CATHALOGUE

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CASE REPORT

Drug-Coated Balloon DCB in Coronary Bifurcation Lesions; a strategy less utilized

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Abstract

Background: The case involved a challenging coronary bifurcation lesion with a Medina classification of 0,1,1 involving the left main, left circumflex, and high obtuse marginal (OM) arteries. The left circumflex artery had a barely visible stump, with the high OM branch originating from the same root. Initially, the treatment plan was a provisional percutaneous coronary intervention (PCI) to the left circumflex artery (LCX) with planned crossover of the high OM branch. However, the complex anatomy presented challenges, leading to a decision to switch to a drug-coated balloon (DCB) only strategy for both the LCX and high OM due to unsuitability for conventional stenting.

Case Presentation: A 37-year-old male, with no history of diabetes or hypertension but with a smoking habit, presented with non-ST-segment elevation myocardial infarction (NSTEMI) in June 2022. Elevated troponin levels indicated myocardial damage, while 2-D echocardiography demonstrated preserved left ventricular (LV) function.

Management and Results: Given the patient's clinical presentation and coronary anatomy, PCI was performed using DCB on the LCX and high OM branches. The DCB approach facilitated angioplasty without the need for complex stenting, thereby minimizing the risk of branch compromise. Post-angioplasty angiography revealed satisfactory results, with restoration of coronary flow and no significant complications. Furthermore, the patient experienced improved clinical outcomes following the intervention.

Conclusion: In cases of coronary bifurcation lesions where conventional stenting is not feasible due to anatomical constraints, the use of DCB represents a pragmatic approach. By avoiding complex stenting and potential branch compromise, this strategy optimizes patient care and enhances clinical outcomes.

Keywords

DCB(Drug coated balloon), Left main stem, Bifurcation

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Introduction

Coronary bifurcation lesions present a unique challenge in interventional cardiology due to their complex anatomy and varied treatment strategies. Traditionally, the management of these lesions has involved either a provisional single stent approach or a two-stent strategy, each with its own set of advantages and limitations. However, in cases where the coronary anatomy is not amenable to these conventional approaches and surgical intervention is not indicated due to the patient's clinical profile, alternative strategies must be considered.

One such alternative is the use of drug-coated balloons (DCB) in the treatment of coronary bifurcation lesions. DCBs deliver antiproliferative drugs directly to the lesion site, inhibiting neointimal hyperplasia and reducing the risk of restenosis without the need for permanent stent implantation. While the use of DCBs in coronary interventions has gained traction in recent years, their efficacy and safety in the context of bifurcation lesions remain areas of ongoing research and debate.

The management of coronary bifurcation lesions has been extensively studied, with numerous clinical trials and meta-analyses comparing different treatment strategies. The provisional single stent approach, where a stent is initially placed in the main vessel with optional stenting of the side branch if necessary, has been shown to be effective in many cases. However, this strategy may result in incomplete coverage of the side branch or compromise its patency, leading to suboptimal outcomes.

Alternatively, the two-stent strategy, which involves stenting both the main vessel and the side branch, offers complete coverage of the lesion but is associated with a higher risk of stent thrombosis, restenosis, and procedural complications. Additionally, the use of multiple stents can make the procedure technically challenging and may increase the risk of future revascularization procedures.

In recent years, there has been growing interest in the use of DCBs as an alternative to conventional stenting in the treatment of coronary bifurcation lesions. DCBs have several potential advantages in this setting, including their ability to deliver targeted drug therapy to the lesion site without leaving behind permanent implants. This may reduce the risk of restenosis and stent thrombosis, particularly in lesions involving small vessels or complex anatomies.

Several clinical studies have evaluated the efficacy and safety of DCBs in coronary bifurcation lesions, with mixed results. While some studies have reported favorable outcomes with DCB angioplasty, including reduced rates of restenosis and target lesion revascularization, others have found no significant difference compared to conventional stenting. Additionally, concerns have been raised about the potential for vessel recoil and late lumen loss following DCB angioplasty, particularly in lesions with a large plaque burden or extensive calcification.

Despite these challenges, the use of DCBs in coronary bifurcation lesions holds promise as a less invasive alternative to conventional stenting. The objective of this approach is to achieve complete revascularization with optimal angiographic results while minimizing the risks associated with permanent stent implantation, such as stent thrombosis, restenosis, and procedural complications. In the case presented, the importance lies in demonstrating the feasibility and efficacy of DCB angioplasty in a patient with complex coronary anatomy not amenable to traditional stenting strategies. By successfully treating the lesion with DCB without the need for complex stenting or surgical intervention, complete revascularization was achieved, leading to favorable clinical outcomes. This highlights the potential role of DCB angioplasty in select cases of coronary bifurcation lesions, where conventional approaches are not feasible or optimal. Further research and clinical experience are needed to better define the role of DCBs in this challenging patient population and to optimize treatment strategies for improved long-term outcomes.

