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Case Report
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Side-Branch and Coaxial Intravascular Ultrasound Guided Wire Re-Entry after Failed Retrograde Approach of Chronic Total Occlusion Intervention

Ruey-Hsing Chou,[1] Chih-Hung Lai[2,3] and Tse-Min Lu[1,3]

Intravascular ultrasound (IVUS) can provide valuable information during the intervention of difficult chronic total occlusion (CTO) lesion. Stumpless CTO lesions with an adjacent side branch are associated with a significantly lower success rate because the proper entry point is not always clearly identified and the guidewires easily slip into the side branch. Herein we presented a case of a stumpless middle left circumflex (LCX) artery CTO lesion with auto-collateral from obtuse marginal branch. Initially, we positioned the IVUS into the side-branch to find the entry point of LCX-CTO lesion. However, the punctured wire went into the false lumen. A retrograde approach was tried but later failed. Therefore, we used IVUS to find the entry point where the true lumen transited to the false lumen, and used a stiff guidewire to puncture the entry point. After we confirmed with IVUS that the whole guidewire was in the true lumen, we deployed 3 drug-eluting stents. The final angiogram showed TIMI 3 flow with preservation of all side branches. The patient was angina-free during the 6-month follow-up. By presenting this case, we have demonstrated the application of both side-branch and coaxial IVUS-guided recanalization technique in the stumpless CTO lesion.

Key Words: Chronic total occlusion • Coronary intervention • Intravascular ultrasound

INTRODUCTION

A 48-year-old man with coronary artery disease received bypass surgery in 2013, and presented to our facility showing signs of aggravating angina in the past 3 months. Coronary angiogram revealed a chronic total occlusion (CTO) lesion over the middle-left circumflex artery (LCX) with auto-collateral from obtuse marginal (OM) branch. We first placed the intravascular ultrasound (IVUS) in the side-branch to find the LCX-CTO lesion entry point, and then we used a stiff wire to puncture the middle LCX CTO lesion (side-branch IVUS-guided re-entry technique). However, the stiff wire went into the false lumen; the retrograde approach was tried but failed later. Consequently, we used IVUS to find the entry-point where the true lumen transited to the false lumen, and used a Conquest Pro 8-20 guidewire to puncture into the true lumen (coaxial IVUS-guided re-entry technique). Fortunately, the stiff wire was able to enter the true lumen. After confirmation with IVUS that the entire guidewire was in the true lumen, we inserted 3 drug-eluting stents. The final angiogram showed a satisfactory result with TIMI 3 flow. By presenting this case, we have demonstrated the application of side-branch and coaxial IVUS guided wire re-entry technique in a stumpless CTO lesion.

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[1]Division of Cardiology, Department of Internal Medicine, Taipei Veterans General Hospital, Taipei; [2]Division of Interventional Cardiology, Cardiovascular Center, Taichung Veterans General Hospital, Taichung; [3]School of Medicine, National Yang-Ming University, Taipei, Taiwan.
Address correspondence and reprint requests to: Dr. Tse-Min Lu, Division of Cardiology, Department of Internal Medicine, Taipei Veterans General Hospital, and School of Medicine, National Yang-Ming University, No. 201, Sec. 2, Shih-Pai Road, Taipei, Taiwan. Tel: 886-2-2871-2121 ext. 2997; Fax: 886-2-2873-2131; E-mail: tmlu@vghtpe.gov.tw

CASE REPORT

A 48-year-old man with cardiovascular risk of hypertension, diabetes, and a family history of coronary artery disease was admitted with signs of progressive exertional angina during the prior 3 months. He underwent double coronary artery bypass surgery 1 year earlier, with one sphenous venous graft to the posterior descending artery (PDA) of the right coronary artery, and one left internal mammary artery to the distal left anterior descending (LAD) artery. The thallium scan still showed reversible ischemia over the inferolateral wall of the left ventricle 1 year after surgery. Coronary angiogram revealed CTO of the middle LCX and proximal LAD (Figure 1A), and the arterial and venous grafts were still patent. Therefore, considering the non-invasive evidence of ischemia over the inferolateral wall of left ventricle, we targeted the middle LCX CTO lesion. The CTO lesion had a blunt end with side branch, occlusion length exceeding 20 mm, and distal calcification, with a collateral circulation from OM branch. According to the J-CTO score, this is a "very difficult" lesion on which to use the antegrade approach (J-CTO score: 3). The retrograde approach can be challenging due to the corkscrew-shaped collateral vessels. However, IVUS guided recanalization may be the last option when both the antegrade approach and retrograde approach have failed.

