Journal of Cardiac Interventions
Volume 2, Issue 1, 62-65 Pages

Case Report

Bailout Angiography-Guided Three-Dimensional Wiring for Intraprocedural Coronary Artery Occlusion: A Case Report

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Received: 05 June 2023; **Revised:** 13 August 2023 **Accepted:** 21 August 2023; **Published:** 28 August 2023

ABSTRACT

We present a case of bailout for an intraprocedural coronary artery occlusion using three-dimensional (3D) wiring, a technique that has been generally used for a chronic total occlusion (CTO).

The target vessel initially had antegrade flow; however, it was completely occluded after a guidewire entered a dissection plane. Although the distal true lumen was visualized by collateral flow from the left circumflex artery, these collaterals did not appear interventional for the retrograde approach. We manipulated the Conquest Pro 12 guidewire according to 3D wiring theory on two orthogonal projections; the guidewire was then crossed into the distal true lumen without expanding the dissection plane. After the wire course was confirmed by intravascular ultrasonography, the target vessel was successfully stented with an excellent final angiographic result.

When an iatrogenic coronary dissection caused by a guidewire occurs during percutaneous coronary intervention, a careless wiring might cause inadvertent expansion of a false lumen.

Keywords: Complications . Percutaneous coronary angioplasty . Coronary artery disease . Angina pectoris . Coronary vessel.

Introduction

Complex high-risk indicated percutaneous coronary intervention, which contains the potential hazard of serious procedural complications, has recently attracted much attention, and more and more such patient subsets as elderly people are being treated [1-3].

Intraprocedural coronary artery occlusion, which typically occurs when a guidewire iatrogenically injures a severely stenotic lesion and enters the dissection plane, may lead to a periprocedural myocardial infarction or, in the worst case, emergent coronary artery bypass grafting.

Three-dimensional (3D) wiring is currently known as an accurate guidewire control method for manipulating guidewires to treat chronic total occlusions (CTOs) [4,5].

Case Presentation

An 86-year-old man with drug-refractory stable angina underwent diagnostic coronary angiography, which revealed a nearly occluded lesion with antegrade flow in the large first diagonal branch (Figure 1A–F). Percutaneous coronary intervention (PCI) was performed with a 6-Fr IL3.5 guide; however, a SION blue guidewire (ASAHI Intec, Nagoya, Japan) did not pass due to resistance, and a complex channel with an invisible part was revealed by contrast injection from a microcatheter (Figure 2A, B). The lesion was completely occluded after the Gladius guidewire (ASAHI Intec, Nagoya, Japan) entered a false lumen (Figure 3). Although the distal true lumen was visualized by slight epicardial collateral flows from the left circumflex artery, these collaterals did not appear promising for the

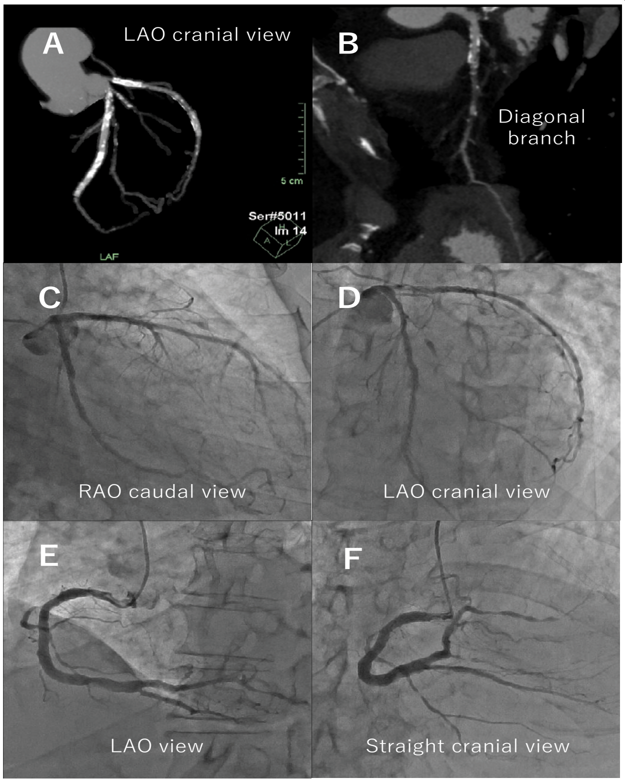

Figure 1: Computed tomography images of the left coronary artery (A) and the large first diagonal branch that is the target of the percutaneous coronary intervention (B). Angiographic image of the left (C, D) and right coronary arteries (E, F) at baseline.

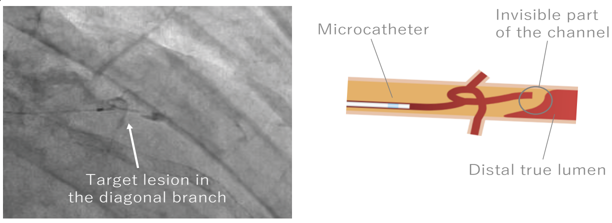

Figure 2: An angiographic image and illustration of a complicated channel in the diagonal branch.

