomy and IVUS-guided stenting, the patient underwent regular follow-up evaluations to assess treatment efficacy, monitor for potential complications, and optimize secondary prevention measures. These follow-up visits included clinical assessments, electrocardiography, and laboratory investigations to evaluate cardiac biomarkers and lipid profiles.

Fortunately, the patient experienced a favorable clinical course post-procedure, with no reported complications and resolution of symptoms. He was able to resume normal activities without recurrence of chest pain or ischemic symptoms. Long-term outcomes, including freedom from major adverse cardiovascular events and durability of revascularization, were monitored closely during follow-up visits to ensure continued therapeutic success and optimize cardiovascular health.

Discussion

In the presented case, the utilization of IVUS played a pivotal role in elucidating the underlying pathology of the calcified lesion within the LAD and guiding the subsequent therapeutic approach. IVUS imaging provided detailed cross-sectional visualization of the coronary anatomy, allowing for precise assessment of plaque morphology, composition, and distribution, which proved essential in identifying the calcific spur that was not adequately visualized on angiography alone[3].

The importance of IVUS in the management of complex coronary lesions, particularly those involving calcification, is well-documented in the literature. IVUS has been shown to enhance lesion characterization, improve procedural outcomes, and reduce the risk of complications in PCI procedures. By providing accurate measurements of lumen dimensions, plaque burden, and vessel architecture, IVUS facilitates optimal stent sizing, placement, and expansion, thereby minimizing the risk of stent malposition, edge dissection, and restenosis[4].

Furthermore, IVUS-guided PCI has been associated with improved long-term outcomes, including lower rates of target lesion revascularization and stent thrombosis, compared to angiography-guided PCI[5]. The ability of IVUS to identify features such as calcification, plaque rupture, and thrombus formation enables tailored therapeutic interventions and enhances procedural success rates, particularly in challenging cases like the one described herein.

The decision to employ rotational atherectomy as a plaque modification technique was supported by recommendations from the literature, which advocate for the use of atheroablative devices in cases of severe calcific coronary lesions resistant to standard angioplasty techniques. Rotational atherectomy, with its ability to effectively debulk and modify calcified plaque, addresses the mechanical challenges posed by calcification and facilitates optimal stent delivery and expansion. However, the success of rotational atherectomy hinges on meticulous lesion preparation, patient optimization, and adherence to procedural guidelines and safety protocols.

Procedural prerequisites for rotational atherectomy include adequate hydration, administration of vasodilators to prevent coronary spasm, and optimization of antithrombotic therapy. Additionally, proper selection of rotational burr size and speed, careful lesion crossing, and avoidance of complications such as burr entrapment are critical considerations during the procedure. By adhering to established procedural techniques and safety measures, interventionalists can mitigate the risk of adverse events and optimize treatment outcomes in patients with calcific coronary artery disease.

Conclusion

The presented case underscores the indispensable role of IVUS in guiding therapeutic decision-making and optimizing procedural outcomes in patients with calcific coronary lesions. The successful application of rotational atherectomy in conjunction with IVUS-guided stenting highlights the importance of a comprehensive, multidisciplinary approach to the management of complex coronary artery disease. Moving forward, continued research and technological advancements in intravascular imaging and interventional techniques will further enhance our ability to effectively treat and manage calcified lesions, ultimately improving patient outcomes and quality of life..

Learning points

- **Intravascular Imaging Enhances Lesion Assessment:** This case highlights the limitations of angiography alone in accurately assessing complex coronary lesions, particularly those involving calcification. The use of intravascular imaging modalities such as intravascular ultrasound (IVUS) can provide invaluable information about plaque morphology, composition, and distribution, enabling more precise diagnosis and treatment planning.
- **Proper Equipment Preparation is Crucial:** The unsuccessful initial attempt at PCI due to the inadequacy of available equipment underscores the importance of thorough preparation before undertaking invasive procedures. Ensuring the availability and functionality of all necessary equipment and adjunctive devices is essential to minimize procedural complications and optimize patient outcomes.
- **Intracoronary Imaging Improves Procedural and Long-Term Outcomes:** The use of IVUS-guided PCI in this case facilitated successful lesion modification and stent deployment, ultimately leading to improved procedural success rates and long-term clinical outcomes. Incorporating intravascular imaging into routine practice can enhance procedural safety, optimize stent placement, and reduce the risk of complications such as stent malapposition and restenosis, thereby improving patient care and satisfaction.