Case Presentation

A 37-year-old gentleman, with no history of diabetes or hypertension but with a habit of occasional smoking, presented to the cardiology department in June 2022 with symptoms suggestive of non-ST-segment elevation myocardial infarction (NSTEMI). On initial evaluation, the patient reported chest discomfort and shortness of breath, prompting further investigation.

Clinical examination revealed no significant abnormalities apart from signs of distress due to chest discomfort. Laboratory investigations revealed elevated troponin levels, consistent with myocardial injury, while other biochemical parameters were within normal limits.

A 2-D echocardiogram was performed, revealing good left ventricular (LV) function with no evidence of regional wall motion abnormalities or structural heart disease. These findings suggested preserved cardiac function despite the acute coronary event.

Given the clinical suspicion of myocardial infarction, coronary angiography was performed to assess the underlying coronary artery disease. The angiographic findings revealed significant stenosis in the coronary arteries, consistent with single-vessel coronary artery disease. Specifically, the angiogram demonstrated Severe stenosis of the ostium of left circumflex and high OM branch with normal LMS and LAD indicative of significant disease burden.

The isolated disease at the ostium of left circumflex and high om just after origin of vessels left little foothold. This complex coronary anatomy posed challenges for intervention and necessitated careful consideration of treatment options.

Given the patient's clinical presentation, risk factors, and angiographic findings, the decision was made to proceed with percutaneous coronary intervention (PCI) to address the underlying coronary artery disease and restore coronary blood flow.

However, the complexity of the coronary lesions, including the bifurcation involvement and diffuse disease, presented challenges for conventional stenting strategies. Considering the patient's age, clinical profile, and the complexity of the lesions, a less invasive approach using DCBs was deemed appropriate.

The DCB angioplasty procedure was performed successfully, achieving optimal angiographic results with satisfactory restoration of coronary blood flow. The use of DCBs avoided the need for complex stenting and minimized the risk of stent-related complications in the challenging coronary anatomy.

Post-procedural recovery was uneventful, with resolution of the patient's symptoms and normalization of cardiac biomarkers. The patient was discharged with appropriate medical therapy and advised on lifestyle modifications to reduce cardiovascular risk factors, including smoking cessation.

Follow-up evaluations revealed continued improvement in the patient's clinical status, with no evidence of recurrent ischemic symptoms or adverse cardiac events. This case underscores the importance of individualized treatment strategies in managing complex coronary artery disease and highlights the potential role of DCB angioplasty in select patients with challenging coronary anatomy.

Diagnostic Assessment

Upon the patient's initial presentation with symptoms suggestive of NSTEMI in June 2022, a comprehensive diagnostic assessment was conducted to evaluate the underlying cause of the cardiac event and determine the appropriate management strategy.

The patient's clinical history revealed a 37-year-old gentleman with a history of occasional smoking, presenting with chest discomfort and shortness of breath consistent with angina. On examination, signs of distress due to chest discomfort were noted, prompting further evaluation.

Laboratory investigations, including cardiac biomarkers such as troponin levels, were conducted to assess myocardial injury. Elevated troponin levels were indicative of myocardial damage, consistent with the clinical suspicion of NSTEMI. Other biochemical parameters were within normal limits.

A 2-D echocardiogram was performed to assess cardiac structure and function. The echocardiogram revealed good left ventricular (LV) function with no evidence of regional wall motion abnormalities or structural heart disease, indicating preserved cardiac function despite the acute coronary event.

Coronary angiography was performed to evaluate the underlying coronary artery disease and determine the extent and severity of coronary lesions. The angiographic findings revealed Significant stenosis at the ostium of left circumflex artery and high obtuse marginal branch, consistent with single-vessel coronary artery disease and small vessel coronary artery disease (SVCAD). The complexity of the coronary lesions, including bifurcation involvement and diffuse disease, posed challenges for intervention and necessitated careful consideration of treatment options.

