ESC European Society of Cardiology

European Heart Journal - Case Reports (2024) **8**, ytae537
https://doi.org/10.1093/ehjcr/ytae537

CASE SERIES
Coronary intervention

A U-turn wiring technique for reverse-angled branches adjacent to ectasia: a case series

Masashi Yamaguchi, Yutaka Tanaka *, Daisuke Sato , and Shigeru Saito

Department of Cardiology, Shonan Kamakura General Hospital, Okamoto 1370-1 Kamakura, Kamakura, 247-8533 Japan

Received 3 May 2024; revised 29 June 2024; accepted 20 September 2024; online publish-ahead-of-print 27 September 2024

Background The reverse-wiring technique (RWT) using a hairpin-bend wire is useful for percutaneous coronary intervention of a bifurcation lesion with an extremely angulated side branch (SB); however, it is not necessarily effective in some anatomical situations. We report a novel SB wiring technique, the U-turn wiring technique (UWT), that is useful for wiring an extremely angled SB proximal to the ectasia.

Case summary In the first case, the bare wire took a U-turn in the ectasia of the diagonal branch and crossed towards the angled left anterior descending artery, but a coronary dissection occurred in the diagonal branch due to the continuous wire-pushing force. Therefore, in the second case, we used a microcatheter with distal flexibility to prevent guidewire-induced vessel injury at the ectasia site and safely advanced the wire to the distal portion of the extremely angulated SB.

Discussion The UWT takes advantage of the ectasia as a space to U-turn the guidewire. The UWT does not require a hairpin-bend guidewire or a dual-lumen catheter. The guidewire can be easily pushed forward through a reversed SB. After successful wire insertion, the guidewire can be easily advanced deep into the side branch. The UWT facilitates wire crossing to a reverse-angled branch utilizing the coronary ectasia anatomy through a simple manipulation.

Keywords Percutaneous coronary intervention • Bifurcation • Wiring technique • Case series

ESC curriculum 3.1 Coronary artery disease • 3.4 Coronary angiography

Learning points

(1) A novel side branch (SB) U-turn wiring technique could be useful in the treatment of patients with an extremely angled SB and some specific anatomies.
(2) This technique, entirely different from the reverse-wiring technique, does not require the bending of the wire and facilitates deep wire crossing without complicated procedures.

