CATHALOGUE

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CASE REPORT

DK Crush in Unprotected LMS

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Abstract

Introduction: This case report highlights a novel approach in the management of refractory angina by utilizing advanced interventional techniques for Chronic Total Occlusion (CTO) lesions. While conventional interventional cardiology tends to avoid treating CTO due to potential complications, this case presents the modern crush techniques, such as Double Kissing (DK) Crush.

Case Presentation: The patient under study presented with refractory angina, a condition characterized by persistent chest pain despite medical treatment. The focus was on a CTO lesion, which traditionally poses high risks and often necessitates surgical intervention. However, in this instance, the patient's condition and suitable anatomical characteristics made them a candidate for an alternative approach.

Results: The management involved the use of advanced CTO equipment and endovascular methods, deviating from the conventional surgical route. The chosen Percutaneous Coronary Intervention (PCI) approach proved successful, resulting in the complete resolution of the CTO lesion. This intervention led to a notable improvement in the patient's overall cardiac function, both regionally and globally, as evidenced by follow-up assessments.

Conclusion: This case underscores the potential of advanced CTO PCI techniques in managing refractory angina patients with appropriate anatomical features. The modern crush techniques, such as DK-Crush, are providing excellent results on mid and long-term follow up, suggesting that it's a good way to obtain surgical-like outcomes in the treatment of complex LM bifurcation disease.

Keywords

CTO, PCI, DK Crush, Angina NSTEMI, Angiography.

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Introduction

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide. Among its manifestations, involvement of the left main stem (LMS) is particularly concerning due to its crucial role in supplying a significant portion of the myocardium. Historically, coronary artery bypass grafting (CABG) has been the preferred method of revascularization in patients with significant LMS disease, offering durable results and established long-term outcomes. However, the advent of percutaneous coronary intervention (PCI) has introduced a paradigm shift in the management of LMS disease, offering a less invasive alternative to surgery.

The decision-making process in selecting the optimal revascularization strategy for patients with LMS disease involves careful consideration of various factors, including anatomical complexity, patient comorbidities, and procedural risks. While CABG remains the cornerstone of treatment in many cases, PCI has emerged as a compelling option, particularly in patients deemed high risk for surgery or those with anatomically suitable lesions[1].

In recent years, advancements in PCI techniques and technology have expanded the applicability of this approach, enabling the successful treatment of increasingly complex lesions, including those involving the LMS. Techniques such as the double kissing (DK) crush, which involves sequential stenting of the main vessel and side branch, have demonstrated promising outcomes in the management of bifurcation lesions, including those affecting the LMS[2].

Despite these advancements, PCI on the unprotected LMS continues to pose significant challenges, given its inherent anatomical and physiological complexities. Nevertheless, with meticulous patient selection, appropriate procedural planning, and skilled execution, PCI can offer favorable outcomes comparable to CABG in select patient populations.

This case study illustrates the clinical decision-making process and procedural intricacies involved in performing PCI on the unprotected LMS in a patient with recurrent chest pain and significant CAD. Through a multidisciplinary approach and utilization of advanced PCI techniques, successful revascularization was achieved, highlighting the evolving role of PCI in the management of complex CAD, particularly in patients unsuitable for or averse to surgical intervention.

Case Presentation

The case involves a 38-year-old female patient with a notable medical history of hypertension and a positive family history of ischemic heart disease. The patient presented with a chief complaint of recurrent chest pain persisting for the duration of one year.

Upon initial assessment, the patient's vital signs were stable, with blood pressure measured at 110/70 mm Hg, heart rate at 76 beats per minute, respiratory rate at 16 breaths per minute, and oxygen saturation at 97% on room air. Physical examination findings were unremarkable, except for the presence of non-specific ST-T changes on electrocardiography (ECG).

Further evaluation via echocardiography revealed preserved biventricular systolic function with no detectable segmental wall motion abnormalities. Laboratory investigations, including blood tests, were within normal limits.

