Spontaneously Recanalized Thrombus Revealed by Intravascular Imaging – A Case Series

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Introduction

There are few case reports about intervention regarding spontaneous recanalization of coronary thrombus (SRCT) lesions due to their rare occurrence and difficulty in diagnosis by angiography alone. We present three SRCT cases that relied on intravascular imaging for diagnosis and intervention guidance.

Spontaneously recanalized coronary thrombus (SRCT) is a coronary lesion that was first discovered by Dr. Terashima in 2002 using intracoronary ultrasound (IVUS). He called it "arteries within the artery". Intracoronary imaging reveals a detailed, complex structural appearance with multiple intraluminal channels connecting to each other. There are no treatment guidelines regarding coronary intervention. In this report, we present three cases that underwent percutaneous coronary or peripheral intervention assisted by optical coherence tomography (OCT) and IVUS to achieve optimal results.

Case 1

This case is a 56-year-old female patient with a history of hyperthyroidism who underwent thyroidectomy and thyroxine treatment. She presented with chest tightness and shortness of breath upon effort, after COVID-19 vaccination. Cardiovascular risk factors included dyslipidemia and smoking. Electrocardiography showed sinus rhythm with low voltage and precordial Q wave. Transthoracic echocardiography disclosed moderate left ventricle (LV) systolic dysfunction with left ventricular ejection fraction (LVEF) of 38% and LV apex aneurysm formation. Stress myocardial perfusion scan revealed fixed apex perfusion defect.

Percutaneous Coronary Intervention: Diagnostic coronary angiography revealed a stenotic lesion with braided appearance at the proximal to mid-segment of the left anterior descending artery (LAD), including bifurcation involving the ostial portion of the diagonal branch. The right coronary artery (RCA) and left circumflex artery (LCX) were both patent. First, side branch protection of the diagonal branch with another guide wire was undertaken, with a dual lumen microcatheter to attempt to deploy guide wires to the same channel. Subsequent OCT evaluation of the LAD revealed multiple channels with the two guidewires in different channels, separated by fibrous septa. A 2.5 x 10 mm cutting balloon, slightly smaller than the LAD lumen diameter but large enough to disrupt the septa, was used for lesion preparation. OCT evaluation after cutting balloon angioplasty revealed disruption of the plaque and the septa between the guide wires. A two-stent strategy with a 3.0 x 20 mm drug-

