

Case Series

Provisional Stenting for Left Main Bifurcation Disease under IVUS guidance: A Case Series

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Abstract

Around 15-20% coronary lesions include bifurcation, and among which left main (LM) bifurcation lesions are critical and complex to manage. Though two-stent strategy is preferred option for complex LM bifurcation lesion, provisional strategy should be considered if side branch is disease free to avoid peri- and post-procedural complications. Thus, precise anatomical and physiological assessment of LM lesion should be made using intravascular imaging techniques for appropriate decision making. Here, we report three case of successfully managed LM bifurcation lesions using provisional stenting technique with a guidance of intravascular ultrasound, fractional flow reserve and heart team. All three patients were doing well and were ischemia free on stress echocardiography at three months follow-up.

Introduction

Despite considerable progress in the field of interventional cardiology, percutaneous coronary intervention (PCI) of coronary bifurcations continues to be associated with a lower procedural success rate and higher incidence of adverse events [1]. The provisional stenting has been considered as a gold standard approach for most bifurcations, however, 15-30% bifurcation lesions require two-stent strategy from the beginning of the procedure [2]. However, in few instances implantation of second stent in provisional stenting is required due to complexity of side branch. Thus, the management of bifurcation lesions, especially left main (LM) bifurcation lesions emphasizes on an integrated approach involving tailored techniques, adjunctive physiological and morphologic evaluation using multi-modalities, hemodynamic devices, and pharmacological agents to improve procedural and clinical outcomes [2, 3]. Here, we report three cases of LM bifurcation successfully managed with provisional stenting using intravascular ultrasound (IVUS) and fractional flow reserve (FFR) in decision making.

Case Presentation

CASE-1

A 54-year-old gentleman, presented with angina at rest for three days, diagnosed with non-ST elevation myocardial infarction (NSTEMI). The patient had a medical history of hypertension, diabetes, and dyslipidemia

and five years back underwent PCI to left anterior descending (LAD) artery with drug-eluting stent (DES). The patient was symptomatic. He was on beta-blocker (Metocard XL – 100 mg OD), long-acting nitrates (Imdur – 60 mg OD) and antiplatelets on aspirin 75mg OD and clopidogrel 75mg BD. The 10-year risk of fatal cardiovascular disease according to SCORE chart is 18%. Electrocardiography (ECG) revealed normal sinus rhythm (72 beats/minute) with change in ST-T wave from V1 to V6. Echocardiography revealed moderate left ventricular dysfunction (ejection fraction - 35%) and regional wall motion abnormality in LAD territory. {His Troponin-I and CPKMB were raised}.

Coronary angiography showed distal LM stenosis with triple vessel disease and restenosis with clot in LAD proximal (Figure 1A). {Syntax score-} Heart team considerations were taken, and PCI was planned. Before PCI, a run of IVUS was performed, and distal and proximal reference diameters were recorded from the tightest point in LM coronary artery (Figure 1C). IVUS of proximal LAD and ostial left circumflex (LCx) with bifurcation disease showed under deployment of previous stent in LAD. Vascular excess was obtained using femoral 7F long sheaths. 7F extra backup (EBU) 3.5 (Medtronic, USA) catheter with side holes was utilized to engage LAD and a workhorse wire was advanced into LAD and a direct stenting with 2.5 x 38 mm everolimus-eluting stent (Xience Xpedition; Abbott Vascular, California, USA) was performed at 14 atm and another stent 4 x 23 mm everolimus-eluting stent (Xience Xpedition; Abbott Vascular, California, USA) was deployed from LM to LAD at 16 atm.

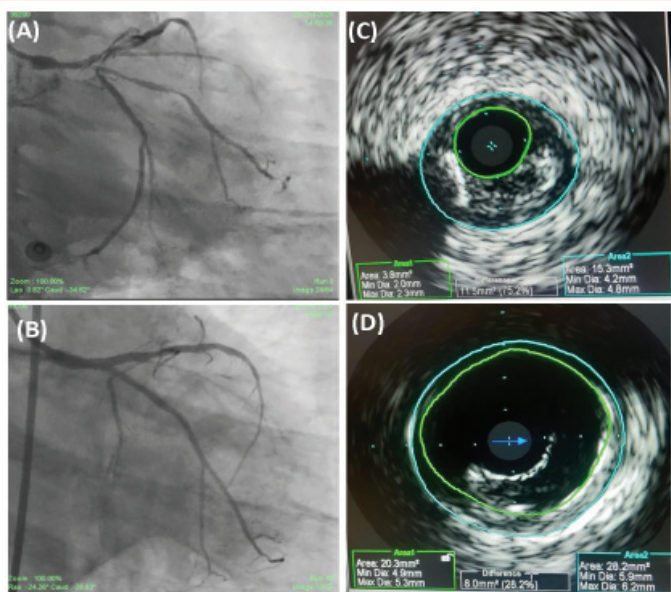


Figure 1: Case 1 - (A) and (B) Coronary Angiograms pre-and post-PCI; and (C) and (D) Intravascular ultrasound images pre- and post-PCI.

