Exacerbated Peri-Stent Contrast Staining on Serial Angiography and Optical Coherence Tomography After Platinum-Chromium Everolimus-Eluting Stent Implantation for Infrapopliteal Artery Lesions

Yusuke Tomoi,1 MD, Shoichi Kuramitsu,1 MD, Yoshimitsu Soga,1 MD, Seiichi Hiramori,1 MD and Kenji Ando,1 MD

Summary
Unlike coronary arteries, little is known about peri-stent contrast staining (PSS) formation after drug-eluting stent (DES) implantation for infrapopliteal arteries. Herein, we report exacerbated PSS assessed by serial angiography and optical coherence tomography (OCT) after platinum-chromium everolimus-eluting stent (PtCr-EES) implantation for infrapopliteal artery lesions. A 68-year-old women with recurrent left critical limb ischemia was admitted to our hospital. Standard endovascular techniques were performed for the popliteal artery (POP) and tibioperoneal trunk (TPT), but residual stenosis occurred. Therefore, a 4.0 × 38-mm PtCr-EES was placed from the distal POP to TPT using OCT guidance. Ten months later, the patient was referred to our hospital due to recurrent left leg rest pain. Angiography showed severe stenosis from the distal POP to the proximal site of the stent, and diffuse in-stent restenosis (ISR). At the ISR site, stent fracture and compression were observed and vessel evaginations were newly detected on OCT. At that time, good angiographic results were obtained by conventional balloon angioplasty alone. At 6 months follow-up, recurrence of ISR was suspected on duplex ultrasonography. Angiography showed no significant ISR, but PSS had markedly exacerbated from focal type to segmental type. OCT showed exacerbated vessel evagination and in-stent thrombus. The incidence and clinical impact of PSS after DES implantation in infrapopliteal artery lesions remain unclear; therefore, careful follow-up may be needed in such cases.

Key words: Endovascular therapy, Drug-eluting stent

Revascularization for peripheral artery disease is shifting to endovascular therapy (EVT) because of development of less invasive devices and techniques.1,2) There have been several recent reports of acceptable outcomes of infrapopliteal EVT for patients with critical limb ischemia (CLI).3,4) However, conventional balloon angioplasty (POBA) for infrapopliteal artery lesions has high restenosis and re-intervention rates.5) Therefore, the strategy is changing to use of drug-eluting solutions. Drug-eluting stent (DES) implantation for infrapopliteal artery lesion significantly reduces restenosis and re-intervention compared with POBA or bare-metal stent implantation.6,8) However, there are no data for serial angiographic and imaging assessment after DES implantation for infrapopliteal artery lesions. In this study, we report an interesting case with exacerbated peri-stent contrast staining (PSS) on serial angiography and optical coherence tomography (OCT) after implantation of a platinum-chromium everolimus-eluting stent (PtCr-EES) (Promus Premier™; Boston Scientific, Natick, MA, USA) for an infrapopliteal artery lesion.

Case Report
A 68-year-old woman with left CLI (Rutherford category 5) was admitted to our hospital. She had a history of hypertension, diabetes, hemodialysis, and severe frailty that caused her to use a wheelchair. After bare-metal nitinol stent implantation (S.M.A.R.T stents; Cordis Corp., Miami Lakes, FL, USA) for a left superficial artery lesion, and POBA from left distal popliteal artery (POP) to tibioperoneal artery (TPT) lesions, major left leg amputation was avoided. However, eight months later, she developed uncontrolled left leg pain at rest. Angiography showed recurrent distal POP occlusion (Figure 1A). A 6.5-Fr sheath (Parent Plus 45™; Medikit, Tokyo, Japan) was inserted via ipsilateral left femoral artery. After passing a 0.014-inch guide wire (Neo’s Cruise™; Getz Bros. & Co. Inc., Chicago, IL, USA) through the lesion, the lesion was dilated using a balloon catheter (4.0 × 20 mm,
Bandicoot RX™; St. Jude Medical, St. Paul, MN, USA) at nominal pressure from distal POP to TPT. Because residual stenosis was observed after POBA, we decided to place a 4.0 × 38-mm PtCr-EES from the distal POP to TPT using OCT guidance (Figure 1C, white line). Post-stent dilation was also performed (5.0 × 20 mm, Bandicoot RX™) at 10 atm. Final angiography and OCT showed good results (Figure 1C, D1-3). Aspirin (100 mg/day) and clopidogrel (75 mg/day) were prescribed after PtCr-EES implantation.