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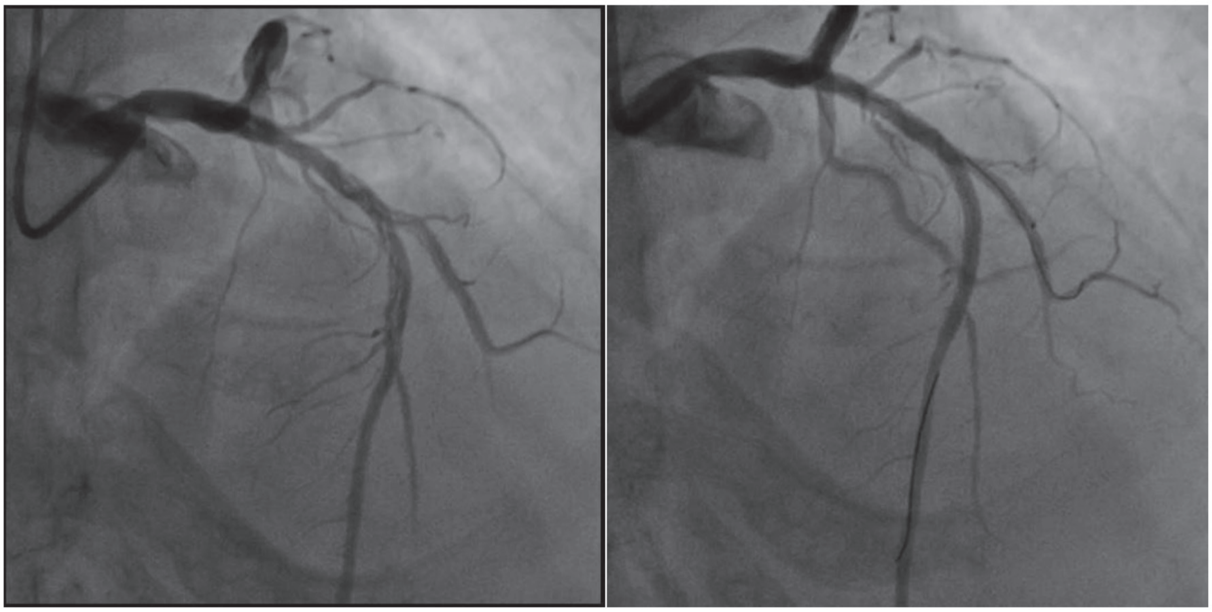
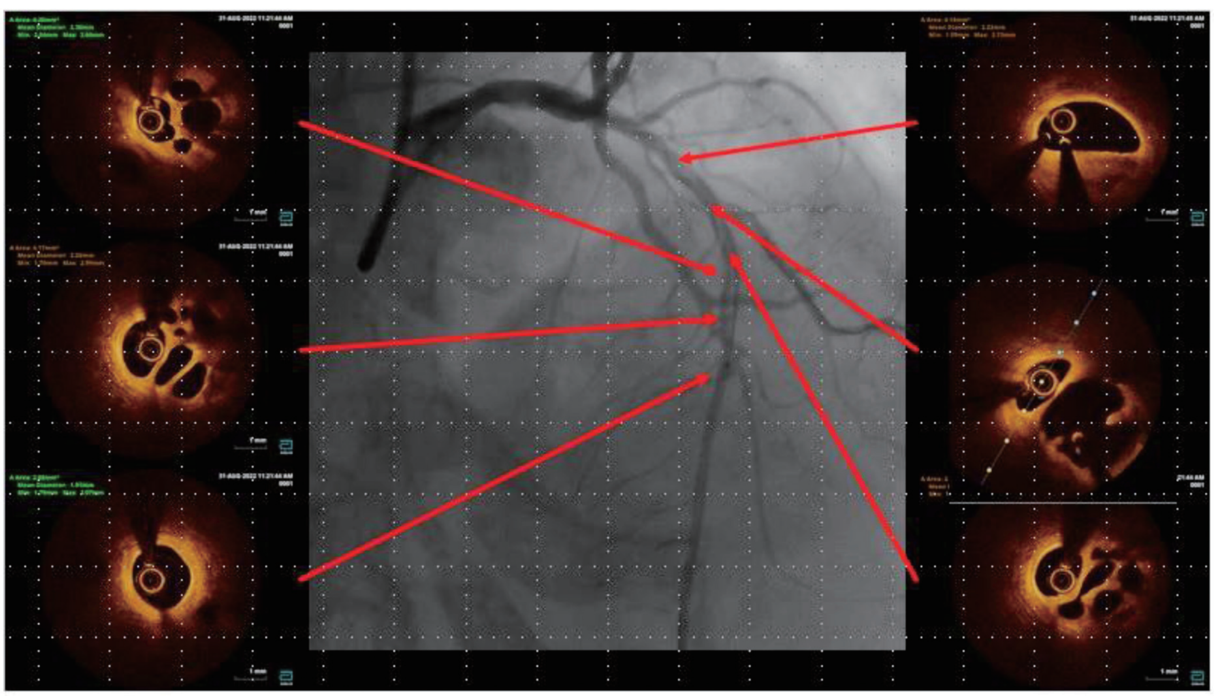
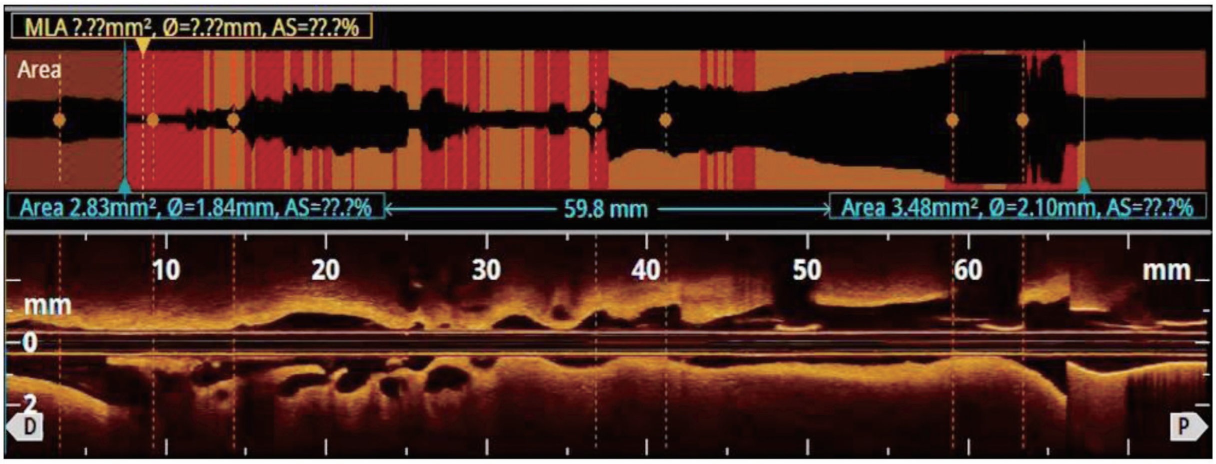
eluting stent (DES) at the LAD and a 2.5 x16 mm DES at the diagonal branch was executed using the mini-crush technique. Post-stenting OCT evaluation disclosed under-expansion at the proximal part of the LAD stent. Stent optimization was performed with a 3.25 x 12 mm noncompliant balloon. Contrast injection showed TIMI flow grade 3.

