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CASE REPORT

Enhancing Stent Apposition in ACS: IVUS-Guided Primary PCI Case Study

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Abstract

Introduction: Primary PCI is pivotal in ACS management. IVUS enhances stent apposition and plaque rupture understanding. Challenges encompass patient hemodynamics and complications.

Case Presentation: A case of acute AWMI underwent primary PCI with IVUS guidance. Pre and post stent deployment IVUS was employed without complications.

Results: IVUS suggested a mid-LAD stent size of 4.5. Post-deployment, 4.5 NC led to under deployment, necessitating 5.0x12mm NC post-dilatation. IVUS improved stent apposition beyond typical 3.5mm diameter.

Conclusion: IVUS-guided primary PCI in AWMI showcases stent optimization's potential benefits. Despite challenges, IVUS aids apposition. Individualized approach improves outcomes.

Keywords

Acute Coronary Syndrome, Primary Percutaneous Coronary Intervention, Intravascular Ultrasound, Stent Apposition, Myocardial Infarction, Complications.

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Introduction

The utilization of intravascular ultrasound (IVUS) within the context of primary percutaneous coronary intervention (PCI) represents a dynamic balance between risks, procedural considerations, and potential benefits. While IVUS is not routinely incorporated into primary PCI due to the extended procedural time and heightened risks associated with the acute setting, its value becomes increasingly evident when placed in the hands of skilled operators. This case serves as a compelling example of how IVUS, when judiciously employed, can transcend these challenges and significantly enhance the quality of care. In the realm of interventional cardiology, where time is of the essence, the introduction of an imaging modality like IVUS comes with inherent complexities. The extended procedural duration required for IVUS, coupled with the unstable hemodynamic state of patients undergoing primary PCI, has historically discouraged its widespread adoption. However, the case reminds us that the expertise of the operator plays a pivotal role in navigating these challenges. When performed by experienced practitioners, IVUS can effectively counterbalance the perceived risks by bringing forth a multitude of advantages that directly impact patient outcomes.

One of the most significant advantages of IVUS lies in its ability to mitigate procedural complications. By providing a high-resolution, real-time visualization of the coronary anatomy, IVUS can effectively guide stent deployment, ensuring that the stent apposition is optimal and that the risk of complications like edge dissections is minimized. Furthermore, IVUS enhances the understanding of plaque morphology, as highlighted by the identification of an ulcerated ruptured fibrofatty plaque in this case. This intricate visualization allows operators to tailor their approach, select appropriate devices, and anticipate potential issues based on the specific characteristics of the plaque. Vessel diameter estimation is another critical aspect where IVUS excels. Manual estimation by visual inspection is fraught with inaccuracies, often leading to the selection of stents that are either too small or too large for the actual vessel dimensions. IVUS provides an objective measurement, enhancing precision and reducing the likelihood of suboptimal stent sizing. This aspect of IVUS can significantly influence procedural success by minimizing the risk of malapposition or stent thrombosis. In essence, this case study showcases how IVUS's strengths can be harnessed to transform the primary PCI landscape. By overcoming procedural complexities through operator expertise and carefully weighing the risks and benefits, IVUS emerges as a potent tool for precise stent deployment, accurate vessel assessment, and informed decision-making. As the interventional cardiology field continues to evolve, the lessons from this case encourage us to consider the individualized approach that IVUS-guided primary PCI can offer in achieving optimal patient outcomes.

Case Presentation

A 56-year-old male with a medical history marked by diabetes, hypertension, and a smoking habit arrived at the emergency department of CPEIC on February 10, 2022. His chief complaint was intense central chest pain that had persisted for a duration of six hours. An initial electrocardiogram (ECG) conducted in the emergency room unveiled the presence of an Acute Anterior Wall Myocardial Infarction (MI). Notably, the patient had no noteworthy history of prior medical procedures or surgeries. Additionally, his family history failed to yield any significant cardiac events. A thorough physical examination revealed stable vital signs: blood pressure measuring 130/80 mmHg, pulse rate at 98 beats per minute, and an oxygen saturation level of 98% while breathing room air. With the patient's informed consent secured, he was expeditiously transferred to the catheterization laboratory (cath lab) for immediate primary percutaneous coronary intervention (PCI).