We used an 8-French guiding catheter to engage the left main coronary artery via the transfemoral approach. A hydrophilic guidewire (Fielder FC, Asahi Intecc, Aichi, Japan) was advanced to the middle part of the LCX supported by a microcatheter (FineCross, Terumo Intecc, Tokyo, Japan), but failed to cross the proximal cap of the CTO lesion. We advanced the wire to the acute marginal (AM) branch, and tried to identify the entry point of the main trunk of LCX by IVUS (Volcano Intecc) (Figure 1B, Figure 2A-2B). Then we attempted the side-branch IVUS-guided technique to puncture the proximal cap of CTO with a stiff wire (ProVia 12, Medtronic Intecc), but the guidewire still failed to enter the true lumen. Parallel wire technique was performed with another stiff wire (Conquest Pro 12, Asahi Intecc), but it still advanced to the subintimal space. Then, we tried the retrograde approach with a soft wire (Sion, Asahi Intecc) with micro-

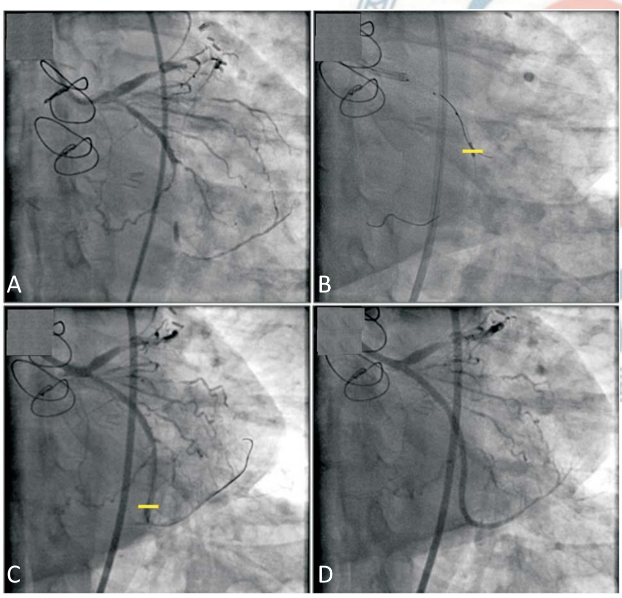

Figure 1. *Sequential coronary angiogram of the whole procedure. (A) A stumpless CTO lesion at the middle LCX, with a side branch and auto-collateral from the OM branch. (B) IVUS was placed in the side branch of the stumpless CTO lesion, the AM branch, to identify the entry point of main trunk. Slash = the position of IVUS on angiogram. (C) After coaxial IVUS guided recanalization, IVUS was placed in the adjacent subintimal space to confirm the position of the punctured wire. (D) Final angiogram of LCX was successful with all side branches preserved. * AM, acute marginal; CTO, chronic total occlusion; LCX, left circumflex artery; OM, obtuse marginal.*

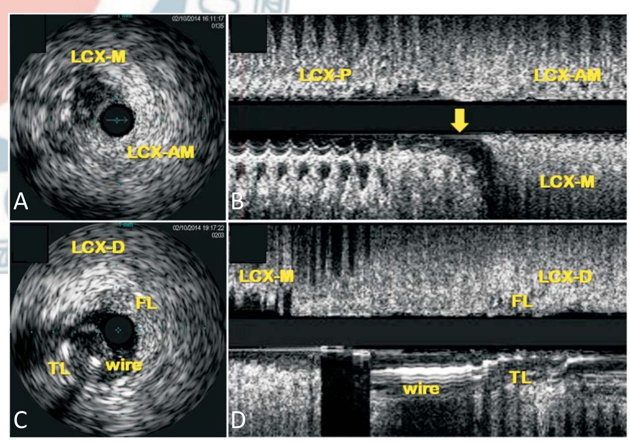

Figure 2. *IVUS images of side-branch (A-B) and coaxial IVUS guidance technique (C-D). (A) IVUS was placed at AM branch, and showed the LCX main trunk was at the upper left of AM branch. (B) Under the longitudinal view, the entry point of LCX main trunk was clearly identified. Arrow = the entry point of side branch to main trunk. (C) IVUS was placed in the subintimal space adjacent to distal LCX, and showed the TL was at the lower left of the FL, with the punctured wire inside. (D) Under the longitudinal view, the TL was just below the FL. The punctured wire was clearly identified to be in the TL. * AM, acute marginal; FL, false lumen; IVUS, intravascular ultrasound; LCX, left circumflex artery; TL, true lumen.*

catheter support (FineCross, Terumo Intecc). The Finecross microcatheter could not cross the screw-like collateral vessel; therefore, we tried direct wire crossing. Finally, the Sion wire crossed the collateral vessel and CTO lesion, and advanced to the proximal portion of LCX. Using the tip-in technique, the retrograde wire was passed into the antegrade microcatheter (Corsair, Asahi Intecc) within the guiding catheter. Though the Sion wire finally passed into the antegrade microcatheter, it is very likely that part of the Sion wire was in the false lumen created by the antegrade wire. Furthermore, the antegrade Corsair microcatheter could not advance further with the support of retrograde Sion wire. Probably, the tip of the Corsair microcatheter was still in the false lumen, and the antegrade wire also entered the false lumen after the retrograde wire was retracted. We thereafter again tried to cross the auto-collateral vessel, but failed due to vessel spasm. Therefore, we tried to identify the entry point of proximal true lumen to false lumen by IVUS check. As shown on Supplement 1, IUVS was performed by way of the antegrade wire punctured through to the false lumen. A compressed, small vessel was found at the level where true lumen transited to false lumen. After confirmation of the entry point of true lumen, we used another stiff wire (Conquest Pro 8-20, Asahi Intecc) to puncture in the direction of the true lumen under real-time IVUS guidance. Fortunately, the Conquest Pro 8-20 wire finally entered the true lumen, which was confirmed by IVUS (Figure 1C, Figure 2C-2D). Then, we sequentially positioned 3 drug-eluting stents from the distal to the proximal LCX (Biomatrix 2.25 × 28 mm, 2.5 × 36 mm, 2.75 × 28 mm). The final angiogram showed TIMI 3 flow and preservation of all side branches in LCX (Figure 1D). The patient was discharged 2 days later, and was angina-free during the 6-month follow-up at the out-patient department.