Therapeutic Intervention

The therapeutic intervention for the patient, following a detailed diagnostic assessment, involved a carefully planned approach to address the complex coronary anatomy and alleviate the patient's ongoing symptoms of unremitting angina despite optimal medical treatment. Initially, the plan was to provisionally stent the left circumflex artery (LCX) by crossing over the high obtuse marginal (OM) branch. However, during the procedure, it became evident that both the LCX and High OM branches originated from a single site, posing a challenge as stenting at this ostium would compromise the high OM branch. To adapt to this anatomical complexity, an improvised strategy was employed, opting for DCB angioplasty instead. The high OM branch was treated first using a 2.0x15mm DCB, followed by DCB angioplasty of the LCX using a 2.5x15mm DCB. This approach successfully achieved optimal angiographic results, with an approximately 80% reduction in stenosis observed. Post-procedurally, the patient's clinical status improved significantly, with resolution of angina symptoms. Close monitoring was continued, along with appropriate medical therapy and lifestyle modifications, to ensure long-term cardiovascular health. This case underscores the importance of a tailored therapeutic approach in managing complex coronary artery disease, emphasizing the role of DCB angioplasty in addressing anatomical challenges and optimizing patient outcomes.

Follow-up and Outcomes

Over the past eighteen months, the patient has undergone thorough follow-up assessments to gauge the effectiveness of the therapeutic intervention and track his progress. Remarkably, his anginal symptoms have completely subsided, leading to discontinuation of antianginal medications. Furthermore, his functional capacity has significantly improved, nearing normal levels, indicating successful management of coronary artery disease and restoration of adequate coronary blood flow. To objectively evaluate myocardial perfusion, a myocardial perfusion imaging (MPI) scan was conducted eight months post-intervention, revealing no evidence of ischemia. These findings affirm the sustained efficacy of the therapeutic approach and underscore the importance of individualized treatment strategies in achieving favorable long-term outcomes in patients with complex coronary artery disease.

Discussion

The therapeutic approach employed in this case, utilizing DCB angioplasty for revascularization in coronary bifurcation disease, aligns with emerging evidence supporting the efficacy of this technique in selected patients. Recent studies have highlighted the feasibility of preserving a provisional strategy, particularly in cases where the coronary anatomy is suitable, such as Medina 0,0,1 or 0,1,1 lesions. This approach is advantageous as it minimizes the need for complex stenting

techniques, reducing the risk of procedural complications and improving patient outcomes[1, 2].

Moreover, the use of DCBs offers additional benefits, including the prevention of carina shifting, which is a common challenge encountered during bifurcation PCI procedures. By delivering antiproliferative drugs directly to the lesion site, DCBs inhibit neointimal hyperplasia and reduce the risk of restenosis without leaving behind permanent implants. However, it is essential to acknowledge the potential drawbacks associated with DCB use, including lesion recoil, negative vessel remodeling, and coronary dissections. Therefore, meticulous lesion preparation and appropriate sizing of the DCB at adequate pressure for an adequate duration are crucial to optimize outcomes and minimize complications[3].

In this case, the efficacy of DCB angioplasty was enhanced by adequate lesion preparation and meticulous sizing at optimal pressure and duration. The angiographic results, demonstrating an 80% reduction in stenosis, underscore the effectiveness of this approach in achieving optimal revascularization. Furthermore, the documented improvement in clinical outcomes, as evidenced by the perfusion scan, reinforces the value of DCB angioplasty in managing complex coronary artery disease.

To further enhance the precision and clarity of management in similar cases, the use of intravascular imaging modalities such as optical coherence tomography (OCT) or intravascular ultrasound (IVUS) could be considered. These imaging techniques provide detailed information about plaque morphology, vessel dimensions, and stent apposition, facilitating more accurate lesion assessment and guiding optimal treatment strategies.

Conclusion

The use of DCBs in the management of coronary bifurcation lesions offers a promising approach to achieve optimal revascularization while minimizing the risk of procedural complications. By exercising caution in patient selection, ensuring proper lesion preparation, and utilizing adequate sizing of the DCB, clinicians can optimize outcomes and improve long-term clinical success in this challenging patient population.

Learning points

- **Judicious Use of DCB in Coronary Bifurcations:**
  The use of DCBs should be judiciously considered in selected patients with coronary bifurcation lesions. While conventional stenting techniques remain the mainstay of treatment in many cases, DCBs offer a valuable alternative, particularly when anatomical complexities or significant branch compromise are anticipated. Clinicians should carefully evaluate patient-specific factors, including lesion characteristics, vessel anatomy, and procedural risks, to determine the appropriateness of DCB angioplasty in each individual case.

- **Application in Isolated Ostial LCX Lesions and Non-Left Main Bifurcations:** DCBs can be effectively utilized in the treatment of isolated ostial LCX lesions or other non-left main bifurcations where significant branch compromise is expected. These lesions pose unique challenges due to their proximity to the carina and the risk of compromising side branches during stent deployment. DCBs offer a less invasive approach to address these lesions, minimizing the risk of restenosis and reducing the need for complex stenting techniques.