Diagnostic Assessment

Upon admission to the cath lab, the medical team opted for the right radial route to initiate the procedure. Subsequent coronary angiography findings disclosed a normally functioning left main stem (LMS), an optimally sized wrap-around vessel in the left anterior descending artery (LAD) displaying a severe mid-disease condition, a non-dominant but adequately sized vessel in the left circumflex artery (LCX), and a dominant and unimpaired vessel in the right coronary artery (RCA). Given the clinical circumstances, the decision was made to employ intravascular ultrasound (IVUS) for a more comprehensive assessment. The objectives of the IVUS were multi-fold:

- To meticulously evaluate the morphology of the lesion.
- To quantify the diameter of the affected vessel.
- To estimate the extent of plaque burden.
- To align with the parameters set by the IVUS-ACS ULTIMATE DAPT TRIAL.

The IVUS analysis conducted before stent deployment yielded the following intricate insights like the diameter of the vessel was measured at 4.6mm. The lesion site bore a substantial plaque burden, calculated at 76%. The specific characteristics of the plaque were identified as an ulcerated ruptured fibrofatty plaque.

Therapeutic Intervention

During procedure unfractionated heparin was given titrated with ACT according to the patient weight. Tab. Aspirin 75mg stat and Tab. Ticagrelor 180mg was given as loading dose. Consequently, a preparatory step involving balloon pre-dilatation was executed, using a balloon measuring 2.0mm x 10mm. Facilitating this process was the utilization of a Boston Scientific OptiCross IVUS catheter with a diameter of 3.0 French. The subsequent course of action entailed selecting a Resolute Integrity stent measuring 4.0 x 26 mm for deployment. Despite an initial post-dilation attempt using a 4.5 x 12mm balloon, a subsequent IVUS evaluation uncovered suboptimal expansion of the stent. As an intervention, a non-compliant balloon of dimensions 5.0 x 12mm was employed for further post-deployment dilation. The use of IVUS in this case lead us to the understanding that the human naked eye is misleading in selection of the stent size usually in the mid LAD the use of 4.0mm diameter stent is not routinely done and the use of 5.0 mm diameter NC is not imagined but by the use of IVUS in this case it is clear that the use of imaging modality like IVUS can lead to better selection and deployment of stent leading to lesser post procedural complications and better understanding of the plaque morphology and plaque burden at the lesion site A subsequent IVUS assessment provided the reassurance of satisfactory stent deployment and proper apposition within the vessel. Upon discharge, the patient was prescribed Aspirin 75mg OD, Ticagrelor 90mg BD, Rosuvastatin 10mg HS, Metoprolol 50mg BD, and Lisinopril 5mg HS

Follow-Up and Outcomes

Regular follow-ups were conducted at 15 days, 1 month, 3 months, 6 months, and 1 year post-procedure. The patient remained asymptomatic throughout the treatment course, with no reported treatment-related complications.

Discussion

The presented case involves the use of intravascular ultrasound (IVUS) in the setting of primary percutaneous coronary intervention (PCI) for a patient with acute anterior wall myocardial infarction (AWMI). This discussion will delve into the existing literature, highlighting the rationale, benefits, challenges, and outcomes associated with IVUS-guided primary PCI. As the introduction of IVUS into the realm of coronary interventions has revolutionized the approach to stent deployment and lesion assessment. In primary PCI for acute coronary syndromes (ACS), such as AWMI, accurate stent apposition and optimal lesion characterization are critical for ensuring successful outcomes and reducing the risk of complications. The rationale behind incorporating IVUS into primary PCI lies in its ability to provide high-resolution cross-sectional imaging of the vessel, allowing for precise assessment of vessel diameter, plaque morphology, and stent apposition. This case aligns with previous studies that have advocated for the integration of IVUS to improve procedural outcomes.

The case presentation highlights several benefits associated with IVUS-guided primary PCI. First and foremost, IVUS allows for accurate assessment of vessel diameter, plaque burden, and morphology. This information is invaluable for selecting appropriate stent size and optimizing stent deployment. The case demonstrates that relying solely on visual estimation can lead to stent underdeployment, which can adversely impact long-term outcomes. IVUS-guided procedures have been shown to reduce the occurrence of edge dissections, malapposition, and stent thrombosis, ultimately enhancing procedural success rates and patient safety. The presented case aligns with previous studies showcasing the advantages of IVUS in stent optimization and patient outcomes.

While IVUS offers numerous advantages, it also presents challenges, particularly in the context of primary PCI for ACS[1,2]. The patient's unstable hemodynamic state and the urgency of the procedure can hinder the seamless integration of IVUS. The prolonged procedural time associated with IVUS can lead to delays in reperfusion, which is a crucial determinant of myocardial salvage in ACS. Additionally, the risk of complications such as slow flow or no-reflow due to the use of IVUS raises concerns about exacerbating ongoing ischemia. These challenges underscore the need for experienced operators and careful patient selection when opting for IVUS-guided primary PCI.