Given the persistent nature of the patient's chest pain and the findings suggestive of ischemic heart disease on ECG, coronary angiography was performed at Wazirabad Institute of Cardiology. The angiographic images revealed significant pathology, including an unprotected left main stem (LMS) bifurcation lesion and chronic total occlusion (CTO) of the left anterior descending artery (LAD).

The presence of these complex coronary lesions posed a considerable challenge to the management team, necessitating a comprehensive assessment of the patient's clinical status and consideration of the available treatment options.

The case was subsequently discussed by a multidisciplinary heart team, comprising cardiologists, interventionalists, and cardiac surgeons. Despite the option of coronary artery bypass grafting (CABG) being presented as the primary recommendation, the patient declined surgical intervention, thus prompting the decision to proceed with percutaneous coronary intervention (PCI) for revascularization.

Diagnostic Assessment

The diagnostic assessment phase in this case played a pivotal role in guiding the subsequent interventional approach for revascularization of the patient's complex coronary lesions. The heart team recommended percutaneous coronary intervention (PCI) after the patient declined coronary artery bypass grafting (CABG). Key elements of the diagnostic assessment included the utilization of advanced techniques such as the dual injection method, meticulous wire selection, and comprehensive lesion pre-dilation and stent deployment.

Coronary angiography, performed at Wazirabad Institute Of Cardiology, provided essential insights into the patient's coronary anatomy and the extent of disease. The images obtained revealed challenging lesions, including an unprotected LMS bifurcation and a CTO in the left anterior descending artery (LAD). These findings were presented and discussed in a heart team meeting, where the decision to proceed with PCI was made based on the patient's preferences and the complexity of the lesions.

The identified challenges in the case, namely the LMS bifurcation, unprotected LMS, and CTO-LAD, necessitated a meticulous approach to revascularization. These anatomical complexities required specialized techniques and equipment to ensure successful PCI and optimal patient outcomes.

The utilization of the dual injection technique during coronary angiography enabled enhanced visualization of the coronary arteries and facilitated accurate assessment of the lesions. By simultaneously injecting contrast into the right coronary artery (RCA) and the LMS, the heart team gained valuable insights into the anatomy of the LMS bifurcation and the morphology of the CTO in the LAD. This information guided the selection of appropriate interventional strategies and optimized procedural planning.

Wire selection is critical in navigating complex coronary lesions, particularly CTOs. In this case, the interventional team initially attempted to cross the CTO using a Fielder FC wire. However, due to the challenging nature of the lesion, including the presence of proximal and distal caps, an alternative strategy was required. The parallel wire technique, involving the insertion of a second wire parallel to the primary wire, facilitated successful CTO crossing. This technique allowed for optimal wire positioning and improved procedural success rates.

Following successful wire crossing, lesion pre-dilation and stent deployment were meticulously performed in the LMS, LAD, and left circumflex artery (LCX). Lesion pre-dilation with semi-compliant balloons, followed by the deployment of drug-eluting stents (DES), aimed to restore coronary blood flow and optimize vessel patency. Stents were carefully deployed to cover the entire length of the diseased segments, ensuring adequate apposition and expansion against the vessel wall.

Therapeutic Intervention

The therapeutic intervention in this case involved a comprehensive percutaneous coronary intervention (PCI) procedure aimed at revascularizing the patient's complex coronary lesions. The procedural approach focused on lesion pre-dilation and deployment of drug-eluting stents (DES) in the left main stem (LMS), left anterior descending artery (LAD), and left circumflex artery (LCX). Additionally, the DK Crush technique was employed to address the challenging LMS bifurcation lesion, with the goal of achieving optimal revascularization while minimizing stent protrusion and ensuring long-term patency.

The PCI procedure began with lesion pre-dilation, a crucial step aimed at preparing the target vessels for stent deployment. Semi-compliant balloons were used to dilate the narrowed segments of the coronary arteries, facilitating optimal stent apposition and expansion. Lesion pre-dilation helps improve procedural success rates and enhances long-term outcomes by ensuring adequate stent deployment and minimizing the risk of complications such as stent malposition or edge dissection.

