A Case of Residual Thrombi in the Acute Phase in Drug-eluting and Bare-metal Stents Implanted in a Patient with Acute Coronary Syndrome

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The second-generation drug-eluting stent (DES) reportedly has an antithrombotic effect. An 80-year-old man with acute myocardial infarction (AMI) underwent primary percutaneous coronary intervention. He received both a bare-metal stent (BMS) and a DES at that time, and underwent intravascular ultrasound and coronary angioscopy in the acute and subacute phases. Thrombi were detected in both the BMS and DES in the acute phase. However, thrombus was only detected in the BMS in the subacute phase. It is important to consider the extent of thrombus formation in acute treatment. Therefore, residual thrombus should be evaluated with an intravascular imaging in the chronic phase to help reduce the risk of not only stent thrombosis but also other adverse cardiac events.

Keywords: bare-metal stent, drug-eluting stent, residual in-stent thrombus, angioscopy, acute coronary syndrome

Case

An 80-year-old man with hypertension and diabetes experienced sudden left anterior chest tightness at rest, which improved subsequently. He again experienced chest tightness 2 weeks after the first episode and was examined by his doctor. His coronary risk factors were hypertension, diabetes mellitus, smoking, and hyperuricemia. Electrocardiography was performed, and he was diagnosed with inferior acute myocardial infarction (AMI). He was immediately transferred to the coronary care unit (CCU) in our hospital.

Emergency coronary angiography (CAG) revealed severe stenosis in the right coronary artery (RCA) #3, which was considered responsible for his AMI (Fig. 1a). Intravascular ultrasound (IVUS), optical coherence tomography (OCT), and coronary angioscopy (CAS) were performed before and after percutaneous coronary intervention (PCI).

Before PCI, IVUS identified an eccentric large soft plaque with attenuation and a thrombus (Fig. 1b) in the RCA #3. The OCT images were unclear because of severe stenosis and insufficient removal of red blood corpuscles. Large red thrombi that had

Fig. 1 Intracoronary multiple-imaging findings before PCI
(a) CAG, (b) IVUS, (c-1, c-2) CAS. PCI: percutaneous coronary intervention, CAG: coronary angiography, IVUS: intravascular ultrasound, CAS: coronary angioscopy
been detected on IVUS were observed in the RCA #2 and RCA #3 on CAS (Fig. 1c–1 and c–2). CAG revealed dissection and plaque rupture in the RCA #2 after aspiration of the thrombus (Fig. 2). Additionally, IVUS and OCT showed a thrombus and medial dissection in the RCA #2 and RCA #3 (Fig. 3). The thrombus in the RCA #3 was observed clearly on 3-dimensional (3D)–OCT after aspiration (Fig. 4, yellow arrows).

Stenosis in the RCA #3 was identified as the culprit lesion on CAG performed before PCI; however, a large thrombus was observed on angioscopy in the proximal RCA #2, and was aspirated. Ulceration was then noted in the proximal RCA #2 on angiography, and the lesion in the RCA #2 was also considered responsible for the acute coronary syndrome.

A bare-metal stent (BMS: 4.0/28 mm) and everolimus-eluting stent (EES: 3.5/28 mm) were implanted in the RCA #2 and RCA #3. A residual in-stent thrombus was observed on IVUS and OCT after stent deployment (Fig. 5). An in-stent thrombus was also observed on CAS (Fig. 6).

The clinical course was good after PCI, and the patient was transferred to the general ward from the CCU on postoperative day 3. After cardiac rehabilitation, a follow-up CAG performed 20 days after onset of Acute Coronary Syndrome (ACS) showed no signs of early restenosis (Fig. 7). IVUS showed that the in-stent mural thrombus had moved into the lumen of the BMS and...
was observed as a low-echoic mass (Fig. 8a); OCT (Fig. 8b) showed a red thrombus with a strong signal on an irregular surface with attenuation. This red thrombus was also observed on CAS (Fig. 8c). However, no thrombus was observed in the lumen of the DES on IVUS, OCT, or CAS (Fig. 9).

**Discussion**

We report the case of a patient with AMI who underwent BMS and DES placement and developed thrombi in both the BMS and DES in the acute phase, but only in the BMS in the subacute phase. Stent thrombosis often reportedly occurs in patients with ACS. An additional potential problem is the trapping of throm-
bus between the stent struts and vessel wall, which might contribute to late acquired malapposition after thrombus resolution in the chronic period after stent implantation.\(^1,2\) Nakazawa reported that procedural factors such as underexpansion, dissection at the stent edge, plaque rupture in the residual atherosclerotic lesion, and medial fracture in the early phase are most likely responsible for stent thrombosis.\(^3\)

In the present case, the procedure of stent implantation was performed using IVUS, the stents were completely apposed to the intima without edge dissection, and no stent fracture was observed by OCT, even in the subacute phase. Moreover, early stent thrombosis is associated with a necrotic core and neointimal tears related to the vulnerability of peri-stent plaque in ACS. Kubo et al. reported that the lack of neointimal strut coverage was more frequently observed in patients with unstable angina compared to those with stable angina, which is consistent with the findings at autopsy.\(^4\)

Animal studies have reported that vascular injury induced a rapid increase in tissue factor expression in the media and adventitia.\(^5;6\)

The relationship between residual thrombi found with intravascular imaging modalities and stent thrombosis is unclear. However, we were concerned about future in-stent thrombosis. Therefore, in the present case, we decided to continue dual antiplatelet therapy for at least 12 months after stent deployment. Additionally, the risks of stent thrombosis and myocardial infarction reportedly increase with insufficient platelet aggregation inhibition when using clopidogrel alone.\(^7\)

The reported causes of in-stent thrombosis are multifactorial. In such cases, the cause of in-stent thrombosis might be related to underlying vulnerable plaque rather than to differences in stent type. Ueda et al. reported that in-stent vulnerability observed by angioscopy might be related to cardiac events.\(^8\)

Therefore, it might be better to evaluate residual thrombi due to vulnerable plaque underlying any type of stent in patients with ACS using intravascular imaging in the subacute phase, to help reduce the risk of both stent thrombosis and other adverse cardiac events.

**Conflict of interest**

Dr. Hirayama A and Hiro T work for the department of advanced cardiovascular imaging, Nihon University School of Medicine, which is endowed by Boston Scientific Corporation Japan.

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