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Figure/Video

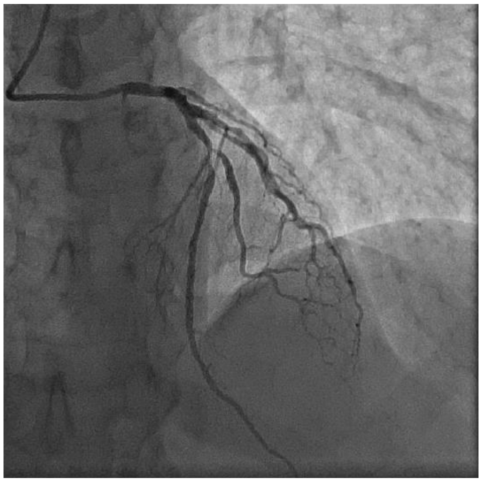

Figure 1: Showing LAD/Diagonal (medina 1,1,1)

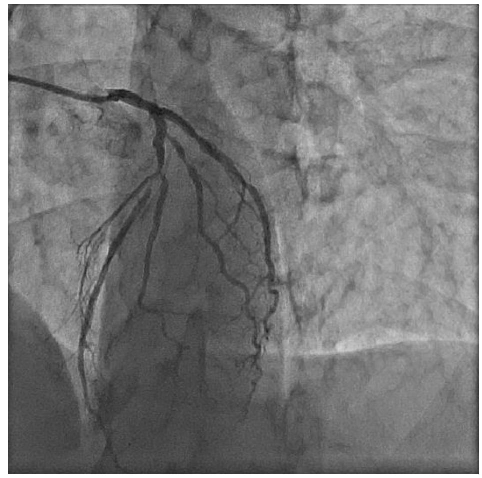

Figure 2: LAD/Diagonal (medina 1,1,1)

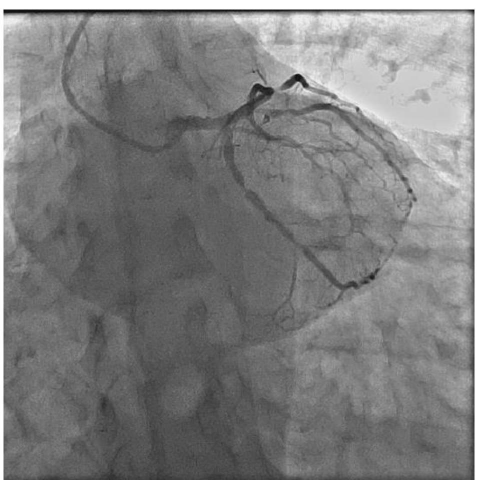

Figure 3 : Severe LCX disease

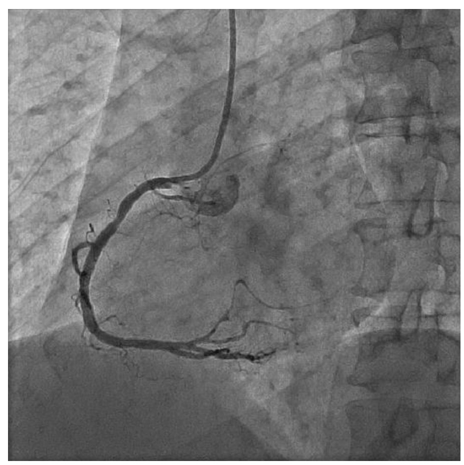

Figure 4 : Mild to moderate RCA disease.

