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Difficult Wiring of a Recanalized Thrombotic Lesion in the Right Coronary Artery Analyzed with Optical Coherence Tomography

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Conflict of interest: None declared

Patient: Male, 87
Final Diagnosis: Recanalized thrombotic lesion
Symptoms: Chest pain
Medication: —
Clinical Procedure: Good
Specialty: Cardiology

Objective: Rare disease

Background: Recanalized thrombi are usually unrecognized in conventional coronary angiography. However, multiple channels have been observed in recanalized thrombotic lesions. Therefore, the wire apparently crosses the lesion in some difficult cases. We analyzed the cause of difficult wiring of a recanalized thrombotic lesion using optical coherence tomography (OCT).

Case Report: An 87-year-old man with chest pain was admitted to our hospital. Coronary angiography showed significant stenosis of the proximal right coronary artery with irregular linear filling and haziness. Crossing of the wire for the lesion was very difficult but was achieved using a parallel wire technique. OCT clearly demonstrated multiple small channels which had ambiguous findings on angiography and intravascular ultrasound. These structures showed a honeycomb-like appearance suggests the recanalized thrombi. A drug-eluting stent was subsequently deployed to fully cover the entire lesion.

Conclusions: OCT is useful to evaluate the accurate tissue characteristics of a recanalized thrombotic lesion. Because recanalized thrombi have multiple small channels and since there are some cases in which a part of the channel only flows into a side branch, it is necessary to carefully monitor wiring at the time of percutaneous coronary intervention.

MeSH Keywords: Coronary Artery Disease • Percutaneous Coronary Intervention • Tomography, Optical Coherence

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Background

There were some reports of recanalized thrombi confirmed by pathology [1,2]. Recanalized thrombi are infrequent and usually unrecognized in conventional coronary angiography. Angiographic features of an irregular intra-luminal contrast defects do not always indicate plaque ulcer, dissection, or calcified lesion. Thus, intravascular imaging devices such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT) are extremely beneficial for understand the lesion characteristics. In particular, since OCT had 10-fold higher resolution than that of IVUS, OCT proved useful for understand pathological conditions [3]. Here, we report our experience with recanalized lesions that we evaluated using OCT, which is why we had difficulty passing the wire through the lesion.

Case Report

An 87-year-old man with chest pain was admitted to our hospital. An electrocardiogram revealed horizontal ST-T depression in leads II, III, and aVF. Chest X-ray showed no abnormal findings. A slight rise in high-sensitivity troponin T was noted, but there were no other abnormal findings. His coronary risk factors were hypertension, dyslipidemia, and current smoking. He had no other noteworthy past medical history. Transthoracic ultrasonography showed reduced left inferior ventricular wall motion (left-ventricular ejection fraction: 48%), suspicious for ischemic heart disease. Because of worsening angina symptoms in the 4 weeks prior to admission, we diagnosed with unstable angina pectoris and scheduled for cardiac catheterization. As shown in Figure 1 and Video 1A, angiography showed a significant stenotic lesion in the proximal right coronary artery (RCA) with irregular linear filling and haziness. Because left coronary angiography revealed no lesions, we decided to attempt revascularization of the RCA by percutaneous coronary intervention (PCI).

Video 1. (**A**) Right coronary angiography showed stenotic lesion in the proximal site with irregular linear filling and haziness. (**B**) The wire could only be guided in the direction of the right ventricular branch despite successful crossing of the stenotic lesion. (**C**) The wire was able to cross into the main artery used by parallel wire technique. (**D**) Optical coherence tomography clearly demonstrated multiple small channels separated by thin high-intensity septa. (**E**) Final angiography after stenting.