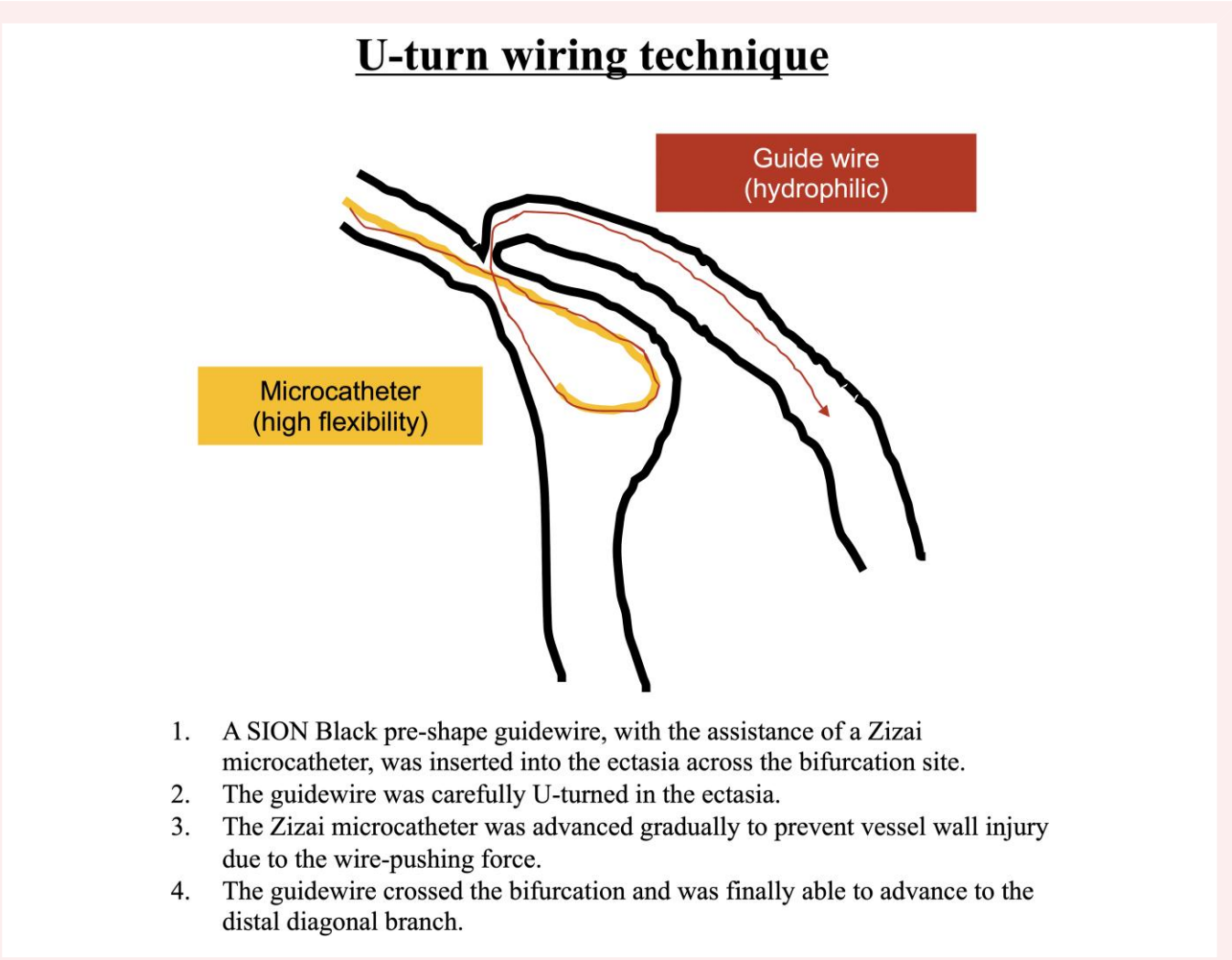
Introduction

Percutaneous coronary intervention (PCI) for bifurcation lesions with an extremely angled side branch (SB), which is attributed to the eccentric nature of the lesion and/or the vessel/bifurcation architecture, is challenging owing to the risk of SB compromise.[1] In 2008, a reverse-wiring technique (RWT) using a hairpin-bend guidewire was reported as a wiring technique for an angled SB, which was then improved with the use of a dual-lumen microcatheter.[2] This technique was more effective for wiring to an extremely angled SB; however, large spaces such as coronary ectasia distal to the side branch, can often hinder the success of RWT owing to difficulties in manipulating the

* Corresponding author. Tel: +81 467 461717, Fax: +81 467 461907, Email: yutakatanaka_circ@yahoo.co.jp
Handling Editor: Josip Andelo Borovac
Peer-reviewers: Alaeldin Addas; Antonios Karanasos
Compliance Editor: Pok-Tin Tang

hairpin-bend wire.[3] Here, we report two cases of bifurcation with an extremely angled SB just proximal to an ectasia that were successfully treated using a novel SB wiring technique, namely, the U-turn wiring technique (UWT).