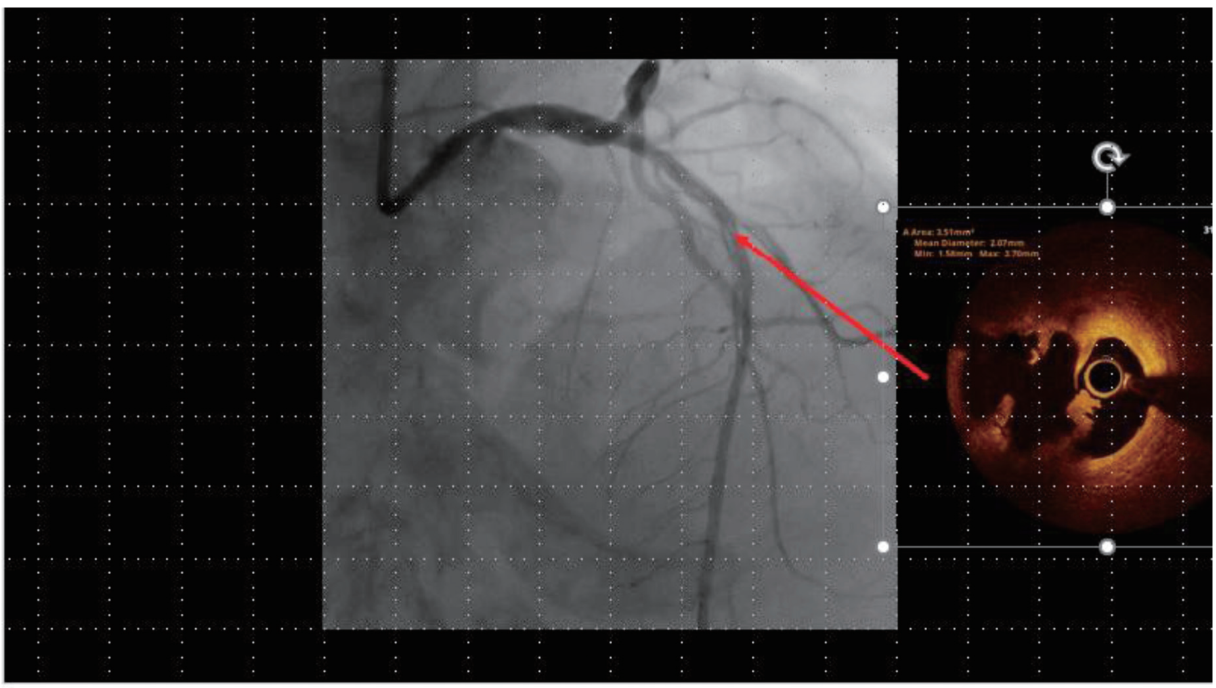


Before and after coronary intervention under OCT guidance

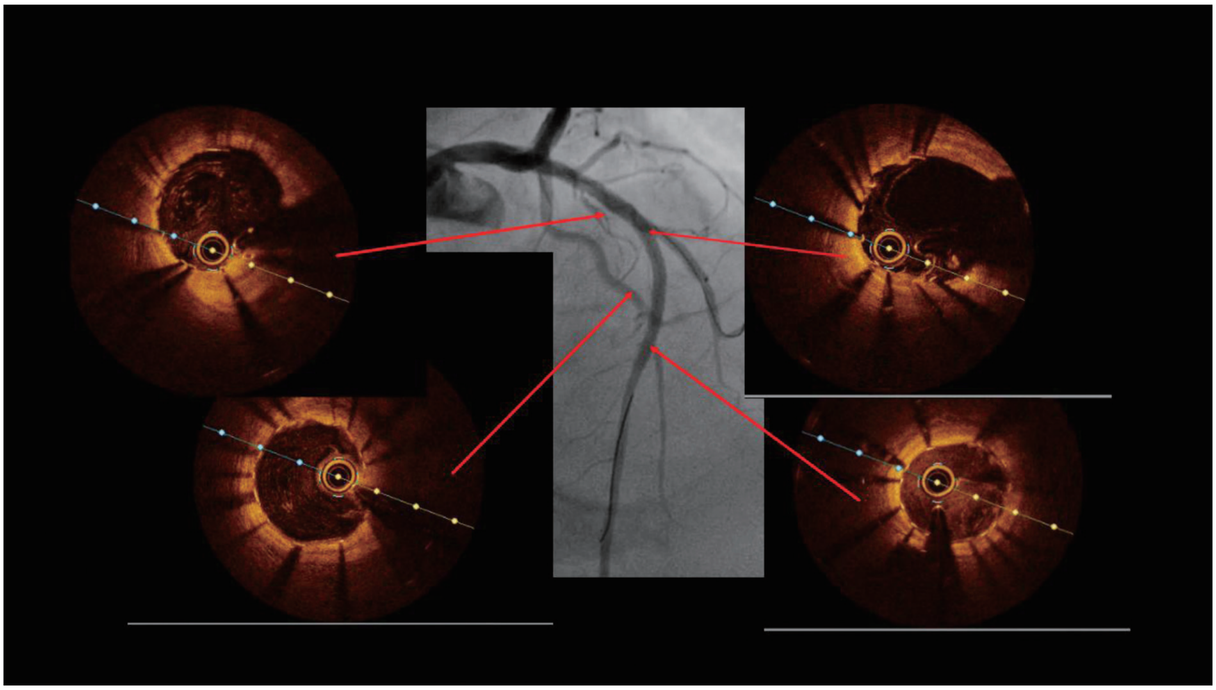


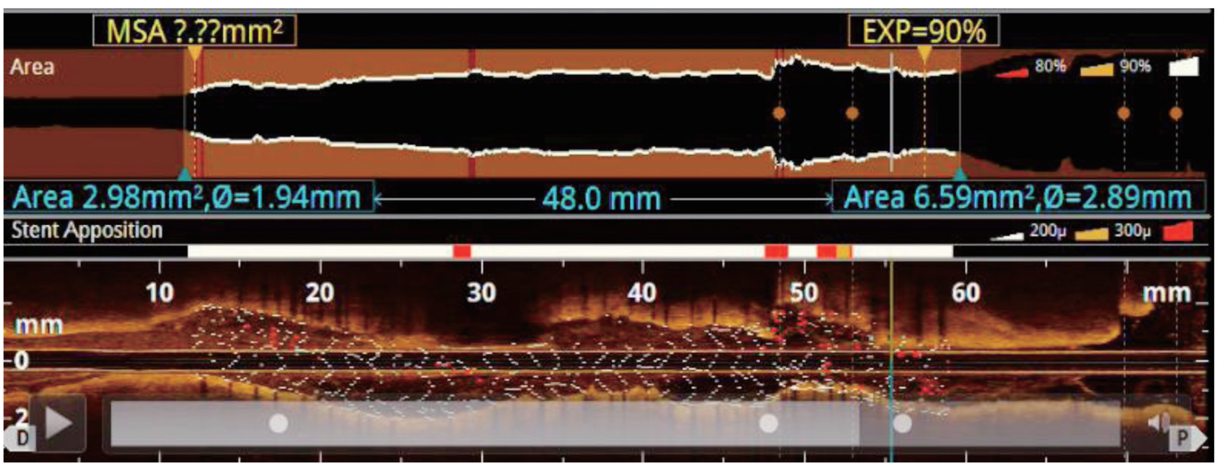


OCT showed multiple channels and