Following lesion pre-dilation, drug-eluting stents (DES) were deployed in the diseased coronary arteries to restore blood flow and alleviate myocardial ischemia. DES are preferred in PCI procedures due to their ability to release medication over time, reducing the risk of restenosis and improving long-term patency compared to bare-metal stents. The stents were carefully selected based on the anatomy of the lesions and the diameter of the target vessels to ensure optimal coverage and apposition against the vessel wall.

The DK Crush technique, a sophisticated bifurcation stenting strategy, was employed to address the complex LMS bifurcation lesion. This technique involves the sequential deployment of two stents in a manner that optimizes vessel scaffolding while minimizing stent overlap and protrusion into the main vessel or side branch. The DK Crush technique aims to achieve complete revascularization of both branches while preserving optimal flow dynamics and minimizing the risk of adverse events such as stent thrombosis or restenosis.

By carefully executing the DK Crush technique, the interventional team aimed to achieve optimal outcomes for the patient, including improved myocardial perfusion, reduced angina symptoms, and enhanced long-term patency of the treated vessels. This advanced stenting approach requires specialized training and expertise in interventional cardiology and is associated with favorable outcomes in select patient populations with complex bifurcation lesions.

Discussion

The management of complex coronary artery disease, particularly involving LMS with bifurcation lesions, presents significant challenges in clinical practice. This case underscores the safety and efficacy of PCI as a viable alternative to CABG, particularly in patients with anatomically suitable lesions who decline surgical intervention. The utilization of advanced PCI techniques, such as the DK Crush method, has demonstrated promising outcomes in achieving optimal revascularization while minimizing procedural risks.

The primary objective of this procedure was to underscore the safety and efficacy of percutaneous PCI in managing unprotected LMS with bifurcation lesions, particularly in centers without on-site surgical backup. While PCI involving unprotected LMS is inherently high-risk due to the critical role of the left main coronary artery in myocardial perfusion, advancements in interventional techniques and equipment have expanded the therapeutic options available to patients who are not candidates for CABG.

Bifurcation lesions, such as the one encountered in this case, present unique challenges in coronary intervention. They are more common and associated with higher risks of major cardiac events and restenosis after PCI compared to non-bifurcation lesions. Managing these lesions requires specialized skills, advanced imaging modalities, and a thorough understanding of the coronary anatomy to minimize procedural complications and optimize long-term outcomes[3].

PCI involving unprotected LMS remains a topic of debate in the field of interventional cardiology. While CABG has traditionally been the preferred treatment option for significant LMS disease, PCI is increasingly recognized as a viable alternative in select patient populations. However, the optimal treatment approach for unprotected LMS lesions remains uncertain, and individualized decision-making based on patient characteristics, lesion complexity, and institutional expertise is paramount.

Studies comparing the safety and efficacy of PCI versus CABG in patients with LMS disease have yielded conflicting results. While PCI has been associated with comparable outcomes to CABG in selected patient groups, including those with low to intermediate SYNTAX scores, the extent of coronary artery disease and patient comorbidities should be carefully considered when determining the most appropriate revascularization strategy. Nevertheless, advancements in PCI techniques, including modern crush techniques like DK-Crush, are providing excellent results on mid and long-term follow-up, suggesting that PCI can achieve surgical-like outcomes in the treatment of complex LMS bifurcation disease.

Moving forward, further research is needed to elucidate the optimal treatment strategies for patients with unprotected LMS bifurcation lesions. Long-term, multicenter studies comparing PCI and CABG outcomes in this patient population will help guide clinical decision-making and inform treatment guidelines. Additionally, ongoing advancements in PCI technology and techniques, coupled with the refinement of patient selection criteria, will continue to enhance the safety, efficacy, and applicability of PCI in managing complex coronary artery disease.

Recent studies have compared the safety and efficacy of percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) in patients with left main stem (LMS) disease, shedding light on the optimal revascularization strategy for this high-risk patient population.

Major adverse cardiac and cerebrovascular events (MACCE) were found to be similar between PCI and CABG arms in patients with low to intermediate SYNTAX scores. However, in patients with high SYNTAX scores (≥33), PCI was associated with significantly increased MACCE rates compared to CABG. This disparity in outcomes underscores the importance of patient risk stratification and lesion complexity assessment in treatment decision-making.