- **Importance of Adequate Lesion Preparation:** Proper lesion preparation is crucial to achieve acceptable angiographic outcomes with DCB angioplasty. This includes meticulous assessment of lesion morphology, optimal vessel sizing, and thorough lesion pre-dilation to ensure effective drug delivery and maximize the therapeutic effect of the DCB. Clinicians should strive to achieve an appropriate vessel size to DCB ratio, avoiding undersizing or oversizing of the balloon, which

may compromise treatment efficacy or increase the risk of complications.

- **Avoidance of Dissections:** One of the key considerations during DCB angioplasty is the avoidance of coronary dissections, which can occur due to inadequate lesion preparation or aggressive balloon inflation. Dissections not only compromise procedural success but also increase the risk of acute vessel closure, myocardial infarction, and the need for additional interventions. Therefore, meticulous attention to lesion preparation techniques, including gradual balloon inflation and careful assessment of vessel response, is essential to minimize the risk of dissections and optimize treatment outcomes.

References

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2) Dash, D. et al. (2022) 'Drug-coated balloon in the treatment of coronary bifurcation lesions: A hope or hype?', Indian Heart Journal, 74(6), pp. 450–457.
3) Corballis NH, Paddock S, Gunawardena T, Merinopoulos I, Vassiliou VS, Eccleshall SC (2021) Drug coated balloons for coronary artery bifurcation lesions: A systematic review and focused meta-analysis. PLoS ONE 16(7): e0251986.

Figure/Video

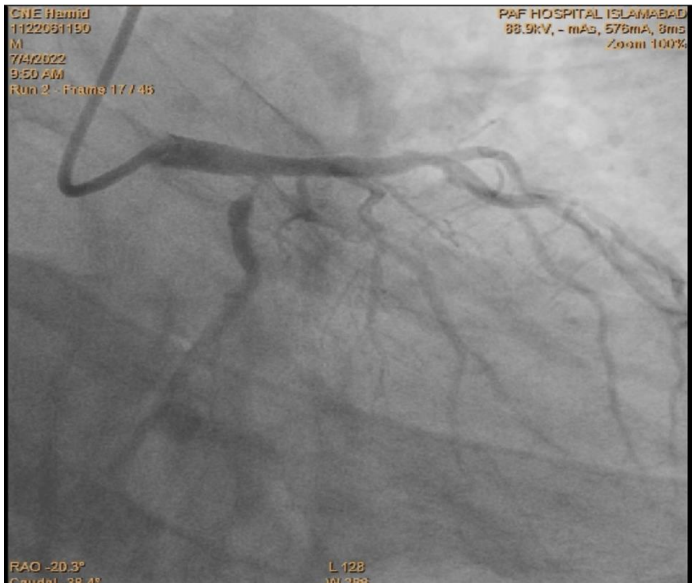
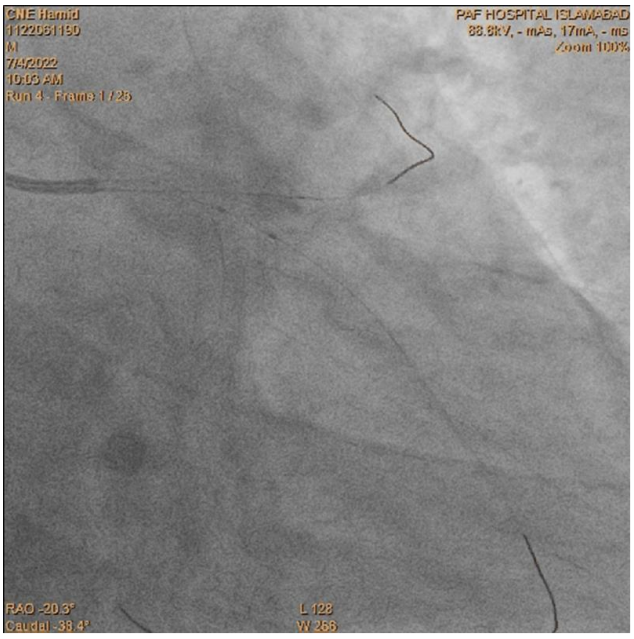