guidewires in the LAD and diagonal branches in different channels.



OCT showed septum disruption after cutting balloon angioplasty.





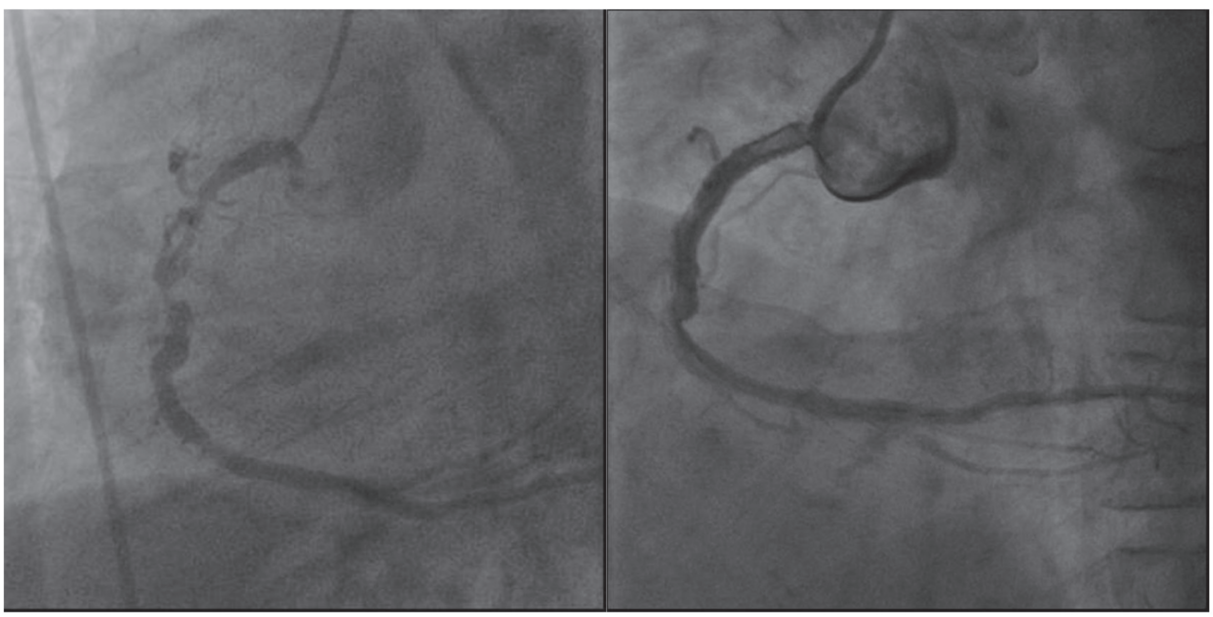
OCT showed good stent apposition and expansion.