At 5 years, overall MACCE rates did not differ significantly between PCI and CABG-treated patients. However, there were notable differences in specific outcomes. PCI-treated patients exhibited a lower incidence of stroke but a higher rate of revascularization procedures compared to those who underwent CABG. These findings suggest that while both PCI and CABG are valid treatment options for LMS patients, the choice between the two modalities should be tailored to individual patient characteristics and lesion complexity.

The extent of coronary artery disease, as reflected by the SYNTAX score, plays a crucial role in determining the most appropriate revascularization strategy for LMS patients. Patients with low to intermediate SYNTAX scores may derive comparable benefits from PCI and CABG, while those with high scores may experience superior outcomes with CABG. Therefore, a comprehensive evaluation of patient-specific factors, including lesion complexity, comorbidities, and anatomical considerations, is essential for informed treatment decision-making.

The findings from these trials highlight the importance of individualized treatment strategies in managing LMS disease. While PCI offers advantages such as minimally invasive access and shorter recovery times, CABG remains the gold standard for patients with extensive coronary artery disease and high SYNTAX scores. Multidisciplinary heart teams should carefully weigh the risks and benefits of each treatment modality to optimize outcomes and improve patient quality of life.

Conclusion

The primary lesson from this case report is that for clinically indicated, selected symptomatic patients with CTO vessels of suitable anatomy and with the availability of expertise, CTO PCI should be considered as a viable therapeutic option. This approach can lead to substantial improvements in patient symptoms and overall well-being, as exemplified by the patient's successful management and enhanced quality of life. While challenges such as patient compliance and reluctance to pursue recommended interventions

were encountered, they underscore the necessity of effective patient education and communication throughout the treatment journey. The case also emphasizes the importance of continuous follow-up and collaboration among healthcare professionals to ensure optimal patient outcomes.

Learning Points

- Individualized Assessment: Clinicians should meticulously evaluate symptomatic patients with CTO for suitability of anatomy and expertise to determine the potential benefits of CTO PCI.
- Innovative Interventions: Advanced CTO PCI techniques offer a promising alternative to traditional surgical intervention for refractory angina, yielding improved outcomes and enhanced ventricular function.
- Patient Compliance and Education: Successful outcomes hinge on patient compliance, lifestyle modifications, and thorough education about recommended diagnostic and therapeutic interventions.
- Collaborative Approach: Effective management of complex cases like CTO requires collaboration among interventional cardiologists, cardiac surgeons, and other healthcare professionals to ensure optimal patient care.
- Regular Follow-Up: Consistent follow-up appointments are essential to monitor patient progress, assess treatment efficacy, and make necessary adjustments to improve patients' quality of life.

References

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2) Creaney C, Walsh SJ. Antegrade chronic total occlusion strategies: a technical focus for 2020. Interv Cardiol Rev. 2020;15.
3) Brilakis ES. THE ROLE OF: Dissection/Re-Entry in CTO PCI. Cardiol Today Interv. 2013;2(1):12.