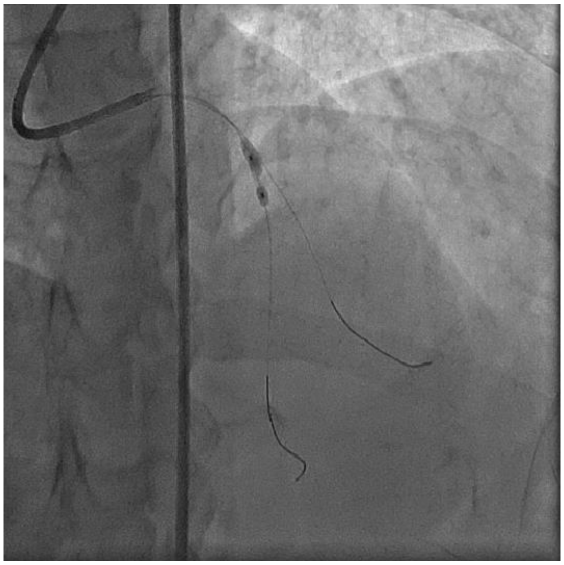

Figure 6 : LAD predilation with 3.0 x 12 mm Balloon.

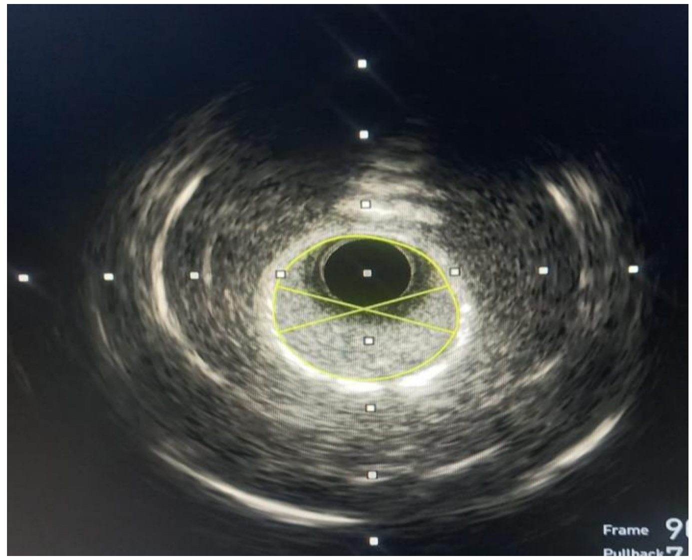

Figure 5 : Superficial calcium at 12 O clock position showing dog-bone effect

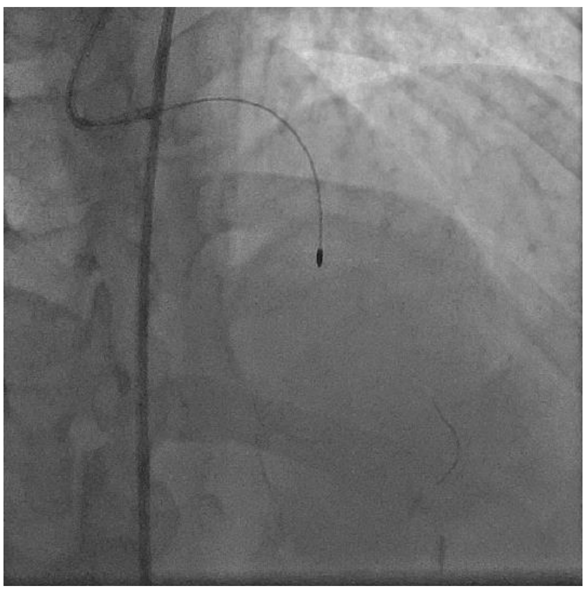