A complicated channel in the diagonal branch lesion was revealed by contrast media injection from a microcatheter.

retrograde approach. Therefore, we performed bailout angiography-guided 3D wiring.

We advanced the Conquest Pro 12 guidewire (ASAHI Intec, Nagoya, Japan) with its tip direction toward the distal true lumen (i.e., directed downward and to the left side) on the right anterior oblique 45° cranial 10° (R-CRA) projection (Figure 4). On the left anterior oblique 45° cranial 10° (L-CRA) projection, the guidewire tip direction appeared to be the left side (Figure 5) and at the same time, should be dorsal (i.e., backward) according to the 3D wiring theory (Figure 6). The position of the true lumen on the L-CRA projection appeared to be the

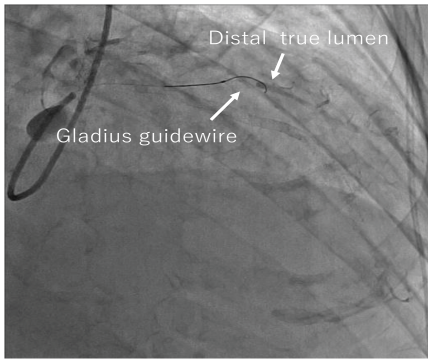

Figure 3: An angiographic image after the lesion was completely occluded.

The Gladius guidewire entering a false lumen and occluding the vessel. The distal true lumen is visualized by collateral flows from the left circumflex artery.

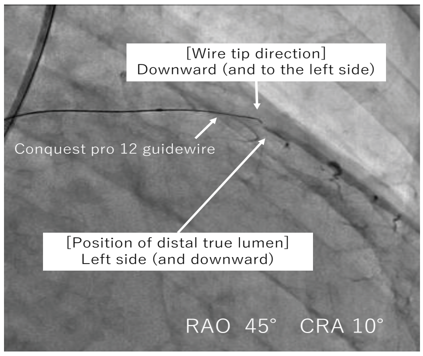

Figure 4: An angiographic image on the right anterior oblique 45° cranial 10° projection before three-dimensional wiring.

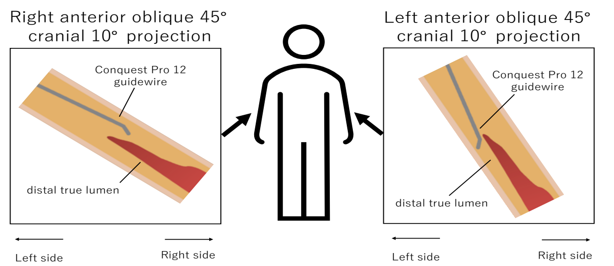

Figure 5: Diagrams illustrating the three-dimensional positional relationship.

The three-dimensional positional relationship of the distal true lumen and the guidewire tip direction on the angiographic image of both right anterior oblique 45° cranial 10° and left anterior oblique 45° cranial 10° projections are shown.

right side, and simultaneously, should be dorsal side (i.e., behind) considering its 3D position (Figure 6). Therefore, we rotated the guidewire “90° clockwise” on the L-CRA projection (if the guidewire had been mistakenly rotated “90° counterclockwise”, the guidewire tip would have been directed to

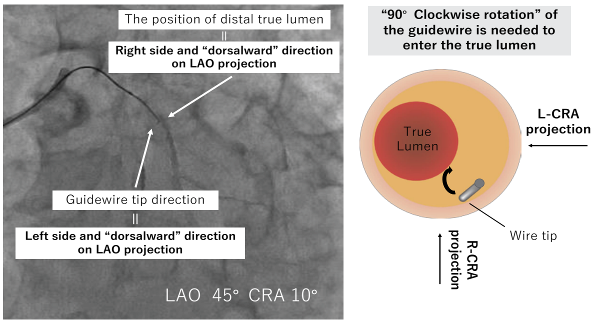

Figure 6: Illustration of three-dimensional wiring.

On the left anterior oblique 45° cranial 10° (L-CRA) projection, the position of the distal true lumen is on the right and "dorsal" side from the Conquest Pro 12 guidewire considering the three-dimensional positional relationship. In addition, the guidewire tip direction is on the left, and the "dorsal" side is on the L-CRA projection. Therefore, a 90° Clockwise rotation of the guidewire is needed to enter the true lumen.

the ventral, that is, the opposite side of the true lumen). The guidewire, whose tip was directed to the true lumen (right and dorsal 3D direction on the L-CRA projection), was advanced and passed through the distal true lumen. The intravascular ultrasonographic (IVUS) image showed that most of the wire course was intraplaque, with an extraplaque track length of a few millimetres, which indicated that once the former guidewire entered the dissection plane, the Conquest Pro 12 guidewire returned to the intraplaque (Figure 7). The target vessel was successfully stented with an excellent final angiographic result (Figure 8).