Figure 1: Angiogram



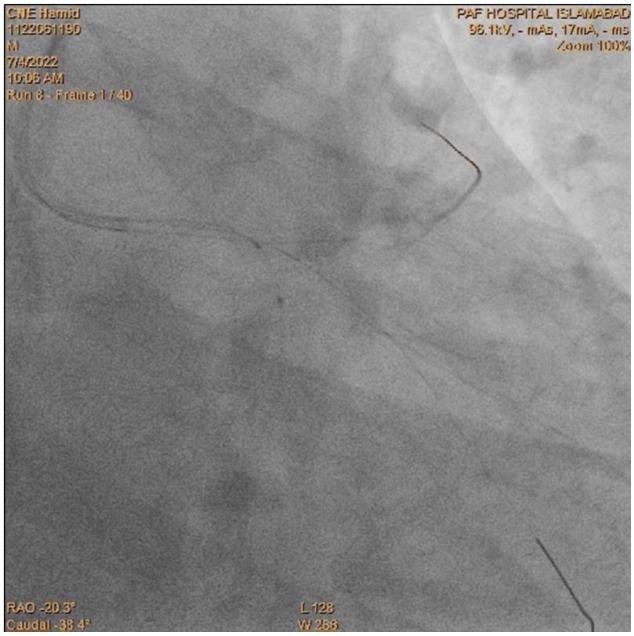


Figure 2: Wiring and pre dilatation with a 2.0x15mm balloon

Figure 3: Post predilation