Follow-up and outcomes: The patient was symptom-free and hemodynamically stable after the procedure, and was discharged after a one-week hospital course.

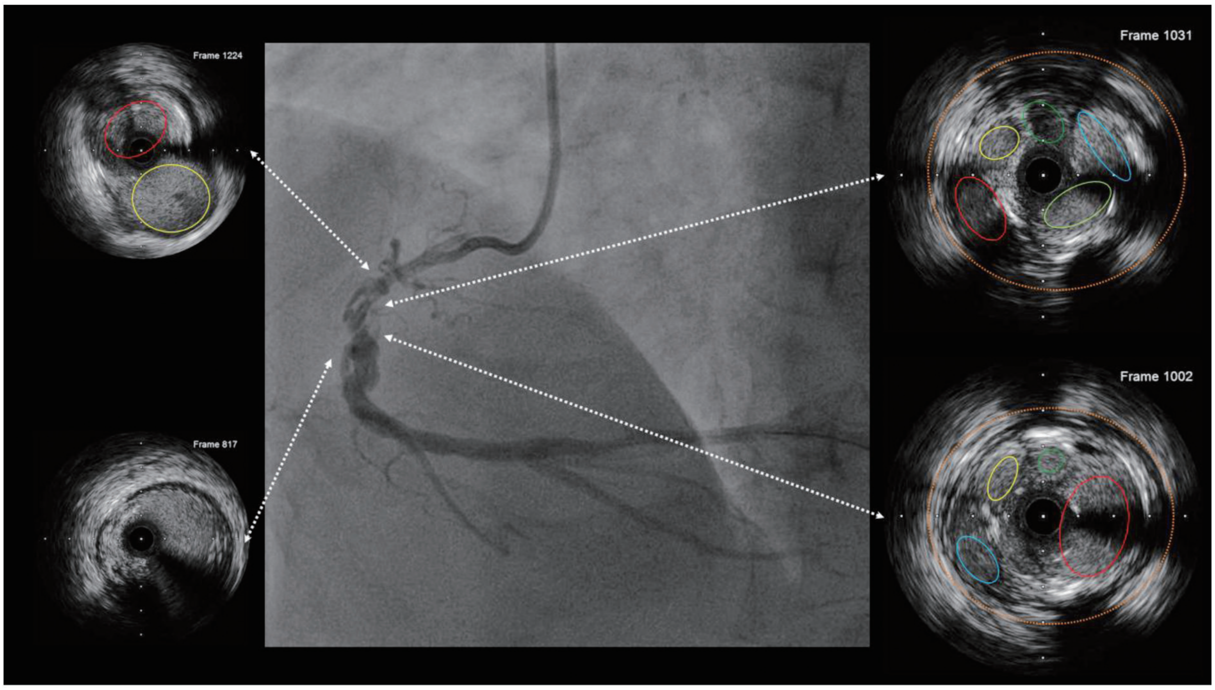
Case 2

This case is a 65-year-old female patient with a history of two-vessel coronary artery disease with near-total occlusion of the proximal to mid RCA, receiving collateral circulation from the LAD and LCX, about 10 years prior. Percutaneous coronary intervention to the RCA was previously attempted but failed. This time, the patient presented with exertional dyspnea for several months. Cardiovascular risk factors included dyslipidemia and hypertension. Electrocardiography showed sinus bradycardia with left anterior hemiblock and inferior Q wave. Transthoracic echocardiography disclosed preserved left ventricular systolic dysfunction with hypokinesis of the infero-posterior wall. Exercise stress test was positive.