A proximal optimization technique (POT) was done in the LM with 5 x 8 mm Mozec™ non-compliant (NC) balloon. Later, LCx was crossed from the distal strut with a workhorse wire, predilated with a 2 x 10 mm NC balloon and 2.5 x 33 mm everolimus-eluting stent (Xience Xpedition; Abbott Vascular, California, USA) was deployed at 16 atm. Finally, a kissing balloon dilatation with 4 x 15 mm NC Balloon (Mozec™ NC PTCA Balloon) in LAD and with withdrawn stent balloon in LCx was done after the sequential dilatation of respective balloons to 18 atm. Re-POT of LM artery was done with 5 x 8 mm NC balloon. The final angiographic result was excellent with TIMI-3 flow (Figure 1B). At last, IVUS was performed which showed optimized stent deployment, no edge dissection, good bifurcation angle, and no procedural major complication (Figure 1D).

Follow-Up

The patient was followed-up at three months in the outpatient department and was asymptomatic. He was on beta-blocker (Metocard XL - 50 mg OD), long-acting nitrates (Imdur - 30 mg) and antiplatelets on aspirin 75mg OD and Ticagrelor 90mg BD. His stress echocardiogram was ischemia free.

CASE-2

A 68-years-old gentleman came with history of type-2 diabetes, hypertension, and dyslipidemia for the last 10 years with normal body weight. The 10-year risk of fatal cardiovascular disease according to SCORE chart is 20%. He also had a history of PCI to distal LCx and obtuse marginal (OM-1). He was presented with Canadian Class-3 angina and dyspnea (respiratory rate of 27 breaths/minute). The patient was symptomatic. He was on beta-blocker (Metocard XL - 100 mg OD), long-acting nitrates (Imdur - 60 mg OD) and antiplatelets on aspirin 75mg OD and Ticagrelor 90mg BD. His examination showed normal blood pressure (120/80 mmHg) and had bilateral basal crepitation. [Patient was started DAPT] The patient's serum creatinine was 3.5 mg/dL. [(Please provide details of Echo and ECG)]. Coronary angiography revealed stenosis in distal LM with diffused LAD lesion and 50% stenosis in ostial LCx with patent stents in distal LCx and OM1 (Figure 2A). [Syntax score].

PCI was planned to treat LM bifurcation lesion as per heart team decision. Before PCI, IVUS was performed, and distal and proximal

reference diameters were reported from the tightest point in LM (Figure 2C). Vascular excess was obtained using femoral artery with 7F long sheath and 7F EBU 3.5 catheter (Medtronic, USA) with side holes was utilized to engage LAD. A workhorse wire was advanced into LAD, and 2.5 x 48 mm and 3.0 x 28 mm everolimus-eluting stents (Xience Xpedition; Abbott Vascular, California, USA) were deployed in lower part of proximal LAD at 16 atm. Later, a 4.0 x 18 mm everolimus-eluting stent (Xience Xpedition; Abbott Vascular, California, USA) was deployed in LMCA to LAD overlapping distal stent at 16 atm which was followed by postdilatation with 3.0 x 13 mm Mozec NC balloon from distal to proximal. A POT was performed in the LM artery using 5 x 8 mm Mozec NC balloon. The final angiographic result was excellent. Fractional flow reserve (FFR) was performed to evaluate the significance of ostial LCx which revealed good patency (FFR - 0.81) and thus LCx was not stented (Figure 2B). Finally, IVUS was done which showed optimized stent deployment with good bifurcation angle, and without any edge dissection and major complications (Figure 2D).

Follow-up

{The patient was followed up at 3- month intervals in the outpatient department. The patient is free angina on minimal doses of beta-blocker (Metocard XL 50mg OD) and long-acting nitrates (Imdur 30mg). patients stress Echo showed no stress induced ischemia}.

CASE-3

A 71-year-old diabetic male presented with of angina (Canadian Class-4) and dyspnea on exertion. The 10-year risk of fatal cardiovascular disease according to SCORE chart is 24%. He underwent echocardiography which showed severe left ventricular dysfunction with ejection fraction of 20%. The patient was symptomatic. He was on beta-blocker (Metocard XL - 50 mg OD), long-acting nitrates (Imdur - 30 mg OD) and antiplatelets on aspirin 75mg OD and Clopidogrel 75mg OD. [Coronary angiography revealed ostial LM disease and diffused stenosis in LAD ISR LCX also shows ISR]. (Figure 3A). [Syntax score].

(As suggested by heart team, he was considered for PCI. Pre-procedural IVUS was performed to know reference diameters of diseased vessels (Figure 3C). Proximal LAD was predilated with 2.5 x 13 mm Mozec NC balloon and two everolimus-eluting stents (3.0 x 32mm and 3.0 x 12

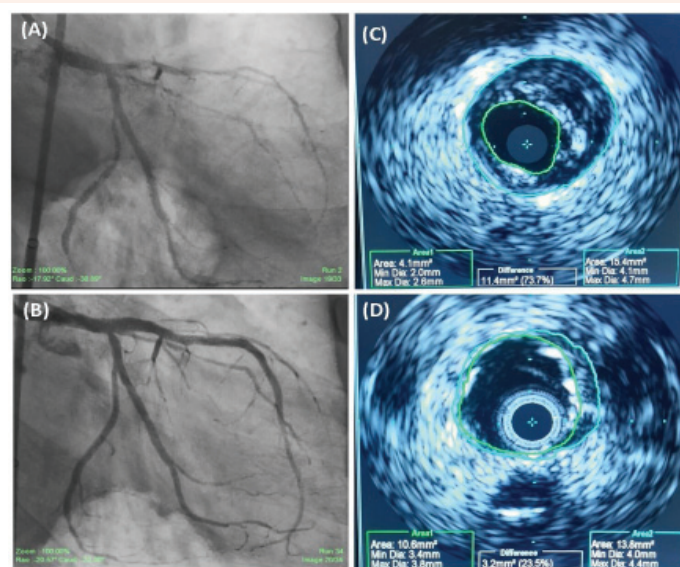


Figure 2: Case 2 - (A) and (B) Coronary Angiograms pre-and post-PCI; and (C) and (D) Intravascular ultrasound images pre- and post-PCI.

mm, Xience Xpedition) was deployed in mid to proximal LAD at 14 atm and 16 atm, respectively. Another 4.0 x 8 mm everolimus-eluting stent (Xience Xpedition) was deployed in ostial LM artery at 22 atm). Final POT was done with 5.0 x 8 mm DES (cobalt-chromium everolimus-eluting stent; Xpedition; Abbott Vascular, Santa Clara, California) in Ostial LMCA at 18 ATM}. The final angiographic result was excellent (Figure 3B). Finally IVUS run was taken to see the final optimization which showed optimized stent deployment, no edge dissection, good bifurcation angle, and no major complication (Figure 3D).

Follow-Up

[The patient was followed up at 3- month intervals in the outpatient department. The patient is free angina on minimal does on minimal does of beta-blocker (Metocard XL 50mg OD) and long-acting nitrates (Imdur 30mg). Patients stress Echo showed no stress induced ischemia].

Discussion

As LM coronary artery bifurcation segment stenosis is more diffuse and concentric with variable anatomical concern, two-dimensional coronary angiography is inaccurate in determining severity of both side branch ostium [4, 5]. Thus, only angiography guided PCI may lead to unnecessary side branch related complication and increases need of complex interventions. Use of intracoronary imaging modalities such as IVUS and optical coherence tomography (OCT) help in assessment of morphological or anatomical severity of LM disease, and FFR helps in determination of hemodynamic significant of LM stenosis. IVUS is most preferred for LM coronary artery examination as with OCT the clearing of LM lumen with adequate flush remains difficult and has reduced depth of penetration compared IVUS [6-8].

Several previous studies have reported the efficient role of IVUS in reducing risk of side branch occlusion, and reduced rates of very late stent thrombosis and long-term mortality in patients with LM bifurcation lesion [9-11]. Pre-PCI IVUS is helpful in the determination of LM plaque characteristic and amount, ostial involvement of daughter branches, provide an approximate ischemic burden of the LM lesion, and also help

in deciding appropriate stenting strategy and optimum stent results. Post-PCI IVUS helps to optimize stent implantation which might improve clinical outcomes in patients with LM stenosis [10, 11].

FFR of side branch after main vessel stenting should be performed, to establish side branch lesion severity and patency, and for decision making for side branch intervention in LM bifurcation lesions after provisional stenting and this might reduce peri-procedural complications associated with side branch [12, 13]. In this technologically advanced era, an invasive assessment of stenosis severity is complementary to only angiographic assessment. Here, in our case series also, we used FFR guided decision making for LCx (side branch) intervention in case-2 and was found effective.

Though provisional stenting is opted for most of the bifurcation lesions as it is technically simpler, careful selection of patients with LM bifurcation for the provisional approach is the most important step in avoiding procedure-related complications and ensuring favorable individual outcomes. Recently, DKCRUSH-V randomized trial compared Double-kissing Crush (DK-crush) technique and provisional stenting for LM distal bifurcation lesions which demonstrated lower rates of target lesion failure (5% versus 10.7%, p=0.02) and stent thrombosis (0.4% versus 3.3%, p=0.02) with DK-crush technique at 1 year [14]. However, weight should be placed on employing techniques to improve peri- and post-procedural outcomes with either strategy. The latest guidelines stress on the importance of a "heart team" approach in management of complex LM bifurcation lesions. The role of heart team is to weighs the risks and benefits of PCI with either strategy, surgery, or medical treatment alone, along with the patient's choice.

In our patients also we opted for provisional stenting based of IVUS, FFR and heart team consideration which provided successful results in all three patients with no reported adverse events at 3 months follow-up. Recently, EBC MAIN trail has been published [15] it shows that in left main bifurcation lesions the best treatment is stepwise layered provisional approach than with planned dual stenting. This trial is latest and is contradiction with DKCRUSH-V trail. This is with respect to death, target lesion revascularization and myocardial infarction in one year. Our cases could have been done in two stent strategies but the simplicity of provisional method and less metal load for the patient might translate into better outcomes.

Conclusion

In high-risk patients with NSTEMI, provisional approach for LM bifurcation stenting is a preferred approach especially when side branch is relatively disease free. However, integrated approach (IVUS, FFR, and heart team decision) should be taken into consideration before deciding any strategy and decision should be individualized. Recently DK crush have emerged preferable strategy for LM bifurcation stenting, but in selective cases provisional stenting can be a philosophy and can be used successfully in many left main bifurcation cases with long term results better than DK crush. The use of imaging like IVUS makes the long-term results better. **"As beautiful simplicity is it can become a tradition that stands in the way of exploration"**.

Author Contributions

The lead author of the case report is Dr Rohit Mody. Dr Debabrata Dash, Dr Bhavya Mody had equal and substantial contributions in the formation of this case report. They were involved in conceptualization, data curation, formal analysis, resources, software, validation, visualization, writing - original draft, writing - review & editing.

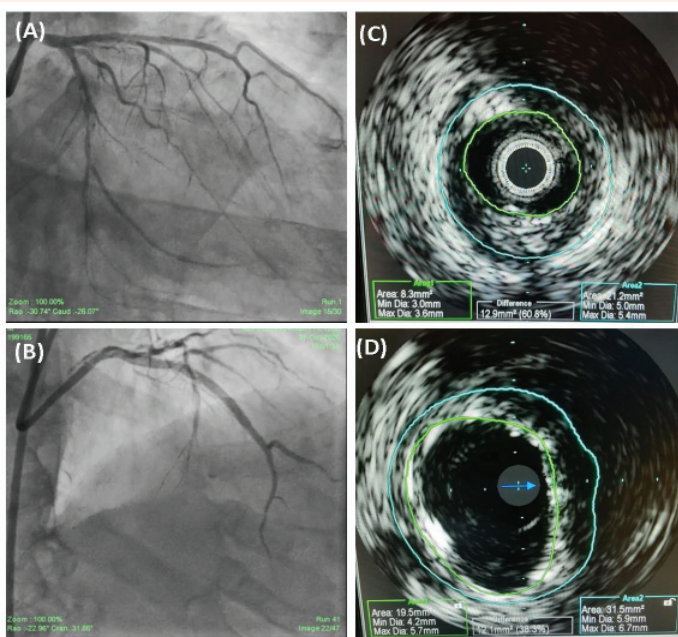


Figure 3: Case 3 - (A) and (B) Coronary Angiograms pre- and post-PCI; and (C) and (D) Intravascular ultrasound images pre- and post-PCI.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval was not required since it is an accepted procedure.

Consent for Publication

Written consent has been obtained to publish the case report from the guardian. The consent copy is available with the authors and ready to be submitted if required.

(Supplementary Material)

Link to procedures:

<https://drive.google.com/file/d/11NwjoPX9zoMqeisslz-1YBjky0rdgEug/view?usp=sharing>

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