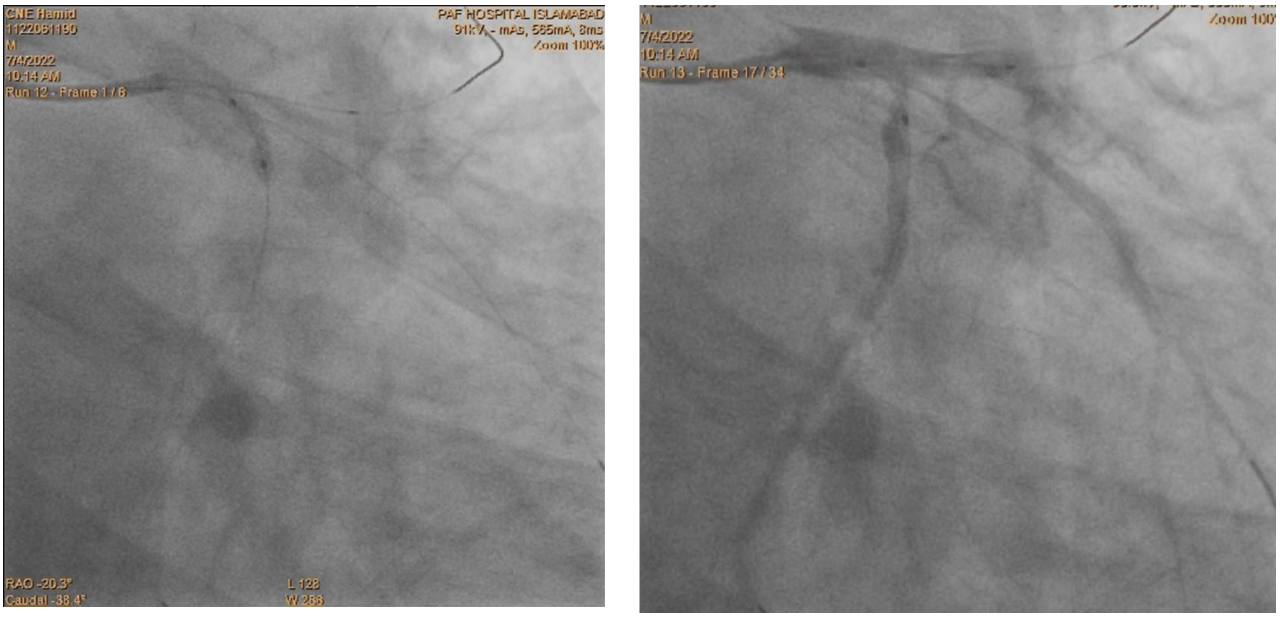


Figure 4: Predilating LCx ostium with a 2.5x15mm compliant balloon

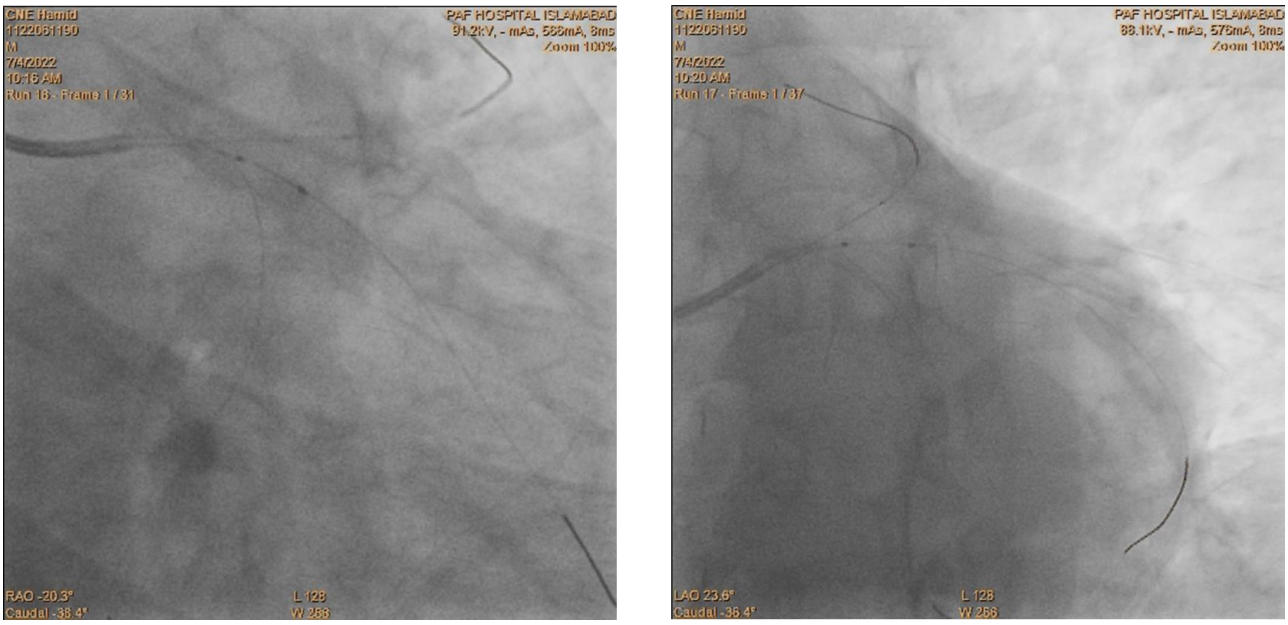


Figure 5: DCB to High OM- 2.0x15mm sequent