Figure/Video

Figure 1: AP cranial view showing total ostial occlusion of LAD

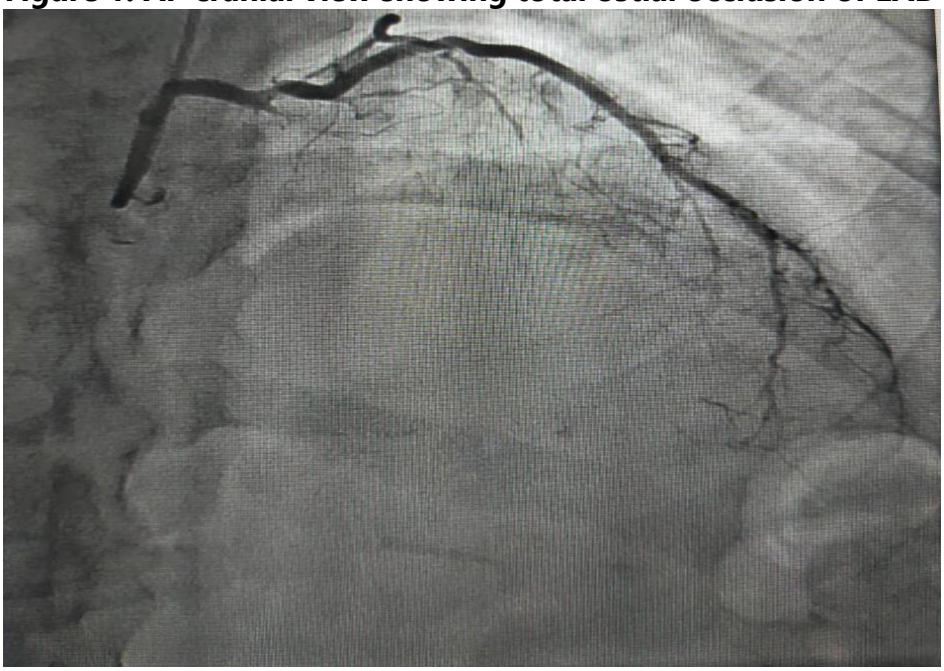

Figure 2: AP caudal view showing moderate distal Left main disease and Total ostial LAD occlusion

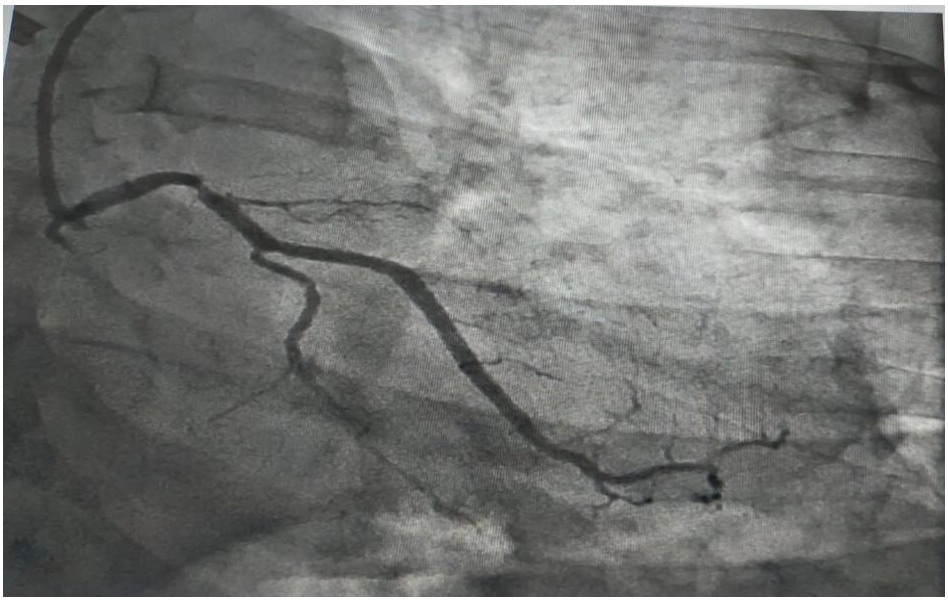

Figure 3: RAO view showing Rentrop3 collaterals to LAD

Figure 4: Showing double stick injection left system being visualized through injection from RCA

