Late-acquired Peri-stent Contrast Staining after Coronary Angioplasty for In-stent Occlusion: A Case with Optical Frequency Domain Imaging and Angioscopic Assessment

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Peri-strut contrast staining (PSS) is rarely observed after drug-eluting stent implantation and has the potential cause of stent thrombosis. A 68-year-old man with ST-elevation myocardial infarction (STEMI) underwent primary percutaneous coronary intervention (PCI) for a totally occluded left anterior descending artery. The lesion was successfully dilated with an everolimus-eluting stent. Ten months later, follow-up angiography revealed in-stent occlusion and revascularization was performed by drug-coated balloon (DCB) angioplasty. Another 12 months after the second PCI, PSS was found at the previous occlusion site. Optical frequency domain imaging (OFDI) was performed for the PSS lesion and showed malapposed stent struts with a protruded mass with irregular surface behind the stent struts, and coronary angioscopy also revealed completely exposed stent struts with an abutting yellow plaque. From these multimodality imaging findings, the possibility was assumed the pathogenesis of PSS, which is thrombus dissolution after stent under dilation for culprit lesion, and the progression of vessel ectasia under the condition of continuing inflammation after drug-eluting stent (DES) implantation and DCB angioplasty. DES implantation and DCB angioplasty for STEM I lesion may contribute to the development of PSS.

Key words: coronary angioscopy, in-stent occlusion, optical frequency domain imaging, peri-stent contrast staining

Case Report

A 68-year-old man was admitted by ambulance due to cardiopulmonary arrest. After successful resuscitation, he was diagnosed with anterior wall ST-elevation myocardial infarction (STEMI) by electrocardiography and echocardiography. Emergency coronary angiography (CAG) showed a total occlusion of the proximal left anterior descending (LAD) branch (Fig. 1A), and PCI was performed. After pre-dilatation with 2.0 mm balloon, revascularization was successfully performed with the deployment of a 2.5 × 28 mm everolimus-eluting stent (EES; Promus PREMIER, Boston Scientific, Natick, MA, USA) (Fig. 1B). The final angiogram revealed thrombolysis in myocardial infarction (TIMI) grade 3 flow. He was discharged with no complications 21 days after admission and was maintained...
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Routine follow-up CAG was performed 10 months after the first PCI. Despite his uneventful clinical course, the LAD was totally occluded at the site of EES (Fig. 2A). The second PCI was performed for the in-stent occlusion in an elective manner. The lesion was finally passed by a Gaia second guide wire (Asahi Intecc Co., Aichi, Japan) and was dilated with a 2.5 mm balloon. The lesion was successfully treated with a 2.5 × 20 mm DCB (SeQuent Please; B. Braun, Melsungen, Germany). For both proximal and distal stent-edge lesions, 3.0 × 22 mm and 2.25 × 16 mm zotarolimus-eluting stents (Resolute Integrity; Medtronic, Santa Rosa, CA, USA) were implanted (Fig. 2B).

Final intravascular ultrasound found no stent under-expansion or stent malapposition. DAPT was continued after a second PCI.

He complained no chest symptom and planned follow-up CAG was performed 12 months after the second PCI for LAD. The angiogram showed no restenosis, but showed contrast staining outside the stent contour at the lesion after EES implantation (Fig. 3A; arrows). For more detailed evaluation of the lesion characteristics, optical frequency domain imaging (OFDI; Terumo Corporation, Tokyo, Japan) and coronary angioscopy (Inter-Tec, Medicals. Corp., Osaka, Japan) were performed. OFDI demonstrated malapposed struts with maximum lumen diameter 3.6 mm and with stent diameter 2.5 mm (Fig. 3b). This OFDI finding supported the diagnosis of angiographic ectasia as PSS. Another OFDI finding demonstrated irregular surface behind the malapposed stent struts (Fig. 3c). Each corresponding angioscopic image revealed that stent struts were completely exposed with evidence of blood flow behind the strut (Fig. 3b′ and 3c′). At the proximal just to the malapposed lesion, OFDI showed stent struts were slightly covered by neointima (Fig. 3a). At the corresponding lesion, coronary angioscopy demonstrated that stent struts were visible with dull light reflection, and detected yellow plaque under the struts (Fig. 3a′).

Discussion

This is the case report late-acquired PSS after angioplasty evaluated by OFDI and angioscopy. PSS is angiographically defined as contrast staining outside the stent contour extending to >20% of the stent diameter, and was recognized as stent malapposition. Several studies demonstrated that PSS is associated with endothelial delayed healing and has a potential risk of stent thrombosis.1,2 The major cause of PSS is regarded as the chronic inflammation, thrombus, chronic total occlusion, and DES implantation. It is also pointed out that second generation DES like EES could be the cause of PSS.3

In this case, PSS developed after EES implantation and DCB angioplasty. OFDI revealed a protruded mass consisted of contour irregularity with strong attenuation behind the malapposed stent struts. We also underwent coronary angioscopic examination to visualize the vascular lumen of PSS. Coronary angioscopy showed poor neointimal coverage with a yellow plaque under stent struts. From multimodality imaging findings, two types of possible mechanisms are considered for the pathogenesis of PSS. First, the previous angioscopic study reported that the early development of yellow plaque after DES reflects chronic inflammation.4 Suppression of neointimal coverage with continuing inflammation might have contributed to the mechanism of PSS. In this case, durable polymer surrounding EES introduce the inflammation, subsequently chronic...
Fig. 2  Serial coronary angiography before and after second angioplasty. ISO at 10 months after first percutaneous coronary intervention (A: arrowheads). DCB angioplasty to the ISO lesion, and additional stent implantation for both proximal and distal stent-edge lesions (B). EES: everolimus-eluting stent, DCB: drug-coated balloon, ISO: in-stent occlusion, R-ZES: resolute zotarolimus-eluting stent

Fig. 3  Peri-strut contrast staining 12 months after DCB angioplasty (A). OFDI showed that stent struts were completely exposed (b). There was a protruded mass with irregular surface behind the stent struts (c). Corresponding angioscopic findings revealed completely exposed stent struts (b′, c′, participate blood flow findings was observed due to insufficient blood exclusion). At the proximal just to the malapposed struts lesion, OFDI showed stent struts were slightly covered by neointima (a). Angioscopy showed visible stent strut with dull light reflection and yellow plaque under the struts (a′). EES: everolimus-eluting stent, DCB: drug-coated balloon, OFDI: optical frequency domain imaging
inflammation read to vessel ectasia, and finally, PSS might be occurred by the result of vessel ectasia progression. Second, the luminal surface may be not visible due to massive thrombus at the time of the first PCI. OFDI showed irregular luminal surface with high backscattering behind the stent struts at the PSS site, suggesting that thrombus dissolution might be a cause of PSS at the site of coronary ectasia. DCB angioplasty might also contribute to the thrombus dissolution and subsequent development of PSS.

This case report suggests that multiple factors have the potential to contribute to the development of PSS, including lesions and procedural factors. Especially in the lesion after different strategy treatment for STEMI, careful follow-up is necessary to develop the risk of PSS. However, favorable treatment for lesions with PSS is not established at this time. Further evidence is needed to prevent the adverse event of PSS.

**Conclusion**

There is a possibility that DCB angioplasty contributes to PSS development after DES implantation for STEMI patient. OFDI and angioscopic findings are useful for the evaluation of the PSS pathogenesis.

**Disclosure Statement**

The authors declare that there is no conflict of interest.

**References**