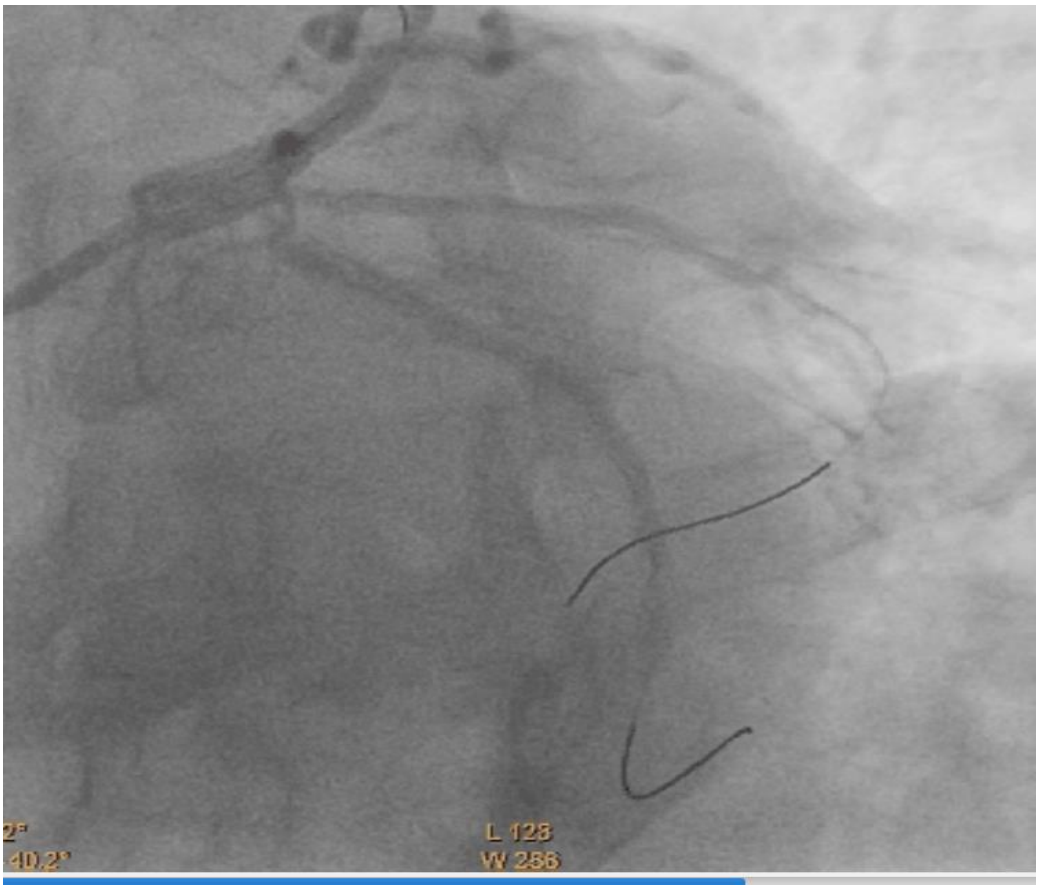


Figure 6: Post DCB views and Reassessment

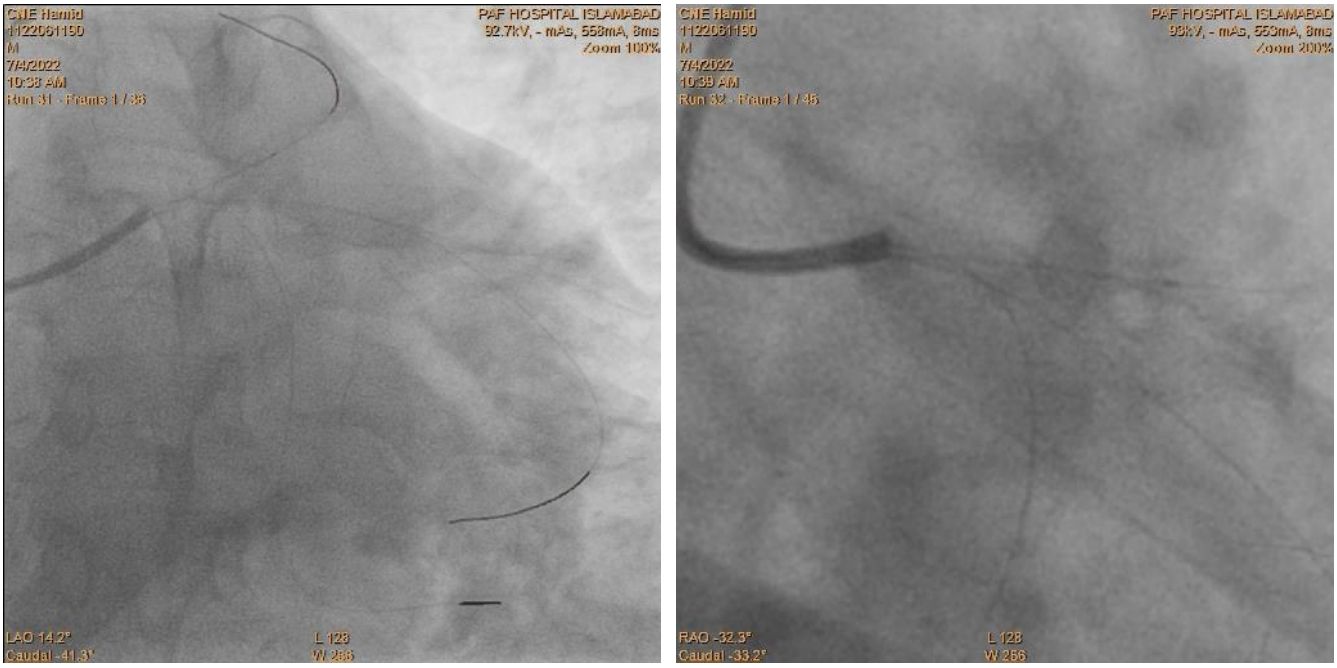


Figure 7: Post DCB Assessment