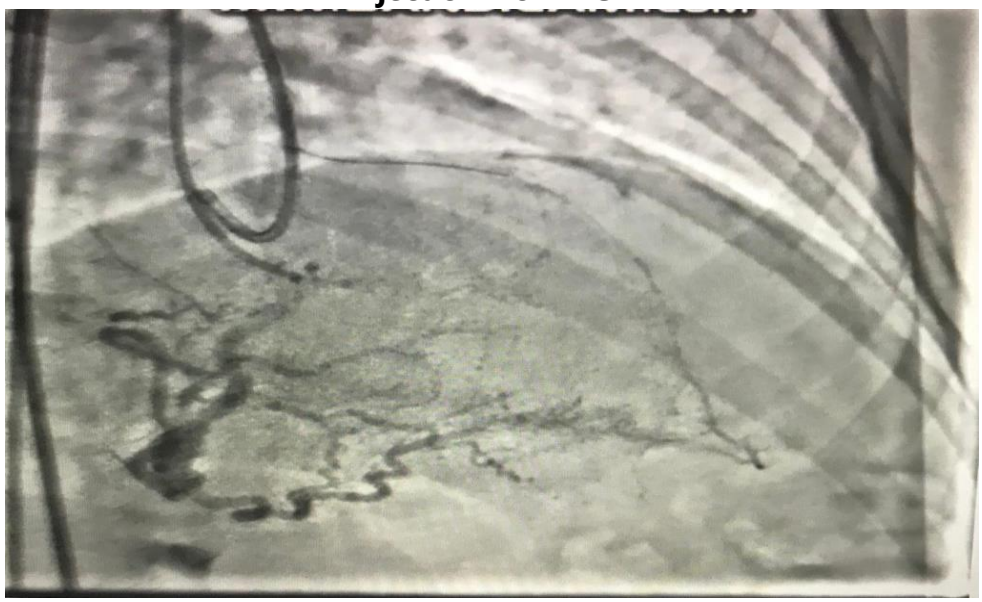

Figure 5 showing Fielder FC wire, it crossed the proximal cap but was unable to track distal cap.

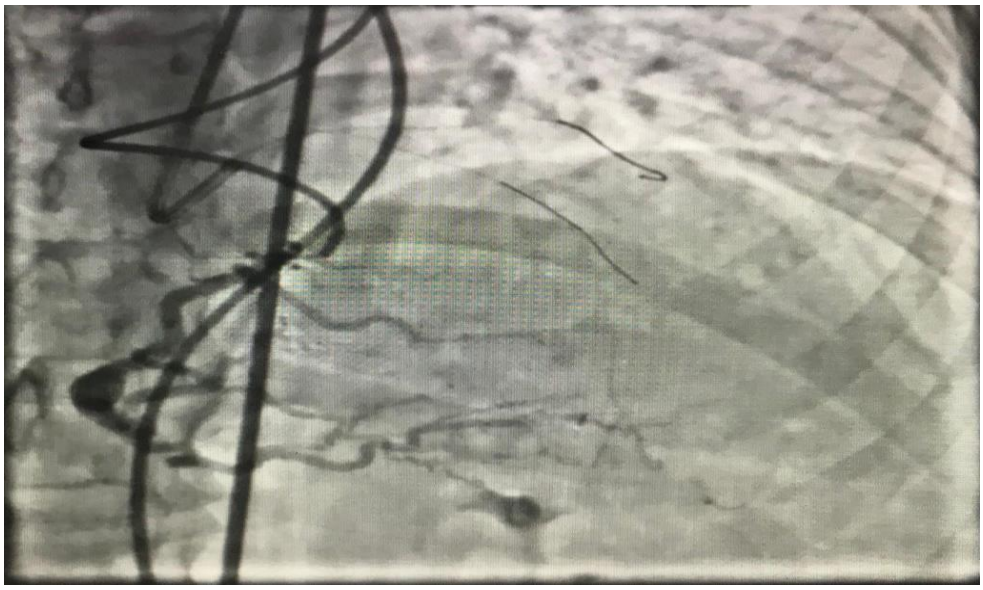

Figure 6: Fielder FC was secured in distal LAD and a MIRACLE 6 was inserted as a parallel wire.