Summary figure



Case 1

A 75-year-old woman with dyslipidaemia was admitted with a heavy weight sensation on the chest during walking. A comprehensive physical examination revealed no significant cardiovascular abnormalities. Twelve-lead and transthoracic echocardiograms demonstrated normal findings. However, a coronary angiogram revealed a significant narrowing of the diagonal branch in the middle of the left anterior descending (LAD) artery (*Figure 1A*), leading to the diagnosis of exertional angina. Therefore, elective PCI was performed on the lesion. The vessel line appeared straight toward the ectatic diagonal branch from which the acutely angled LAD artery diverged. A guiding catheter (6 Fr Taiga EBU 3.5; Medtronic, MN, USA) was inserted into the left coronary artery via the right radial artery. We first attempted to pass a SION Black Pre-shape guidewire (Asahi Intecc, Japan) towards the diagonal branch; however, the wire took an unintended U-turn towards the LAD artery in the ectasia of the diagonal branch. Therefore, we continued to push the wire forward and crossed the wire down the distal LAD artery (*Figure 1B and C*). However, angiography showed a dissection of the diagonal ectasia (*Figure 1D*). Optical frequency domain imaging (OFDI) showed significant calcium accumulation at the bifurcation (*Figure 1D*). The calcium was ablated using a Rotablator burr 1.5 mm (Boston Scientific) (*Figure 1E*). Next, we crossed another guidewire (Fielder FC, Asahi Intecc) to the diagonal branch. The diagonal branch was dilated using a cutting balloon (Wolverine 2.0 × 10 mm; Boston Scientific), and a drug-eluting stent (Synergy XD 2.25 × 24 mm; Boston Scientific) was implanted (*Figure 1F*). The LAD lesion was then dilated using an NC Kamui 3.0 × 10 mm (Asahi Intecc), followed by a Synergy XD 3.0 × 28 mm implantation using a modified jailed balloon technique (*Figure 1G*). Kissing balloon inflation was performed using an NC Kamui 3.0 × 10 mm and Zinrai 1.5 × 10 mm (Kaneka Corporation, Japan) (*Figure 1H*). The final angiogram showed favourable expansion of the target lesion without SB occlusion (*Figure 1I*). At the latest follow-up, which was 1 year after the procedure, the patient's condition was good without any symptom or cardiovascular event.