Figure 5 : Rotational artherectomy with 1.5 mm Rotaburr

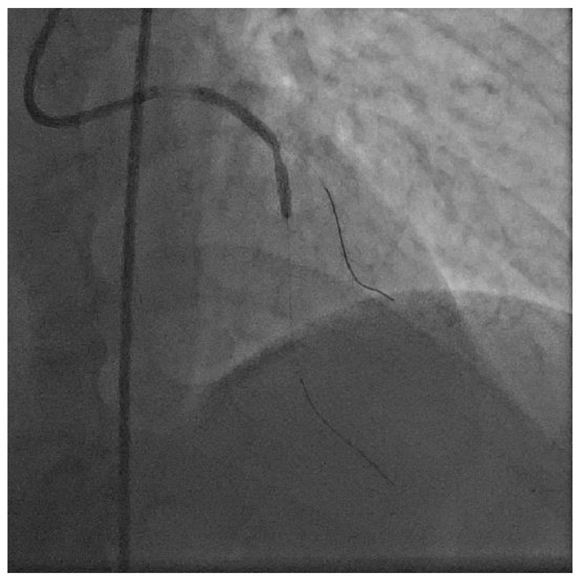

Figure 6 : Placing stent

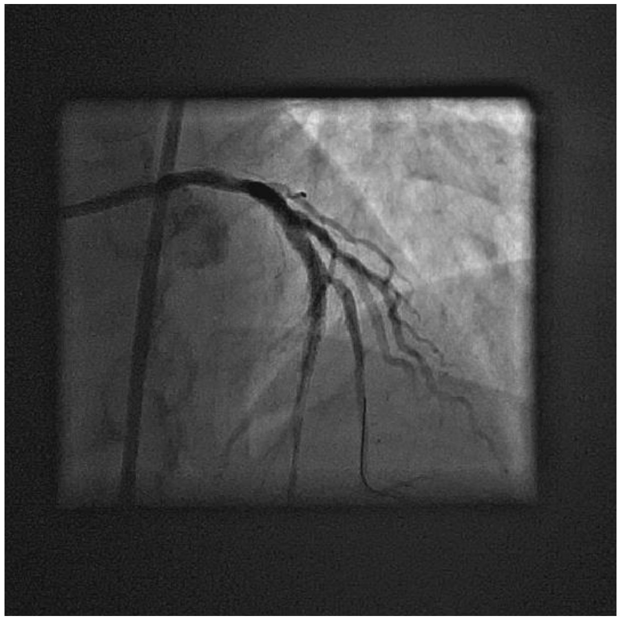

Figure 7: Final close up result

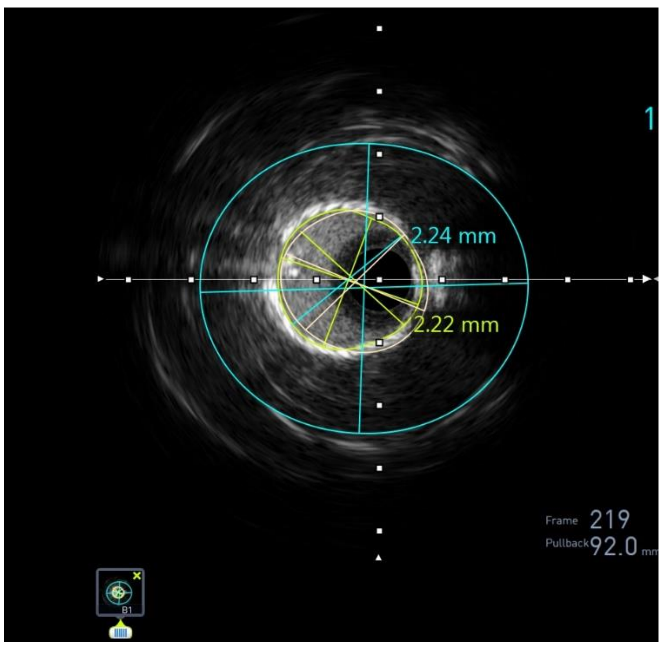

Figure 8: Post stenting: Good stent expansion and apposition.