The approach site was the right radial artery. A guiding catheter (AL1, 6-Fr, 100-cm; Hyperion, Asahi Intecc) was used. Initial wiring with a Sion (Asahi Intecc) was started with support of a micro-catheter (Caravel, Asahi Intecc). We managed to insert the wire and gradually advanced it through the stenotic lesion. However, since there was slight resistance to wiring, we had difficulty proceeding. The wire could only be guided in the direction of the right ventricular (RV) branch despite successful

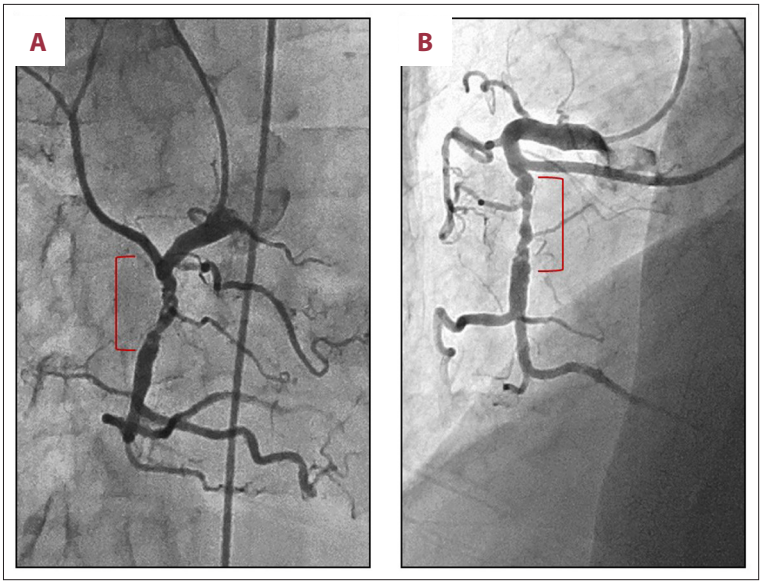

Figure 1. Right coronary angiography showed a stenotic lesion in the proximal site, with irregular linear filling and haziness. (**A**) Anterior posterior cranial view. (**B**) Left anterior oblique view.

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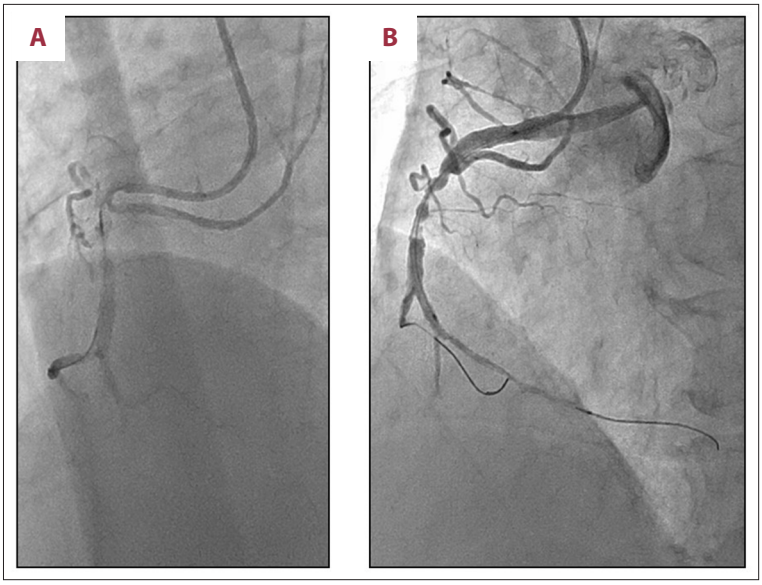

Figure 2. (**A**) The wire could only be guided in the direction of the right ventricular branch despite successful crossing of the stenotic lesion. There was a possibility of aberrant invasion into the subintima, based on both "feel" during wiring and on angiographic findings. (**B**) The wire was able to cross into the main artery using the parallel wire technique.