Percutaneous Coronary Intervention: Diagnostic coronary angiography revealed critically stenotic lesion with braided appearance and multiple aneurysms at the proximal to mid-segment of the dominant RCA. We also noted 50% stenosis at the proximal segment of the LAD with collateral circulation to the right ventricular branch of the RCA from the septal branch of the LAD, and 90% stenosis at the proximal segment of the non-dominant LCX. First, we performed successful wiring to the distal posterolateral branch with a Hi-Torque Pilot 50 workhorse guidewire. The lesion was pre-dilated with a 2.0 x 20 mm semi-compliant balloon. Then the RCA was evaluated by IVUS, which revealed multiple channels separated by fibrous septa with aneurysmal dilation and fibro-calcified plaque. A 3.0 x 20 mm semi-compliant balloon, a 4.0 x 20 mm semi-compliant balloon and a 3.5 x 15 mm noncompliant balloon, slightly smaller than the RCA lumen diameter but large enough to disrupt the septa, were used for lesion preparation. IVUS evaluation after balloon dilatation revealed disruption of the plaque and the septa. A 4.0 x 33 mm DES was implanted at the proximal to mid-segment of the RCA. Stent optimization was performed with a 4.5 x 12 mm noncompliant balloon. Post-stenting IVUS evaluation disclosed good apposition and expansion of the RCA stent. Contrast injection showed TIMI flow grade 3.



Before and after carotid intervention under IVUS guidance



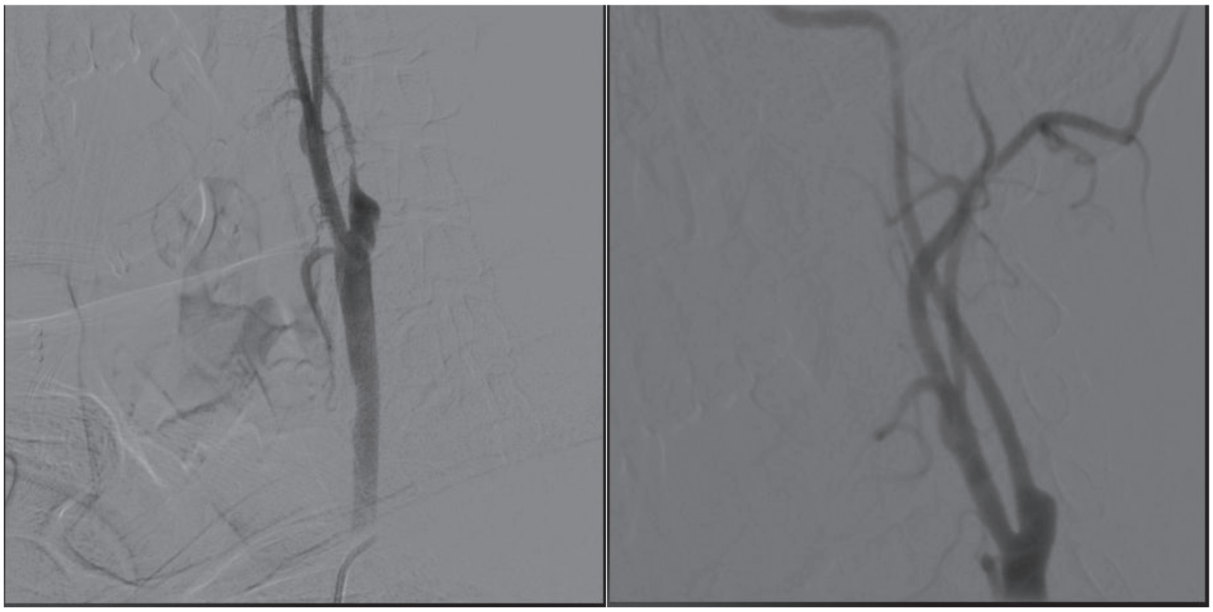
IVUS showed multiple channels.

Follow-up and outcomes: The patient was symptom-free and hemodynamically stable after the procedure, and was discharged after a three-day hospital course.