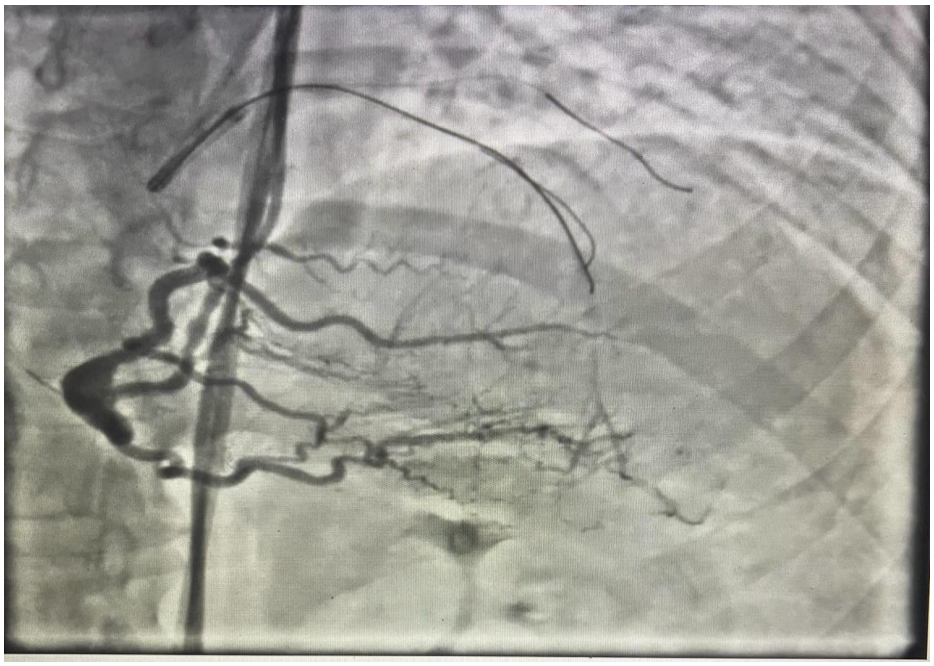

Figure 7: Lesion pre-dilated with SC Balloon 1.5 x 12, followed by 2.0 x 12

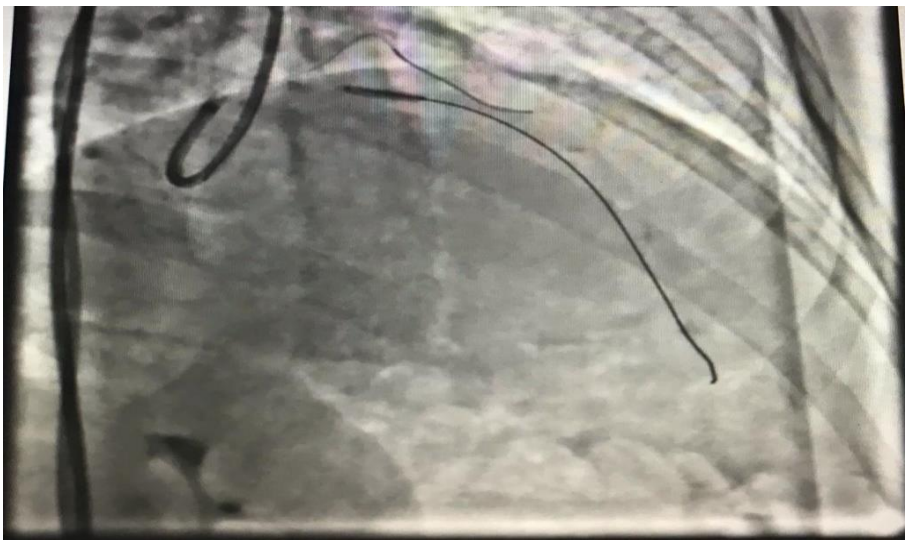

Figure 8: 2.75X24 DES deployed in proximal-mid LAD

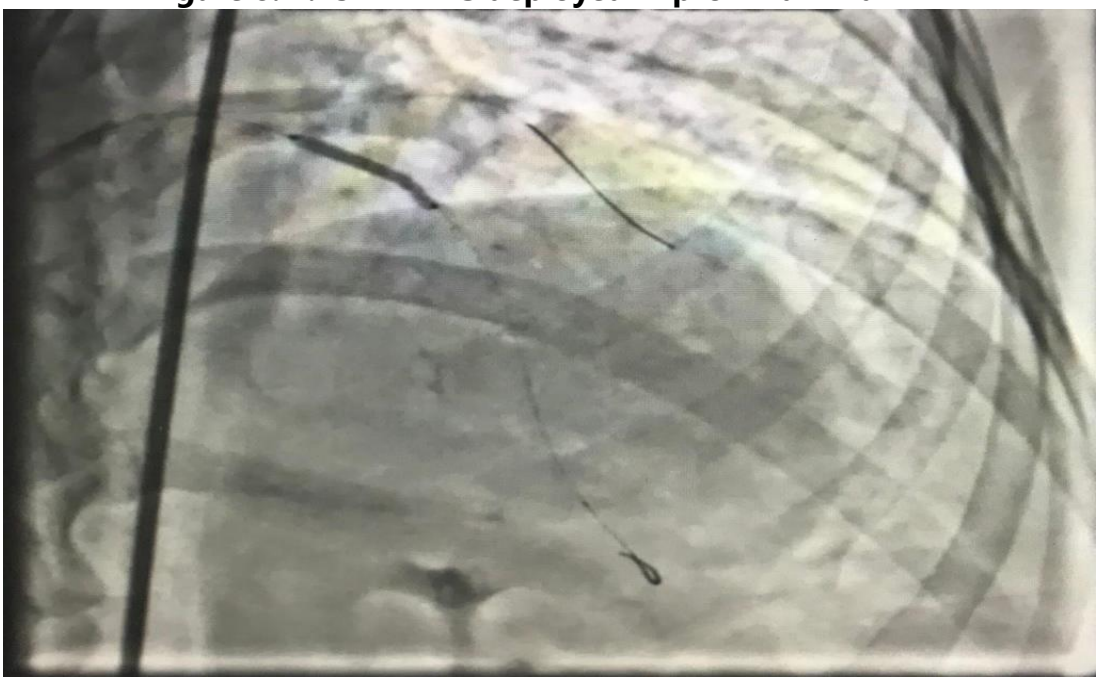