The case's follow-up outcomes, wherein the patient remained asymptomatic and free of treatment-related complications, suggest the successful utilization of IVUS-guided primary PCI. This mirrors findings from existing studies that have reported improved procedural success rates, reduced complications, and better clinical outcomes associated with IVUS-guided interventions[1-3]. Furthermore, the case underscores the importance of a personalized approach to stent selection and deployment, challenging the conventional wisdom of stent sizes based on visual estimation.

Conclusion

The current case study provides a practical illustration of the benefits of IVUS-guided primary PCI in the context of acute AWMI. While challenges such as procedural delays and potential complications exist, the case highlights the pivotal role of IVUS in enhancing stent apposition, plaque morphology assessment, and overall procedural success. A judicious approach, guided by experienced operators, can lead to optimal outcomes, emphasizing the importance of individualized treatment strategies in complex clinical scenarios like primary PCI for ACS. Further studies and clinical trials are warranted to strengthen the evidence base and refine the integration of IVUS in primary PCI protocols. It is recommended that use of IVUS in elective as well as in the setting of ACS can lead to better lesion assessment and procedural results.

Learning Points

- **Precise Lesion Morphology Assessment:** The case underscores that intravascular ultrasound (IVUS) plays a pivotal role in comprehensively understanding lesion morphology. IVUS enables high-resolution imaging of the vessel wall, allowing clinicians to visualize features like ulcerated ruptured fibrofatty plaques, which can influence stent selection and deployment strategies.

- **Accurate Vessel Diameter Estimation:** IVUS serves as a reliable tool for accurately estimating vessel diameter. Unlike visual estimations that can be misleading, IVUS provides quantitative measurements, aiding in the selection of appropriate stent sizes that ensure optimal vessel coverage and stent expansion.
- **Plaque Burden Prediction:** IVUS facilitates the calculation of plaque burden at the lesion site. This information provides valuable insights into the extent of atherosclerotic involvement, helping predict the risk of post-procedural complications such as edge dissections or inadequate stent apposition. IVUS-guided strategies enable clinicians to address plaque burden effectively during intervention.
- **Enhanced Procedural Planning:** Integrating IVUS into primary PCI enhances procedural planning and decision-making. By combining accurate lesion morphology assessment, vessel diameter estimation, and plaque burden calculation, clinicians can tailor interventions to the patient's specific needs, ultimately leading to improved outcomes and reduced complications.
- **Personalized Treatment Strategies:** The case reinforces the significance of adopting a personalized approach to interventional cardiology. IVUS-guided interventions allow for a deeper understanding of the individual patient's coronary anatomy and pathology, guiding stent selection, sizing, and deployment based on objective data rather than subjective judgment.
- **Improved Patient Safety:** Utilizing IVUS in primary PCI contributes to enhanced patient safety by minimizing the risk of complications associated with suboptimal stent placement. By addressing factors such as stent underdeployment and malapposition, IVUS-guided strategies mitigate the potential for adverse events post-procedure.
- **Advancing Evidence-Based Practice:** The case underscores the importance of evidence-based practice in interventional cardiology. By utilizing IVUS and integrating its insights into clinical decision-making, clinicians can align their interventions with the growing body of research supporting the benefits of precise stent apposition and plaque management.
- **Optimal Post-Procedural Outcomes:** IVUS-guided strategies have the potential to contribute to optimal post-procedural outcomes. By refining stent deployment and reducing the risk of complications, IVUS helps achieve complete and well-apposed stent deployment, promoting better long-term results and patient satisfaction.