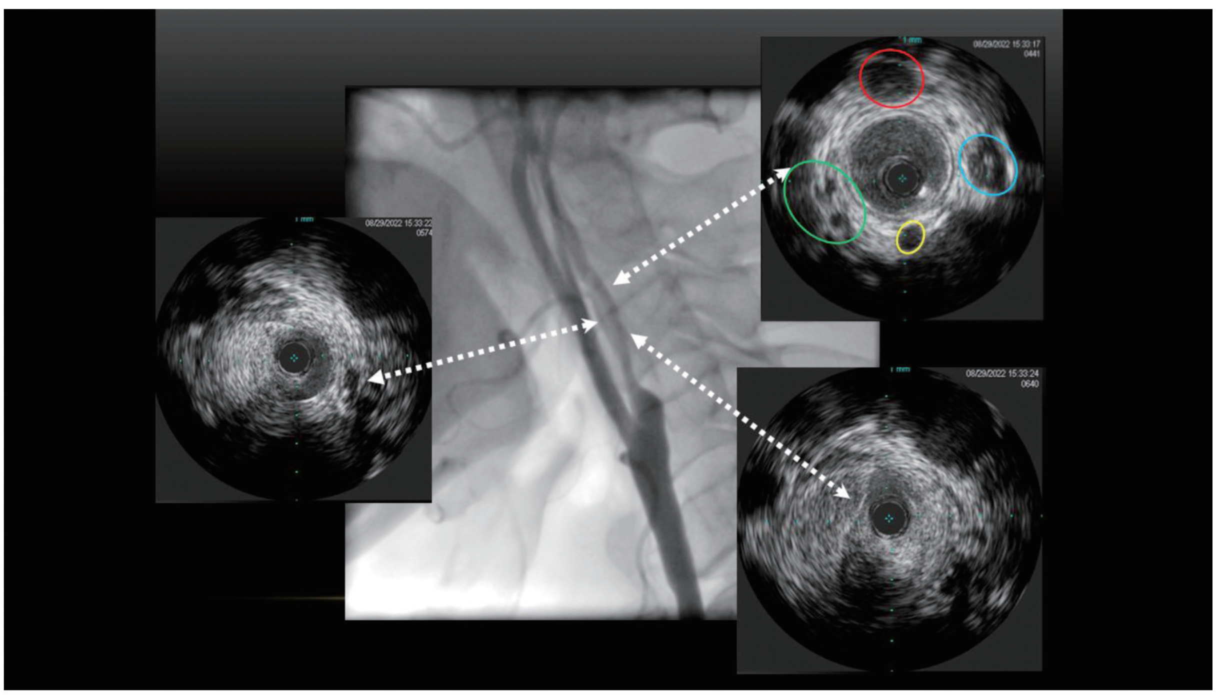
Case 3

This case is an 80-year-old male patient with a history of left main and two-vessel coronary artery disease. He presented with left upper limb numbness and weak left radial pulse for 6 months. Cardiovascular risk factors included hypertension, dyslipidemia and smoking. Carotid sonography revealed 76% stenosis of the left internal carotid artery (ICA) and reversal of flow in the left vertebral artery (VA). Magnetic resonance angiography (MRA) disclosed total occlusion of the left ICA and high-grade stenosis of the left subclavian artery (ScA).

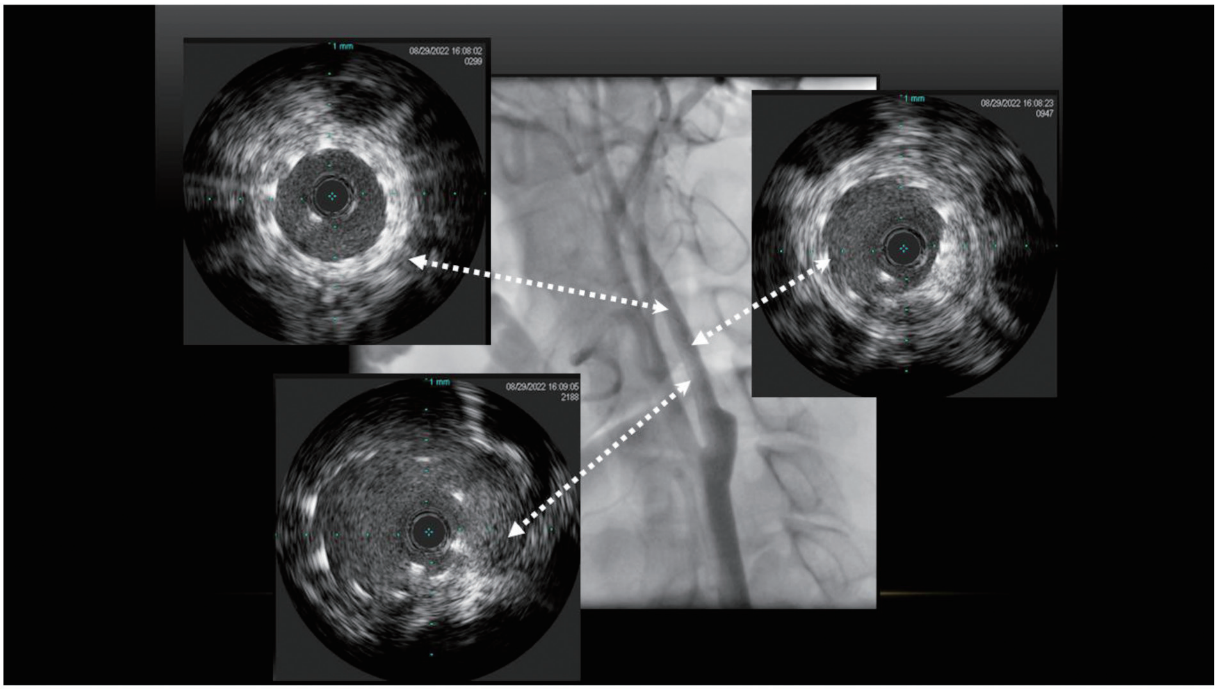
Peripheral Artery Intervention: Diagnostic peripheral angiography revealed total occlusion at the proximal segment of the left internal carotid artery (ICA), left vertebral artery (VA) and left subclavian artery (ScA). A 50% stenosis was observed at the proximal segment of the right ICA, and an intracranial angiogram showed collateral circulation from the right to the left side via the anterior communicating artery. We first performed successful wiring to the left distal ICA with a BMW UNIVERSAL guidewire. Then, an embolic protection device with SpiderFX was deployed at the left distal ICA. A 3.0 x 20 mm semi-compliant balloon was used for lesion preparation. The flow of the left ICA was restored after pre-dilation. IVUS evaluation of the left ICA after balloon dilatation revealed multiple channels with intimal flap. A 5.0 x 30 mm self-expanding stent was implanted at the proximal segment of the left ICA. Stent optimization was performed with a 4.0 x 20 mm semi-compliant balloon and a 7.0 x 20 mm Sterling balloon. Post-stenting IVUS evaluation disclosed good apposition and expansion of the left ICA stent.