Discussion

The angiography-guided 3D wiring technique is a useful bailout method for an intraprocedural coronary artery occlusion case, in which collateral channels appear less promising for the retrograde approach. According to IVUS findings, the length of the extraplaque wire course was limited after the bailout 3D wiring in the present case.

During the bailout of intraprocedural coronary artery occlusion, distal extension of the dissection plane should be avoided, although it easily occurs and lowers the success rate of percutaneous bailouts. The parallel-wire technique could be a good alternative in this case [6]. IVUS-guided wiring could also be another option [7]; however, the extraplaque placement of an IVUS catheter might further extend the dissection plane. If the dissection plane had extremely expanded, we would have switched to the subintimal tracking and re-entry (STAR) technique in the present case [8]; although the re-entry point in this technique is beyond control and likely to extend the dissection plane far distally [9].

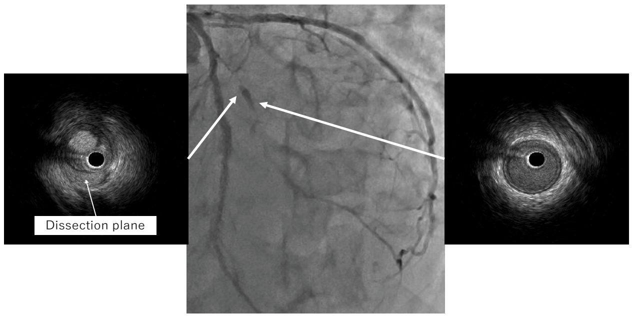

Figure 7: Pre-stenting intravascular ultrasonographic images, with their positions indicated on a pre-intervention angiographic image.

Almost all wire course was intraplaque. The existence of the dissection plane indicates that once a former guidewire enters the dissection plane, the Conquest Pro 12 guidewire returned to the intraplaque.

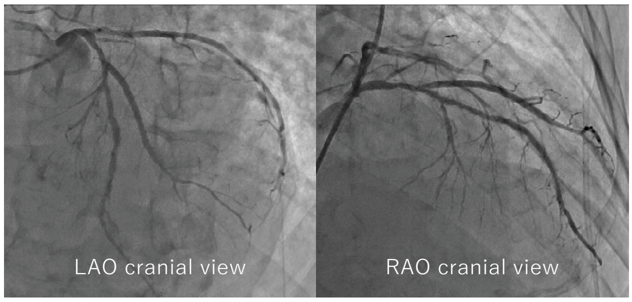

Figure 8: Final angiographic results.

The 3D wiring method helps determine the positional relationship between the guidewire tip direction and the distal true lumen as well as the required rotation angle (e.g., 90°) and rotation direction (e.g., clockwise) for wire manipulation. Okamura et al. reported that their antegrade success rate of CTO PCI was significantly higher in the 3D wiring group than the in non-3D wiring group (100% vs. 89.2%, p = 0.033) and that guidewire perforation tended to be lower in the 3D wiring group than in the non-3D wiring group (1% vs. 11%, p = 0.055) [5].

Guidewire manipulation is performed on a 2D (height and width) screen; therefore, only the position of "up and down direction" (height) and "left and right direction" (width) on the screen can be determined. In fact, guidewire manipulation in ordinary PCIs may be performed without awareness of the "dorsal and ventral direction" (depth) of the guidewire tip. What would have occurred if the guidewire in the present case was manipulated without knowledge of the 3D position? We might have mistakenly repeated our guidewire manipulations with its tip to the "ventral direction". Generally, such a relatively thoughtless manipulation with a hard guidewire easily causes dissection plane expansion or coronary perforation. Wiring without the knowledge of the alignment of the "dorsal and ventral direction" (i.e., 2D wiring) may lead to repetitive vain attempts of the rotation and advancement of a CTO guidewire.

In contrast, 3D wiring enables logical and accurate guidewire manipulation, thereby minimizing risks. We can manipulate a guidewire while checking the 3D position (height, width, and "depth") between the guidewire tip direction and the distal true lumen, aligning their position of the "dorsal-ventral direction" on two orthogonal projections.

The present case has two things to note. First, the two orthogonal projections used in the present case were not optimal because the diagonal branch was foreshortened on the L-CRA projection (i.e., a deeper cranial projection was better). Second, an angiography-guided 3D wiring method should be performed before a dissection plane substantially expands because this method is less effective if used in an expanded dissection plane.

In summary, angiography-guided 3D wiring was useful for the bailout of an accidentally occluded coronary artery during PCI in the present case. When an iatrogenic coronary dissection occurs during PCI, careless wiring might inadvertently expand the false lumen. We suggest that non-CTO operators also should learn angiography-guided 3-dimensional wiring as a bailout method, although this wiring technique is basically a CTO-derived one.

Conflicts of Interest

T.F. is a technical consultant for Terumo Corporation. The remaining authors have no conflicts of interest to declare.

Sources of Funding:

None

Informed consent:

The authors confirm that written consent for the submission and publication of this case report including images and associated text has been obtained from the patient..

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