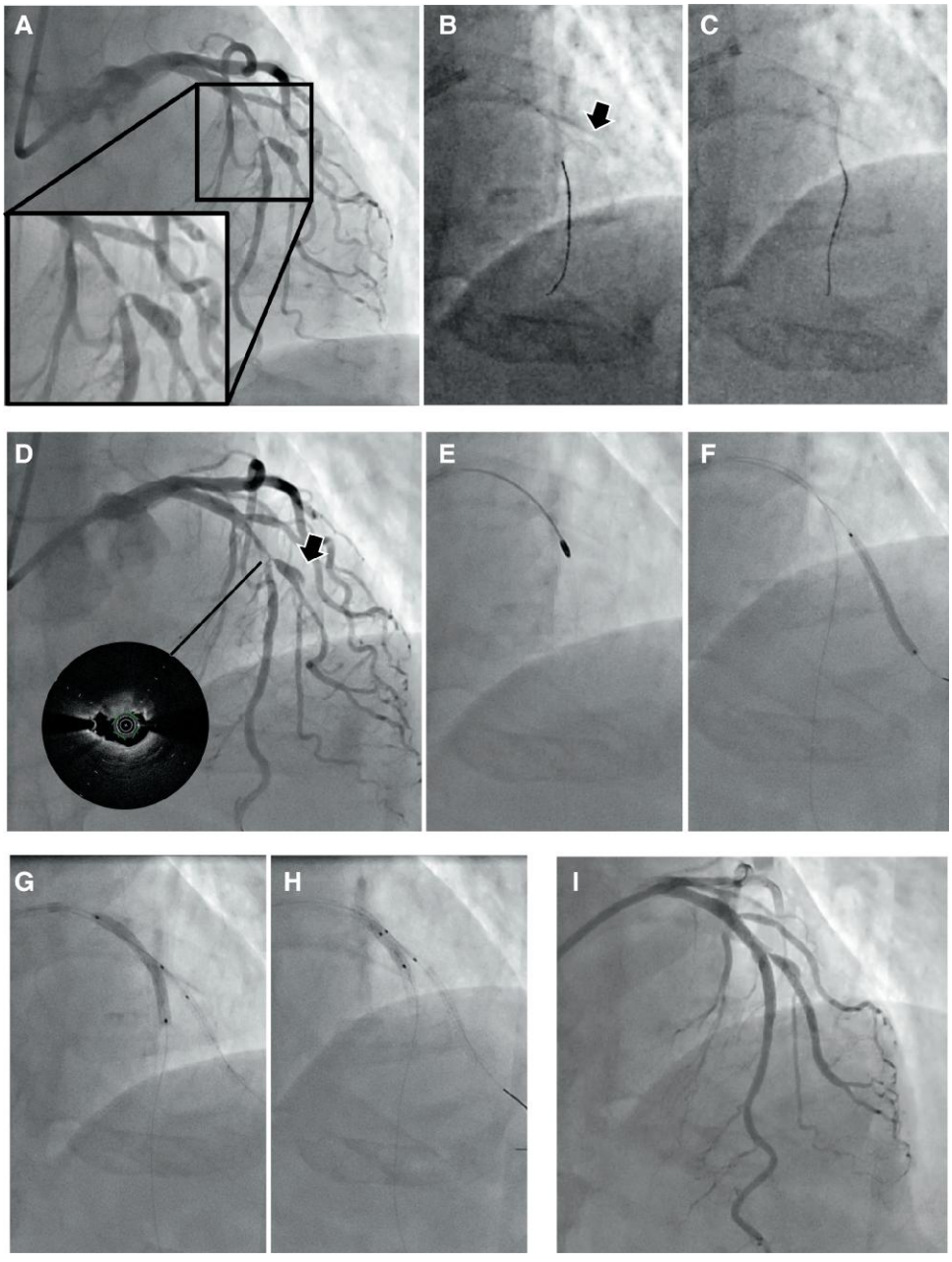


Figure 1 Case 1. *A*) Angiogram showing severe narrowing of the left anterior descending artery bifurcation. An aneurysm was observed in the diagonal artery, which was branched from the left anterior descending at an extreme angle. Significant narrowing just proximal to the diagonal artery was observed. *B, C*) The wire was U-turned in the aneurysm (arrow) and advanced into the LAD artery. *D*) Angiogram showing a dissection in the diagonal branch (arrow) and an OFDI image showing calcification at the bifurcation. *E*) Rotational atherectomy of the left anterior descending artery. *F*) A drug-eluting stent was deployed in the diagonal branch. *G*) Another drug-eluting stent was implanted into the left anterior descending artery using a modified jailed balloon technique. *H*) Kissing balloon inflation. *I*) Final angiogram indicating favourable expansion of the target lesion without occlusion of the diagonal artery. LAD, left anterior descending artery; OFDI, optical frequency domain imaging.

Case 2

An 82-year-old woman with hypertension and dyslipidaemia was referred to our hospital with a 6-month gradual worsening of chest discomfort. On auscultation, a grade 3/6 ejection systolic murmur was identified at the apex of the heart, and mild oedema of the legs was observed. A chest radiograph showed a cardiothoracic ratio of 0.61, with no evidence of pulmonary oedema or pleural effusions. An electrocardiogram showed sinus rhythm without any specific changes. A transthoracic echocardiogram demonstrated an ejection fraction of 52% and moderate mitral regurgitation. A coronary angiogram showed a tight bifurcation lesion in the middle of the LAD artery, leading to the diagnosis of ischaemic heart disease with moderate valvular disease. Consequently, elective PCI was performed on the lesion.