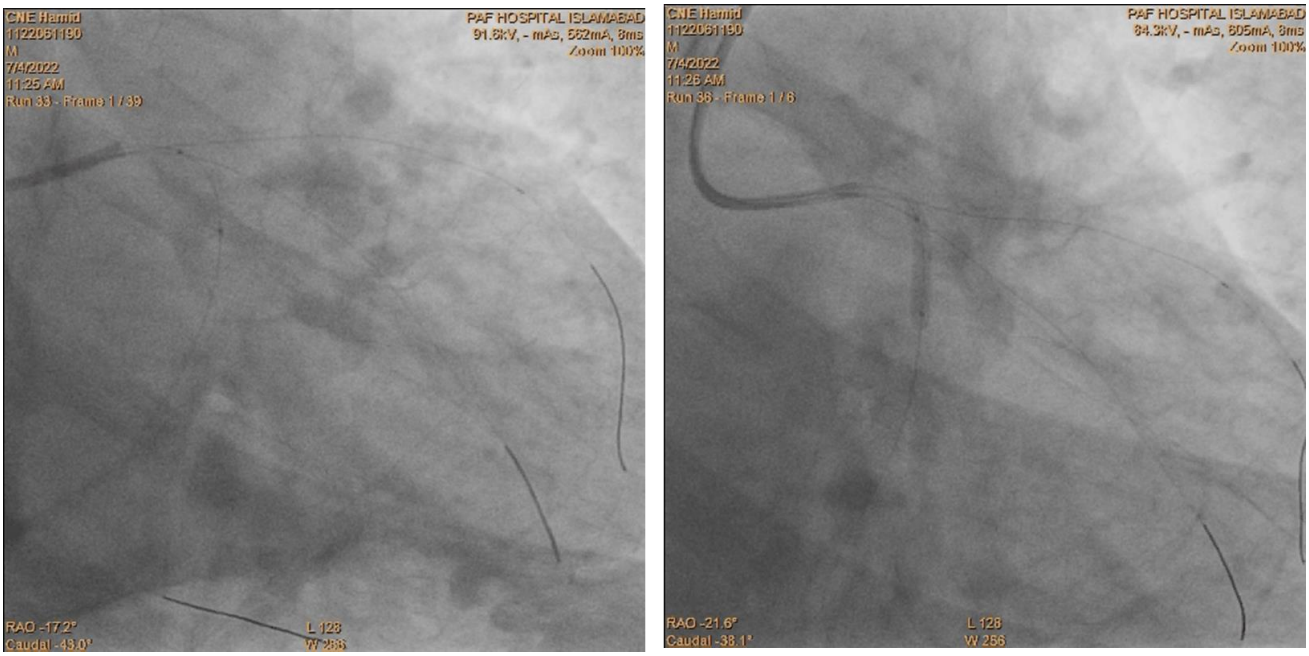


Figure 8: DCB to LCX with 2.5x15mm Protégé

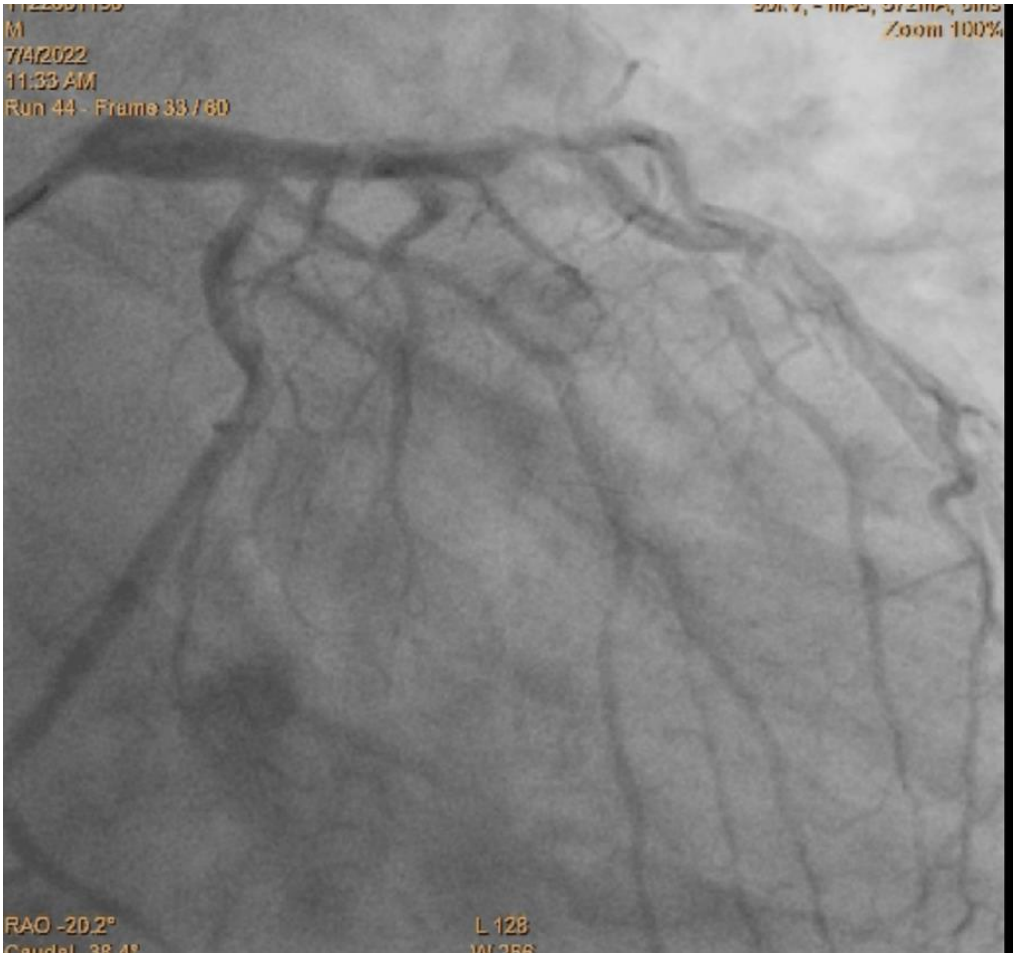


Figure 9: Final Result