IVUS showed multiple channels.



IVUS showed multiple channels and dissection flap with intramural hematoma after balloon angioplasty.



IVUS showed good stent apposition and expansion.

Follow-up and outcomes: The patient was symptom-free and hemodynamically stable after the procedure, and was discharged after a four-day hospital course.

Discussion

The complex anatomy and rare occurrence of SRCT pose significant challenges for percutaneous coronary or peripheral interventions in every aspect of strategy and technique. Therefore, intravascular imaging plays a vital role in guiding intervention strategies by clarifying lesion characteristics, side branch protection, reference vessel size and stent apposition and expansion.

We utilized two different intravascular imaging methods, including IVUS and OCT, to assist with the procedures. Each method can be adapted for individual patient and lesion requirements. IVUS is a 10-60 MHz ultrasound that can penetrate to a depth of 4-8 mm to visualize vessel circumference, and is especially suitable for peripheral artery interventions, as in our Case 3. In addition, its contrast-free imaging is an advantage for patients with impaired renal function. OCT is a near-infrared light technology that provides 10-20 um resolution to reveal detailed lesion characteristics, especially with regard to angle, thickness and length of calcification.

Lesion preparation for SRCT is as important as for other lesions. As we know, the common feature of SRCT is multiple channels separated by fibrous septa. Suzuki et al. biopsied the lesion by directional coronary atherectomy and the histopathological report revealed bilateral endothelial layers with smooth muscle cells in between. Based on this finding, a non-compliant balloon would be able to exert more force to achieve septa disruption than a semi-compliant one for stent optimization. A cutting balloon is a non-compliant balloon with tiny atherotomes to score the lesion including septa to interrupt alignment. Therefore, a cutting balloon may be a better option if the lesion cannot be prepared adequately by non-compliant balloon dilatation.

To treat bifurcation lesions, as in our Case 1, we used side branch protection and 2-stent strategy with two guidewires. Confirmation of the guidewire position in the same channel and prevention of side branch occlusion before stenting is the key step. We used OCT to identify guidewire position before and after septa disruption via cutting balloon angioplasty and to optimize stent implantation.

To treat near-total occlusion lesions, as in our Case 2, we initially adopted wiring with low-tip load with hydrophilic coated workhorse guidewire. Aneurysm formation with chronic thrombus formation and then spontaneous recanalization is the probable etiology. Due to the relatively enlarged vessel size of the aneurysm, we first confirmed that the guidewire was in the true lumen. Then we evaluated the distal & proximal reference vessel diameter, chose the appropriate size of stent and used IVUS to optimize stent implantation.

To treat peripheral artery lesions, as in our Case 3, we acknowledged the first case of SRCT confirmed by intravascular imaging in carotid artery disease from a current literature review. In addition, the total occlusion was also first identified by carotid angiogram. The diagnosis of subcutaneous total occlusion was made for the 20-day time interval between diagnosis and intervention. Some studies have suggested there is no significant difference in the decrease in stroke rate and mortality between successful carotid stenting and optimal medical treatment. However, some studies have also shown improved neurocognitive function after successful stenting. We initially adopted wiring with low-tip load with hydrophilic coated workhorse guidewire. Due to the relatively enlarged vessel size of the carotid artery, we first confirmed that the guidewire was in the true lumen. Then we used IVUS to evaluate the reference vessel diameter, chose the appropriate size of stent and optimize stent implantation.

Conclusion

Due to the relatively limited number of cases and experience, interventions for SRCT lesions have become increasingly difficult. This may affect the result after the procedure. Therefore, the core focus of the intervention should be on lesion preparation and stent optimization. Intravascular imaging can be helpful in guiding and evaluating these procedures.

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