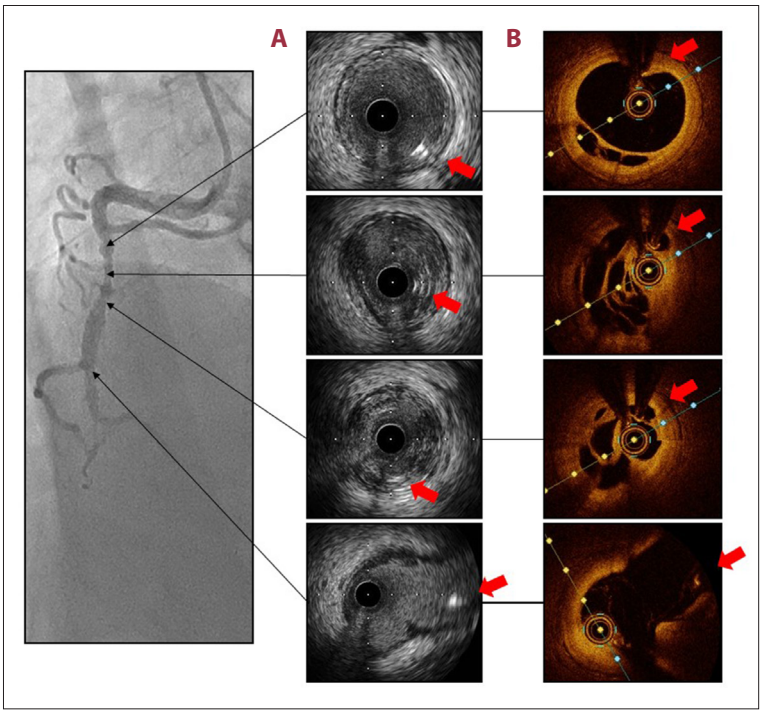

Figure 3. (**A**) Intravascular ultrasound findings. (**B**) Optical coherence tomography findings. The first wire is indicated by the red arrow.

crossing of the stenotic lesion (Figure 2A, Video 1B). As there was a possibility of aberrant invasion into the subintima based on both "feel" during wiring and angiographic finding, a parallel wire technique (PWT) was performed using a double-lumen catheter (Sasuke, Asahi Intecc) and a second wire of a Gaia First (Asahi Intecc). The wire was then able to cross into the main artery (Figure 2B, Video 1C).

To determine why the first wire could not be guided toward the main trunk, we checked both first and second wire routes using IVUS (OptiCross, Boston Scientific, USA). Multiple small channels with blood flow were observed by IVUS (Figure 3A). Since the first wire seemed to be fixed at the edge of the inner membrane on the IVUS image, we thought that the wire went through the space to reach the RV branch after aberrantly crossing into the plaque and partly into the subintimal space. However, since the evaluation of the lesion was insufficient using IVUS, we used OCT, which is capable of higher resolution (dots per inch). OCT clearly demonstrated multiple small channels separated by thin high-intensity septa (Figure 3B, Video 1D). The channels communicated with each other on OCT findings. This honeycomb-like pattern suggests

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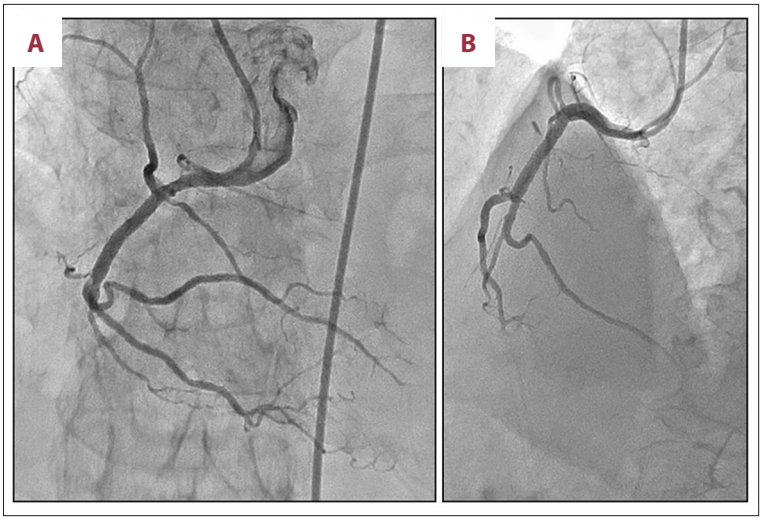

