A New Occluding Balloon-Facilitated Reversed Guidewire Technique in Successful Percutaneous Coronary Intervention for the Right Coronary Artery Chronic Total Occlusion Involving Distal Bifurcation

Kuan-Liang Liu¹ and Chi-Jen Chang²

INTRODUCTION

Chronic total occlusion (CTO) percutaneous coronary intervention (PCI) can be challenging when a bifurcation lesion complicates a distal CTO cap.¹,² Baseline wiring into the true lumen at the point of bifurcation is essential to avoid jeopardizing the side branches (SB).³ The angle of bifurcation is occasionally quite large, and the reversed guidewire technique is useful in this clinical scenario.³ A critical step of the technique involves a second guidewire going into the SB far enough to provide good support. Here, we present a case where an occluding balloon technique facilitated the advance of the second guidewire.

CASE

A 69-year-old man presented with progressive dyspnea upon exertion and exercise intolerance. He had a history of hypertension, stage 3 chronic kidney disease, dyslipidemia, and ischemic stroke. Physical examination revealed peripheral edema and an engorged jugular vein. An echocardiography demonstrated a left ventricular ejection fraction of 38% with global hypokinesia. Nuclear scintigraphy showed a reverse reversible defect at the inferior segment and a fixed defect at the anterior segment. Therefore, he was admitted for a diagnostic coronary angiography, which revealed CTO in the distal part of the right coronary artery (RCA) (Figures 1A&B). There were Rentrop grade 3 collaterals originating from the left coronary artery to the bifurcation of the posterior descending artery (PDA) and posterolateral branch (PL) (Figure 1C). The left circumflex (LCX) coronary artery was chronically occluded as well, with Rentrop grade 3 bridging collaterals. The left anterior descending (LAD) coronary artery was non-obstructive, but the diagonal branch was nearly occluded.

Antegrade crossing into the PDA was achieved using a microcatheter (MC) (Stride, ASAHI INTECC Co., Ltd., Aichi, Japan) with a CTO guidewire (GW) (Fielder XT-A, ASAHI INTECC Co., Ltd., Aichi, Japan). The angle of the PL to the PDA was highly angulated, so the antegrade wiring to the PL failed after several attempts (Figure 1D). A double-lumen MC-facilitated reversed guidewire technique was then used as described previously. In brief, the “reversed wire system” consisted of a Sion black GW (ASAHI INTECC Co., Ltd., Aichi, Japan) and Crusade MC (KANEKA Corp., Osaka, Japan). A reversed sharp curve was made about 3 cm from the tip of the GW in order to pass the CTO segment. For lesion preparation, the distal RCA CTO was dilated with a 2.5 × 20-mm non-compliant (NC) balloon at 12 atm. The whole system was then inserted into the PDA. After pulling back the Crusade MC, the GW was steered carefully, and the tip could enter into the PL to about 2-3 cm in length (Figure 2A). Nevertheless, the GW met resistance and stopped despite further manipulation. It began to prolapse into the PDA when it was pushed.

The support of the radiopaque part of the GW was not strong enough to deliver a flexible MC. The Crusade MC was removed using an extension wire (ASAHI INTECC Co., Ltd., Aichi, Japan), and a 2.5 × 20-mm NC balloon...
was inflated at nominal pressure in the RCA-PDA to occlude the PL ostium. The Sion black GW could now easily be advanced without prolapse into the PDA (Figure 2B). The distal RCA and PL were pre-dilated with a 2.5×20-mm NC balloon at nominal pressure, provisionally stented with 2.5×38-mm and 3.0×30-mm bare metal stents, and post-dilated with a 2.5×20-mm NC balloon, 3.0-mm stent balloon, and a 3.5×20-mm NC balloon at 16 atm. Proximal optimization therapy was performed using the 3.5-mm NC balloon at 16 atm. Final angiography showed Thrombolysis In Myocardial Infarction (TIMI) grade 3 flow in both PDA and PL, without the SB being trapped (Figure 2C).

The patient was discharged uneventfully the next day. Follow-up angiography was performed 4 months later, which showed a 50% in-stent restenosis at the PL ostium (Figure 2D). Because the patient was asymptomatic, PCI was not performed.

**DISCUSSION**

Treatment of atherosclerotic coronary artery disease includes risk factors control and revascularization. In the field of interventional cardiology, CTO PCI is technically challenging, and the success rate depends on the operator’s experience as well as the lesion complexity. Antegrade wiring is sometimes very difficult when a bifurcation lesion complicates a distal CTO exit. As in our case, the first GW went into the distal true lumen, but the distribution of the distal CTO plaque resulted in a takeoff that was too angulated for the second GW to be advanced. For this kind of bifurcation lesion, Kawasaki et al. introduced the reversed guidewire technique, which involves the use of a hairpin curved GW to solve the problem. The technique has been improved by using a double-lumen MC and is adopted widely.

Although the effectiveness and safety of this technique have been proven, some limitations remain, especially in the present case. First, Watanabe et al. recommended a sharp or round hairpin curve depending on the severity of proximal main vessel (MV) lesion. In our experience, a sharp curve suits most cases, whereas a...
round curve makes it difficult for the reversed wire system to pass through. Second, a highly angulated takeoff would become easily approachable in this regard from a distal-to-proximal direction. Hence, it is sufficient to make a small primary curve.

Following the previous concept, it is unnecessary to torque the GW too much, or it will self-twist. One only has to control the direction of the tip of a GW toward the SB ostium. The GW should be pulled slowly and allowed to go into the SB automatically. For this purpose, a polymer-jacket hydrophilic-coated GW is strongly suggested to decrease intravascular friction. Finally, if a significant lesion is present beyond the SB ostium, compromised torquability of the bent guidewire may make the procedure difficult. Pushing the GW when it encounters resistance makes it prolapse into the distal MV.

Nomura et al. recommended delivering a flexible MC through the SB GW, but in this situation, the short, flexible part of the wire inside the side branch may not provide enough support for successful delivery of a balloon catheter. Our technique provides a simple solution by inflating a 1:1 size-matched balloon at lower pressure and crossing over the bifurcation in the proximal and distal MV. This has two functions: (1) occluding the ostium of the distal MV and thus preventing the prolapsing of the GW into it, and (2) restricting the motion of the bent GW within the limited space between the balloon and vessel wall, as well as diminishing the “whiplash effect” when the wire is manipulated. With these mechanisms, the control of the bent wire can be effectively enhanced.

The major advantage of the reversed guidewire technique is that it preserves the SB with antegrade wire. The loss of the SB results in periprocedural myocardial infarction, which is associated with worse prognosis in patients undergoing CTO PCI. Prior studies reported the application of retrograde technique, in which it carries the risk of injury to collateral vessels. By combining the occluding balloon with the reversed guidewire technique, operators can wire both the MV and SB in an antegrade fashion, even if there is a lesion in the SB. The procedure time and the volume of contrast medium can be reduced as well.

**LEARNING POINTS**

Occluding balloon technique could effectively facilitate the reversed guidewire technique in PCI for CTO involving distal bifurcation.

**CONFLICT OF INTEREST**

All the authors declare no conflict of interest.

**REFERENCES**