References

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Figure/Video

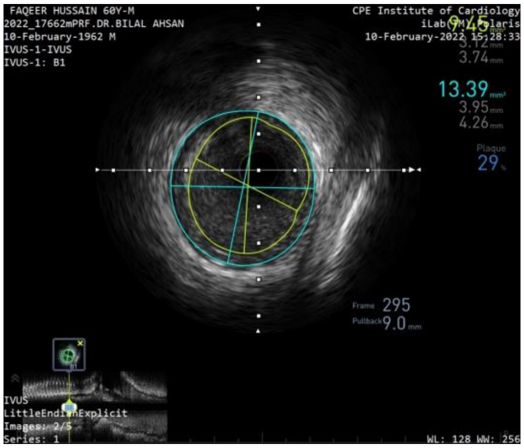

Figure 1: Pre-dilitation 2.0 x 10 mm IVUS at Proximal lesion site

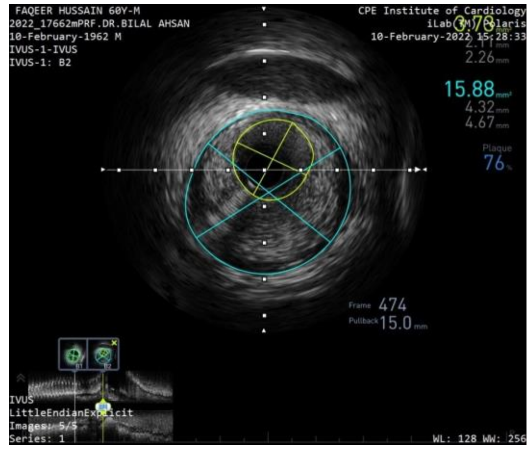

Figure 2: Boston Scientific OptiCross 3.0 F Site of Maximum Stenosis

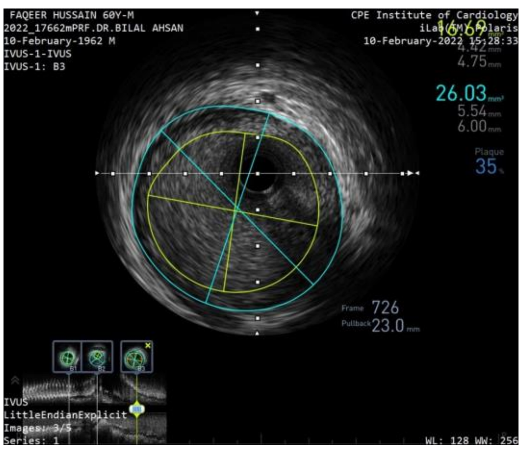

Figure 3: Stent 4.0 x 26 Resoulte Integtrity

Figure 4: NC Euphora 4.5x12 mm and 5x12 mm

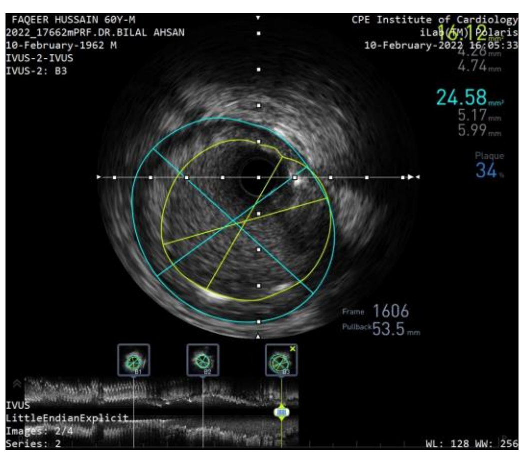

Figure 5: Post Stent IVUS at proximal part

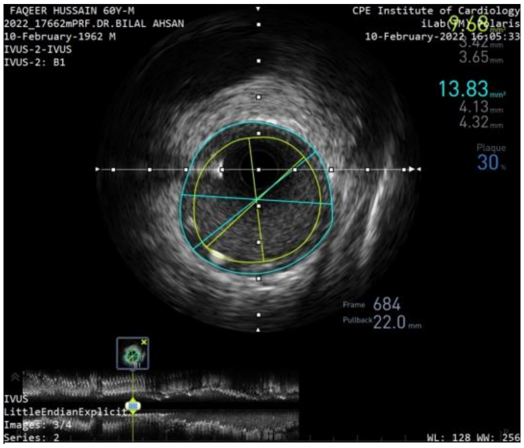

Figure 6: With 4.5 x 12 NC

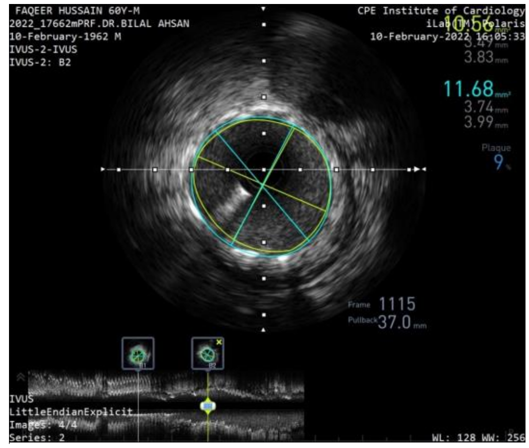

Figure 7: With 5 x 12 NC

Supplementary Materials

Supplementary Videos: