Case Report

Ostial left anterior descending artery chronic total occlusion – Left main coronary artery intramural hematoma

ABSTRACT

Chronic total occlusion (CTO) intervention of ostial left anterior descending artery lesion without clear cap poses challenges for wiring. Intravascular ultrasound-guided antegrade cap puncture and guide extension-assisted reverse-controlled antegrade and retrograde tracking away from the ostium would minimize inflow injuries. This case report explores inflow injury and its detection by imaging in ostial left anterior descending artery CTO percutaneous coronary interventions.

Keywords: Ambiguous cap puncture, flap closure, intramural hematoma, reverse-controlled antegrade and retrograde tracking

INTRODUCTION

Chronic total occlusion (CTO) intervention of ostial left anterior descending artery (LAD)/left circumflex artery (LCX) lesions without a clear cap poses challenges for wiring due to the angle of entry and unclear entry. Ostial LAD CTO, by being in a location supplying a significant portion of the myocardium, increases the risk of percutaneous coronary intervention (PCI) due to inflow injuries such as left main coronary artery (LMCA) dissections or intramural hematoma (IMH).[1] In one of the large-scale analyses of ostial LAD CTO PCI in 13 centers in Korea, it was observed that the cap is ambiguous in 43% of cases and apparent dissections requiring rescue procedures were noted in 5.2% of cases.[2] Ostial LAD CTO is a different animal to tame due to the special operator attention needed to prevent intraprocedural catastrophes such as dissection or IMH of LMCA or LCX.[3] Intravascular ultrasound (IVUS)-guided cap puncture followed by using this wire position for antegrade preparation to receive the retrograde wire beyond the ostium of LAD minimizes aforementioned complications and makes the procedure as predictable as possible.[4] We report a case of ostial LAD CTO intervention, in which LMCA IMH complicated the stenting strategy.

CASE REPORT

We report a 60-year-old male hypertensive, diabetic treated for acute ST elevation inferior wall myocardial infarction (IWMI) with primary angioplasty with stent to the mid-right coronary artery [Figure 1a-c].

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Submitted: 30-Oct-2023 **Revised:** 16-Dec-2023
Accepted: 21-Dec-2023 **Published:** 14-Feb-2024

Videos available on: https://journals.lww.com/mjm

Access this article online	
Website: https://journals.lww.com/mjm	Quick Response Code
DOI: 10.4103/MJM.MJM_2_23	

How to cite this article: Annam SR, Gundala AK, Polavarapu V, Prasad AB, Sharma H. Ostial left anterior descending artery chronic total occlusion – Left main coronary artery intramural hematoma. Medicover J Med 2024;1:37-40.

He was admitted for ostial LAD CTO PCI. As the proximal cap was not clear, IVUS-guided antegrade cap puncture was planned, followed by retrograde if needed. IVUS-guided antegrade cap puncture was done using a double-lumen catheter (Crusade, Kaneka Corporation, Japan) and IVUS catheter (OptiCross, Boston Scientific) on the same workhorse wire through an 8 FR guide [Figure 2a]. Initial cap puncture with Hornet 10 (Boston Scientific) was subintimal [Figure 2b]; however, in subsequent attempts, the wire could be navigated into the proximal cap successfully [Figure 2c]. Workhorse wire on which OptiCross was positioned into LCX was pulled back till the tip of the wire was out of the IVUS catheter monorail exit. Then, the IVUS catheter was withdrawn [Video 1a and b], followed by double-lumen catheter exchanged to corsair XS (Asahi Intecc) [Figure 2d] on LAD wire into and beyond the ostium of LAD to consolidate the position achieved.

Antegrade wire de escalated to GAIA II (Asahi Intecc) and advanced further but halted because of the ambiguous vessel course in retrograde injection. Retrograde wiring through septal collateral was done with caravel 150 mm (Asahi Intecc) through the guide extension in a 7 FR JR guide. After caravel positioned into LAD contrast injection done to delineate the course of LAD for further wiring [Video 2a]. To our surprise, contrast injection created subintimal dissection with retrograde extension to ostial LAD. Conventional reverse cart [Video 2b] with 3.5 × 12 mm balloon over GAIA II in the ostial LAD and Hornet 10 retrograde wire was done successfully, followed by confirmation of intimal

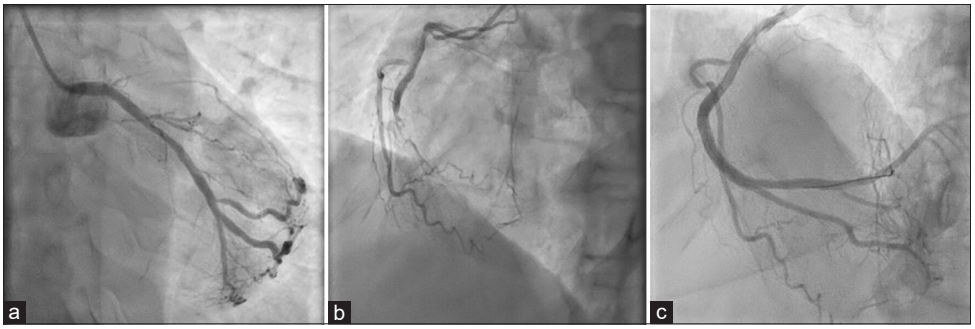

Figure 1: (a) Right coronary artery (RCA) angiogram before primary percutaneous coronary interventions (PCI) - Total thrombotic occlusion of mid-RCA, (b) Left system - ostial left anterior descending artery chronic total occlusion with mild left circumflex artery disease, (c) Post primary PCI to RCA - Dominant RCA with normal distal branches

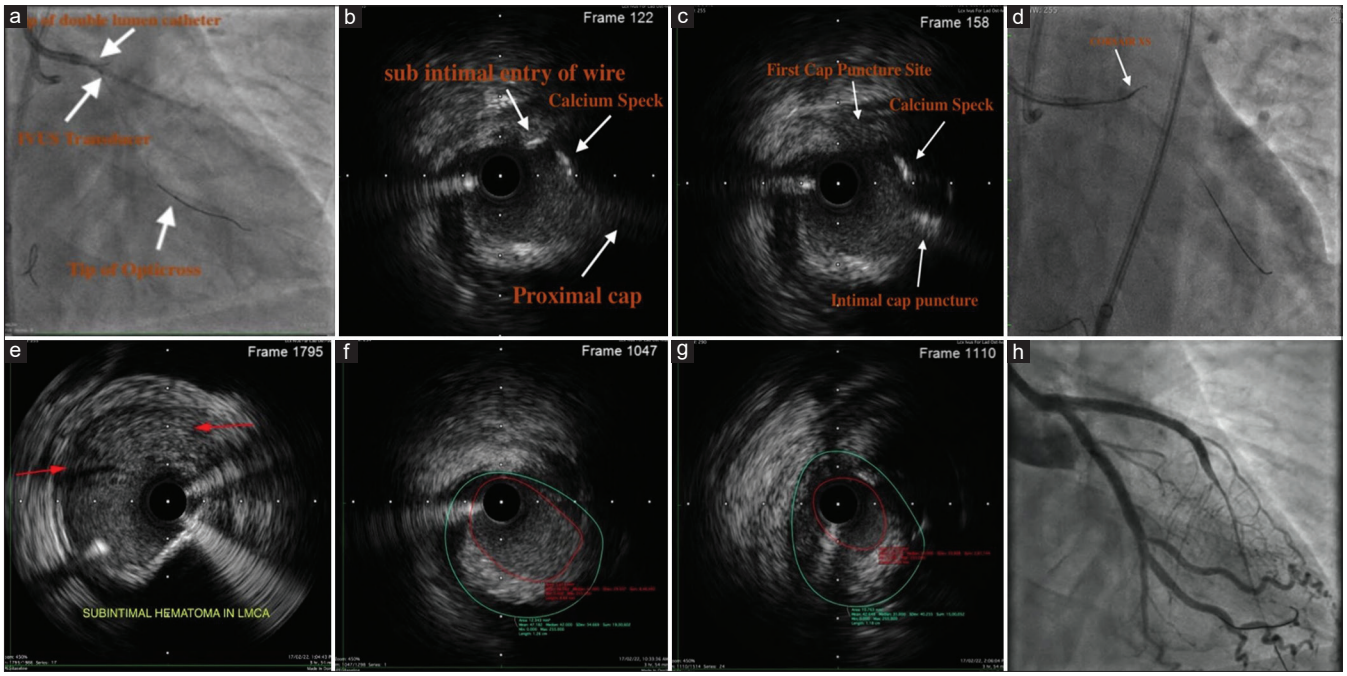

Figure 2: (a) Intravascular ultrasound (IVUS)-guided cap puncture - IVUS catheter, (b) IVUS showing antegrade wire entry at subintimal plane away from cap, (c) IVUS - Hornet 10 in proximal cap, (d) Fluro-Hornet 10 in proximal cap, (e) IVUS - Intramural hematoma compressing true lumen, (f) Ostial left circumflex artery (LCX) minimum lumen area (MLA) in IVUS before LM TO left anterior descending artery (LAD) stent (MLA: 5–6 mm^2), (g) Ostial LCX MLA after left main coronary artery to LAD stent followed by POT (MLA: 2–3 mm^2), (h) Final angiogram result

wire entry from LAD into LMCA by IVUS [Video 2c]. After externalization, predilatation of the lesion was performed, followed by antegrade wiring of distal LAD through the double-lumen catheter on the externalized wire. Retrograde wire is removed, followed by IVUS imaging done from LAD for stenting strategy. IVUS revealed IMH [Figure 2e] extending into distal LMCA. Stenting was done from ostial LMCA into LAD with 2.75 mm × 38 mm and 3.5 mm × 28 mm stent with overlap at no branch zone of proximal LAD. After POT for LMCA and optimization of LAD stent by post dilatation, IVUS from LCX revealed a minimum lumen area of 2.3 mm^2 against the baseline of 5.6 mm^2 [Figure 2f and g]. TAP stenting was done with 3.0 mm × 28 mm stent into LCX, followed by bifurcation optimization [Figure 2h].

DISCUSSION

Ostial LAD CTO poses challenges due to the abnormal angle of attack with the antegrade wire. Furthermore, the presence of ambiguous cap, seen in 43.3% of cases in Korean data, amplifies the technical challenges for antegrade wiring.[2] Figure 3a-c illustrates the ideal wiring strategy for ostial LAD CTO with ambiguous cap to minimize inflow injury.

Indeed, the same Korean study showed a 5.2% incidence of inflow dissections requiring stenting of LMCA or LCX[2]. Understandably, inflow vessel injury/dissection was more frequent in patients with LMCA disease or ambiguous proximal cap. The presence of both anatomic factors would have an additive impact on the incidence of dissection. Other factors in antegrade wiring which might affect inflow injury are angle of attack, type and shape of the wire used, type of microcatheter, and use of imaging. Higher angle of attack, ambiguous cap puncture without imaging guidance, and cap puncture with microcatheter positioned away from the proximal cap increase the incidence of dissection.[5] Double-lumen catheter with live IVUS would increase the accuracy of targeted cap puncture with lesser chances of inflow injury. Antegrade preparation with complete IVUS-guided cap puncture is considered the Achilles heel of ostial LAD CTO.[3] After antegrade cap puncture under IVUS, the wire position achieved must be consolidated by advancing the microcatheter into and beyond the ostial LAD. In the event of failure of antegrade wire reaching the distal true lumen, parallel wire with the double-lumen catheter positioned into the LAD in such a way that the second wire also goes through the same ostial LAD entry can be done or switch to retrograde wiring. When retrograde wiring is used reverse-controlled antegrade and retrograde tracking (CART) should be performed beyond the ostial LAD, preferably, with guide extension assistance to make sure retrograde wire enters LMCA through the antegrade entry created under IVUS. Caution should be taken to stay distal and away from LAD ostium with retrograde wire during reverse CART. Directed reverse CART with retrograde wire directed onto the distal tip of antegrade balloon would minimize the proximal LAD injury in the presence of shorter length of antegrade space created. If guide extension cannot be used, intimal entry of retrograde wire into LMCA should be confirmed by IVUS before externalization. In situations of retrograde wiring without antegrade preparation, retrograde wire navigation into LMCA must be done under IVUS for ideal entry into LMCA without creating inflow injury. In a rare situation, when a high tip-load guidewire is needed to puncture the proximal cap retrogradely but is less controllable (either by poor microcatheter support or severe vessel angulation), elective stenting from the LMCA to the LCX may facilitate direct wiring while ensuring the safety. However, this strategy should be justified by other indications for LMCA-LCX stenting, such as the presence of LMCA disease or ostial LCX disease.[2] Inflow injury is mostly noticed after CTO wiring but sometimes can be seen after predilatation of ostial LAD. Therefore, LMCA anatomy must be analyzed carefully by IVUS from LAD and/or LCX after the lesion preparation before embarking on the stenting strategy. Any inflow dissection or IMH extension into LMCA warrant's two-stent strategy. Consider placing LMCA stent from the ostium to avoid proximal lumen compromise by IMH shift.

Figure 3: Steps for ostial left anterior descending artery chronic total occlusion percutaneous coronary interventions with ambiguous cap. (a) Step 1 - Intravascular ultrasound-guided cap puncture, (b) Step 2 - Going retrograde, (c) Step 3 – Reverse-controlled antegrade and retrograde tracking, beyond the ostium with guide extension

CONCLUSION

Ostial LAD CTO PCI constitutes a special subset due to the larger area of the myocardium at risk. Careful wiring both antegrade and retrograde to prevent inflow injuries and meticulous analysis of LMCA anatomy in IVUS to identify inflow injuries before embarking on stenting strategy are quintessential to prevent catastrophe.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Learning objectives

- Approach to ostial LAD CTO needs special attention to avoid on-table catastrophe
- IVUS-guided antegrade cap puncture is essential, which also acts as an antegrade preparation for retrograde
- Guide extension-assisted reverse CART would ensure favorable retrograde wire entry
- Stenting strategy needs to be dynamic and decide based on the IVUS appearance of distal LMCA after reverse cart.
- IMH in LM in IVUS stenting from LM ostium is a safer strategy
- Always re-assess ostial LCX in IMH scenarios after LMCA to LAD stenting.

Acknowledgment

I would like to acknowledge Dr. Chandana for drafting the manuscript and submitted to the journal.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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