Figure 9: 3.0X 15 DES deployed in ostial LCX with just minimal protrusion in LMS with 3.0x12 NC in LAD to crush LCX stent.

Figure 10: 3.5x30mm DES deployed LMS to LAD followed by second kissing and POT

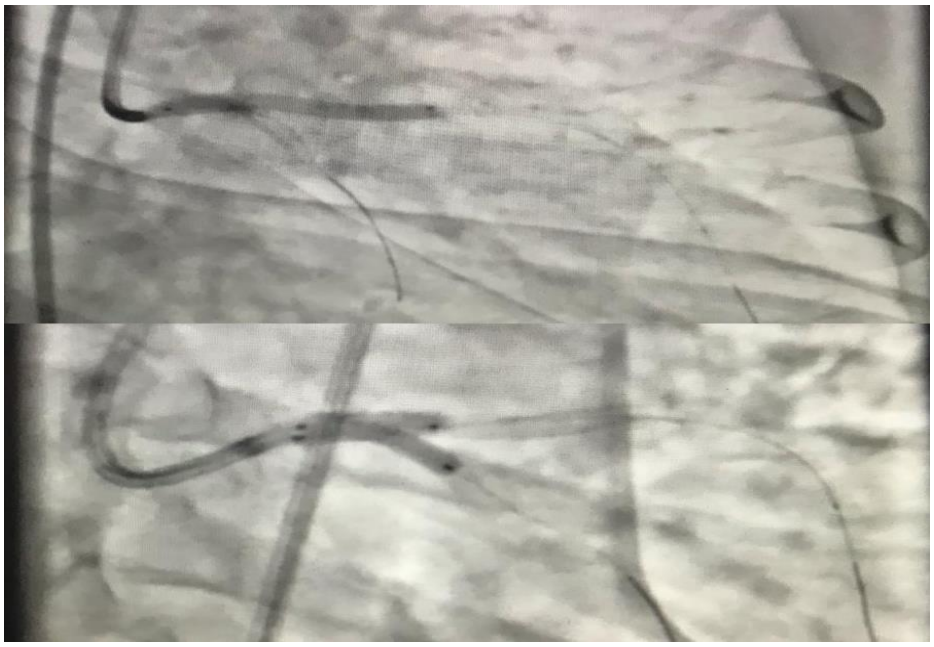

Figure 11: Final result