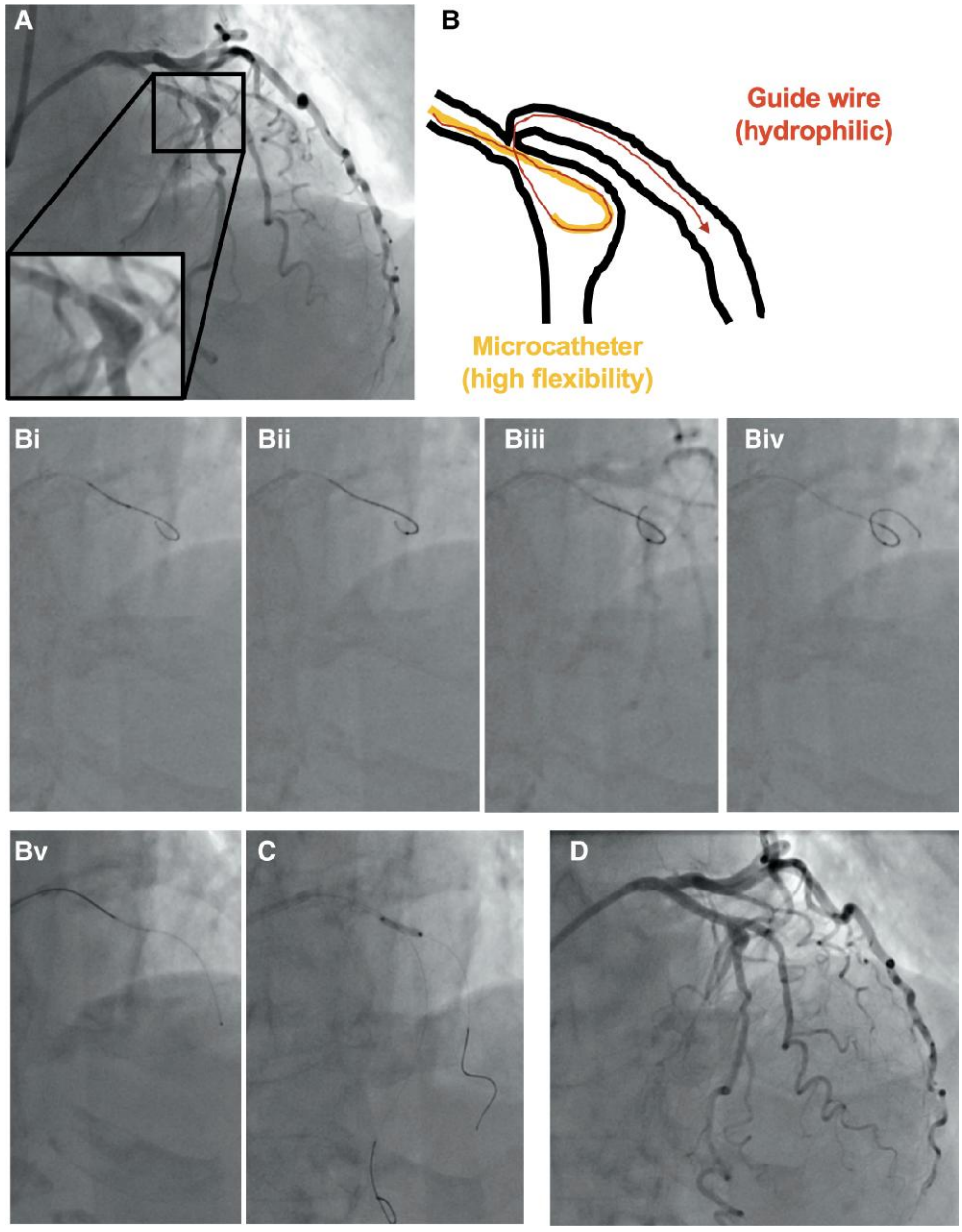


Figure 2 Case 2. *A*) Angiogram indicating a stenosis and aneurysm of the middle left anterior descending artery, where the narrowed diagonal branch bifurcates with extreme angulation. *B*(i–v) Illustration and procedural steps of the U-turn wiring technique with a microcatheter utilizing the aneurysmal anatomy. (i) A SION Black Pre-shape guidewire was looped into the aneurysm. (ii) A Zizai microcatheter was inserted into the aneurysm. (iii, iv) The SION Black Pre-shape guidewire was advanced towards the diagonal branch while preventing wire-induced injury to the aneurysm. (v) The Zizai microcatheter passed the diagonal branch, and its loop was straightened. *C*) A drug-eluting stent was deployed in the LAD to the diagonal branch and post-dilatation. *D*) Final angiogram showing successful recanalization.