Figure 4. Final angiography. (**A**) Anterior posterior cranial view. (**B**) Left anterior oblique view.

the recanalized thrombi. OCT was able to clearly visualize lesion morphology compared with IVUS. It was determined that the first wire could not be guided toward the main trunk because it entered into an extremely small cavity, then only communicated with the RV branch among multiple channels.

In order to expand the lesion by breaking separate walls, predilation was subsequently performed with a 2.5-mm scoring balloon (ScoreFlex, OrbusNeich Medical). Since OCT re-evaluation showed that separate walls were crushed and that the communication between the main trunk and RV branch was observed, a drug-eluting stent was deployed to fully cover the entire lesion. We succeeded in revascularizing the stenotic lesion without losing the RV branch (Figure 4, Video 1E). The postoperative course was good, and the patient had symptomatic improvement after PCI.

Discussion

Because recanalized thrombi are usually unrecognized in conventional coronary angiography, many undiagnosed cases have been treated in real clinical practice without knowledge of the thrombus [4,5]. Coronary angiography sometime demonstrates irregular border and intraluminal lucency in lesions. However, because of poor resolution, it was impossible to determine whether these angiographic findings represented recanalized lesions, atherosclerotic plaque ulcer, dissection, or calcified lesion [6,7]. IVUS is one method to evaluate plaque composition and vessel size. Because the major limitation of IVUS is its insufficient spatial resolution, it is difficult to characterize tissue in detail. Since the resolution of OCT is 10-fold higher than that of IVUS, OCT proved useful for understanding detailed pathological conditions [3]. Determination of the pathological condition was insufficient based on information from IVUS in this case. However, OCT clarified the etiology of the angiographic ambiguity and clearly visualized the recanalized thrombus. OCT might be the key to determining the pathology of the coronary artery lesion and is one of the modalities needed for an optimal therapeutic approach.

When we performed PCI, the information of IVUS, OCT, computed tomography, and magnetic resonance imaging (MRI) played an added important role beyond coronary angiography. Each modality provided detailed information on the coronary artery lesion. As in our case, OCT findings of recanalized thrombi showed a “spider web” or “honeycomb” pattern [6–8]. Since the irregularity of the recanalized thrombotic lesion on coronary angiography was mild but contained multiple lumens, the guidewire could easily have aberrantly crossed into a small channel, making the guidewire difficult to pass through the lesion. Therefore, in order to cross the lesion, it may be necessary in some cases to use a micro-catheter and stiff wire, which can penetrate thorough separate walls. In our case, we succeeded in wiring toward the main trunk after selecting a different route for the first wire by using a double-lumen catheter and a wire of higher penetration force and high torque response as the second wire. Observation by OCT after passing the wire showed that the second wire passed through a different cavity, even though there was a possibility that it might have partly reached the main trunk after passing through separate walls because of the use of a wire with high penetration force. When selecting a cavity that is different from the initial cavity, the double-lumen catheter seemed to be very useful. Because there has been no report of PCI targeting recanalized thrombotic lesions using this technique, we reported the outcome in this article.

A “honeycomb” appearance can occur after recanalization of a thromboembolism, but the mechanism has not been clarified. In future, understanding of tissue characteristics through use of OCT might clarify pathological conditions.

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Conclusions

OCT clearly demonstrated the microstructure of a recanalized thrombus. Wiring of a recanalized thrombotic lesion can be difficult, but PWT using a double-lumen catheter was very useful.

Conflict of interest

There is no conflict of interest to declare.

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