Ten months later, the patient was referred to our hospital due to recurrent left leg rest pain. Angiography showed severe stenosis from the distal POP to the proximal site of the stent and diffuse in-stent restenosis (ISR) (Figure 1E). At the ISR site, stent fracture and compression were observed on plain fluoroscopy without contrast injection (Figure 1F, G, Figure 2). Furthermore, vessel evaginations were newly detected on OCT (Figure 1H2). At that time, good angiographic results were obtained by POBA alone (Figure 1I). POBA was performed using a 5.0 × 40-mm balloon catheter (Bandicoot RX™) at 10 atm to achieve complete stent apposition at the vessel evagination site. At 6 months follow-up, re-ISR was suspected on duplex ultrasonography. Angiography showed no significant ISR, but PSS had markedly exacerbated from the focal type to the segmental type (Figure 1J). OCT showed exacerbated vessel evagination (Figure 1K2) and in-stent thrombus (Figure 1K3, blue arrow).

**Discussion**

EVT is the preferred option for patients with CLI due to occlusive atherosclerotic disease of infrapopliteal arteries requiring revascularization. DES implantation for infrapopliteal artery lesions has favorable outcomes compared with conventional therapy, whereas the hard endpoints do not significantly differ compared with conventional therapy. Therefore, DES implantation for infrapopliteal artery lesions remains controversial and off-label use in many countries, including Japan. To date, there is little information on angiographic outcomes after DES implantation in infrapopliteal artery lesions. To our knowledge, this is the first report showing exacerbated PSS during follow-up after DES implantation for infrapopliteal artery lesions.

In human coronary arteries, pathological studies suggest that PSS may be mechanistically associated with chronic inflammatory or hypersensitivity reactions. The mechanism of PSS formation in infrapopliteal artery lesions after DES implantation is uncertain, but it may be similar to that in coronary arteries. Furthermore, it is intriguing that in our case the stent fractured and compressed over time. Recently, Karnabatidis, et al. reported that fracture and compression of infrapopliteal DES were infrequent, but that they may be related to increased restenosis. In the present case, a PtCr-EES was used because it has been shown to have high fracture resistance among contemporary DESs. Nevertheless, stent fracture and compression occurred in infrapopliteal artery lesions.
treated with PtCr-EES. Stent fracture after DES implantation in infrapopliteal artery lesions may be rare, but if PSS occurs in these lesions, it may allow motion or kinking of the stent within the aneurysm, leading to fracture and compression. Indeed, Imai, et al. found frequent stent fracture in lesions with PSS. Moreover, PSS has been proposed as a risk factor for stent thrombosis after DES implantation in coronary arteries. Therefore, the dual antiplatelet therapy may have to be maintained for life unless contraindicated to prevent the occurrence of stent thrombosis in lesions with PSS. Interestingly, even though dual antiplatelet therapy was continued after EVT in this case, subclinical thrombus was observed at the PSS site. A pathological study demonstrated that PSS could easily cause flow disturbances resulting in high thrombogenicity. In addition, because the circulation in peripheral arteries is quite different from that in coronary arteries, the thrombus formation within the stent may be likely to occur in peripheral arteries. Considering these findings, anticoagulant therapy might play a crucial role in preventing the thrombus formation in peripheral artery lesions with PSS. Although the incidence and clinical impact of PSS after DES implantation in infrapopliteal artery lesions remains unclear, careful clinical follow-up is mandatory in these patients.

Disclosures

Conflicts of interest: The authors declare that they have no conflict of interest.

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