A guiding catheter (6 Fr Taiga EBU 3.25) was inserted into the left coronary artery via the right radial artery. The diagonal branch was at a reverse angle from the LAD (*Figure 2A*). First, a SION Black Pre-shape guidewire, with the assistance of a Zizai microcatheter (Terumo Medical Corporation, Japan), was inserted into the ectasia across the bifurcation site. The guidewire was carefully U-turned into the ectasia, and the Zizai microcatheter was advanced gradually to prevent vessel wall injury due to the wire-pushing force. The guidewire crossed the bifurcation and was finally able to advance to the distal diagonal branch (*Figure 2Bi–v*). A run-through floppy wire (Terumo Medical Corporation) was inserted towards the distal LAD, and the LAD main vessel and diagonal branch were sequentially dilated using a Zinrai 2.0 × 10 mm balloon. We implanted a XIENCE Skypoint 2.5 × 28 mm (Abbott Vascular, IL, USA) from the LAD toward the diagonal branch. The strut of the stent at the distal LAD was dilated using a Zinrai 2.0 mm balloon, and the stent was dilated using an NC Kamui 3.0 × 12 mm (*Figure 2C*). The final angiogram showed excellent results without vascular complications (*Figure 2D*). The patient's chest

discomfort had improved following PCI. However, due to the progression of degenerative mitral regurgitation, the patient underwent transcatheter mitral valve repair 6 months later.

Discussion

Here, we report a novel wiring technique, the UWT, for an angled SB. Two cases of true bifurcation lesions with an extremely angled SB immediately adjacent to the ectasia were successfully treated using UWT. This technique facilitates wire crossing to a reverse-angled branch utilizing the coronary ectasia anatomy through a simple manipulation.

Reverse-wiring technique is now commonly performed as a dual-lumen catheter–facilitated RWT for enhanced support.[4] However, anatomical features such as distal ectasia may be an obstacle, and hairpin bending of the guidewire can frequently be an issue when advancing in a reverse-angled branch. Moreover, passing a microcatheter over the wire, even after successful wiring, is often challenging.

The UWT takes advantage of the ectasia as a space to U-turn the guidewire. The UWT does not require a hairpin-bend guidewire or a dual-lumen catheter as it uses a hydrophilic polymer-coated guidewire and flexible microcatheter in combination. The guidewire can be easily pushed forward through a reversed side branch instead of pulling up a hairpin-bend guidewire. Polymer jacket low gram tip wires, such as a Sion Black Pre-shape, are recommended as they can help avoid subintimal advancement of the wire. After successful wire insertion, the guidewire can be easily advanced deep into the side branch as the wire has not undergone hairpin bending, unlike the wire in the RWT.

In the first case, the bare wire unintentionally took a U-turn in the ectasia of the diagonal branch and crossed towards the LAD artery, but a coronary dissection occurred due to the continuous wire-pushing force. A risk of dissection or perforation exists in patients with ectasia owing to the presence of an extremely friable vessel wall and thinned-out media. Therefore, in the second case, we used a microcatheter with distal flexibility to prevent guidewire-induced vessel injury at the ectasia site and safely advanced the wire to the distal portion of the SB; however, the risk of dissection or perforation may still persist.

The UWT is effective in guidewire crossing into a reverse-angled branch, and using a microcatheter as a protective sheath in the ectasia enabled this technique to be safer and more effective. It is anticipated that this novel SB wiring technique will contribute to more successful wiring of an extremely angled SB adjacent to ectasia.

Conclusion

This novel SB wiring technique, namely, the UWT in combination with a flexible microcatheter, might be useful for guidewire crossing into a reverse-angled bifurcated side branch adjacent to a coronary ectasia, although the potential for complications should be considered.

Lead author biography

Masashi Yamaguchi has been working at Shonan Kamakura General Hospital since April 2020. He graduated from Miyazaki University in 2009. His areas of interest include coronary intervention and structural heart interventions. Memberships: Japanese Circulation Society, Japanese Association of Cardiovascular Intervention and Therapeutics, and Japanese Transcatheter Valve Therapy.

Consent: The authors confirm that witnessed verbal consent for submission and publication of this case series including images and associated text has been obtained from the patients in line with the COPE guidelines.

Conflict of interest: None declared.

Funding: None declared.

Data availability

Derived data supporting the findings of this study are available from the corresponding author upon reasonable request.

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