DISCUSSION

IVUS provides valuable information in percutaneous coronary intervention (PCI), and has been shown to be an important tool in cardiac catheterization for more than 2 decades.[1] IVUS is very useful in measuring vessel size, evaluating plaque distribution, and may also help to avoid stent under-expansion during PCI. In cases involving CTO lesion intervention, IVUS provides information to more effectively identify false lumen and true lumen, the wire position, and facilitates the decision as to where to perform balloon dilatation for controlled antegrade and retrograde subintimal tracking (CART) technique. Furthermore, both side branch IVUS-guided recanalizaation and coaxial IVUS-guided recanalizaation are very useful techniques in the management of CTO lesions. In a small series of 31 CTO lesions (22 had previous failed attempts), successful recanalization was achieved in 100% of cases using a modified retrograde IVUS-guided approach.[2]

Because the proper entry point is not always clearly identified and the guidewires easily slip into the side branch, stumpless CTO lesions with an adjacent side branch arising from the occlusion are associated with a significant lower success rate.[3] The side branch IVUS-guide wiring technique is very useful in identifying the entry point in this condition. In contrast, when antegrade wire enters the subintimal space and the retrograde approach is difficult due to poorly developed collaterals or has failed, IVUS can identify the entry point of the true lumen. Then we can attempt the co-axial IVUS wiring technique by using another stiff wire to puncture the entry point back into the true lumen under IVUS guidance, as in our case. Moreover, after the stiff wire puncture is confirmed, IVUS can be further advanced to check whether or not the whole wire is in the true lumen. However, when the IVUS is used to guide the wire to puncture, we should keep in mind that it inevitably causes large and long dissection, and carries a potential risk of coronary perforation. Therefore, gentle manipulation of IVUS and full metal jacket stenting are always necessary.

CONCLUSIONS

Though IVUS guide wiring technique is associated with prolonged procedure time and increased risk of vessel dissection, which generally cannot be avoided even by an experienced operator, use of this technique enhances the success rate in complex cases of PCI. Furthermore, it is apparent that both side branch and coaxial IVUS-guided recanalization may be helpful during PCI in difficult CTO cases.

CONFLICT OF INTEREST OR EXTERNAL SOURCE OF FUNDING

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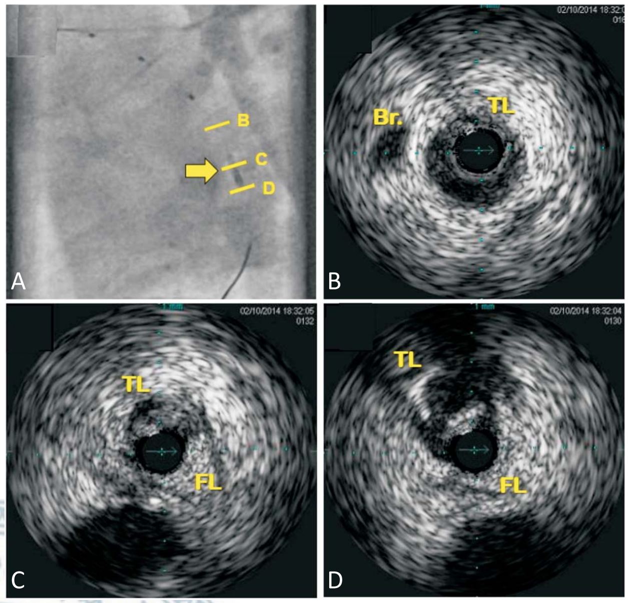
SUPPLEMENT



Supplement Figure 1. *Coaxial IVUS guidance technique used to to identify the entry point of true lumen. (A) IVUS was performed via the wire punctured to the false lumen. Slash = the position of IVUS at 3 different levels on angiogram. Arrow = the entry point where true lumen transited to false lumen. (B) IVUS was placed in the true lumen at middle LCX, with an adjacent side branch. (C) IVUS was now placed in the false lumen at distal LCX. The compressed, small true lumen was at the upper left of the false lumen. (D) When we advanced to distal subintimal space, true lumen was well visible at the upper left of the IVUS, with calcification surround. * Br, branch; FL, false lumen; IVUS, intravascular ultrasound; LCX, left circumflex artery; TL, true lumen.*