Angioscopic Comparison of Six-month Arterial Healing between Bare-metal and Drug-eluting Stents in Superficial Femoral Arteries

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Several clinical studies have shown comparative outcomes of paclitaxel-eluting stent (PES), Zilver PTX and bare-metal stent (BMS), Zilver implanted into the superficial femoral artery. However, detailed process of vascular healing after implantation of the 2 different stents is little known. We assessed a total of 3 patients of successfully deployed 1 BMS and 2 PES who underwent angiographic and angioscopic follow-ups after 6 months of the intervention. The degree of neointimal stent coverage (NSC) was classified into presence of uncovered struts (grade 0), visible struts through a thin neointima (grade 1), or invisible struts with complete neointimal coverage (grade 2). Also, the existence of in-stent thrombus was also evaluated qualitatively using angioscopy. In a case of BMS, follow-up angiography confirmed stent patency. Angioscopy showed that stent struts were fully and homogeneously covered by proliferating white neointima (grade 2) without thrombus. One PES was angiographically patent but another showed diffuse restenosis. In a case without restenosis, angioscopy showed heterogeneous neointimal coverage within the PES segment. Although stent struts were clearly visible and neointimal coverage was absent (grade 0) at the proximal site, thick neointima covered stent and the struts were invisible (grade 2) at the mid and distal segments without thrombus. In a case of restenosis, angioscopy found thin and thick neointima (grade 1 and 2, respectively) as heterogeneous artery healing of the PES with no thrombus. This angioscopic observation revealed that heterogeneous growth of neointima in Zilver PTX, while Zilver showed homogenous healing at 6 months of their implantation.

Key words: arterial healing, angioscopy, bare-metal stents, drug-eluting stents, peripheral artery disease

Introduction

Drug-eluting stents (DES) have dramatically reduced restenosis in comparison with bare-metal stents (BMS) in coronary artery disease. 1) However, stent thrombosis has emerged as a major safety concern after DES implantation. Pathological studies have shown that delayed arterial healing characterized by poor endothelialization and accelerated neoatherosclerosis induced by hypersensitivity reaction to polymer and chronic inflammation, and they possibly increase the risk of late or very late DES thrombosis. 2) Intravascular imaging techniques, such as intravascular ultrasound, optical coherence tomography, and angioscopy, enable assessment of inadequate vascular response after DES implantation and help to understand pathogenesis of DES thrombosis.

Recent years, polymer-free, paclitaxel-coated nitinol drug-eluting stent (Zilver PTX™; Cook Medical, Bloomington, IN, USA) is available for the treatment of peripheral artery disease. Although durable clinical outcomes of Zilver PTX comparing to BMS (Zilver™; Cook Medical) have been reported, 3) its detailed process of arterial repair is unclear.

Angioscopy directly visualizes arterial healing following stenting. 4) Here, we describe angioscopic findings in some cases of each stent, Zilver and Zilver PTX implanted in peripheral arteries.
Case Presentation

A case of BMS

A 77-year-old man complained of intermittent claudication and his left side of ankle brachial index (ABI) could not measure. Angiography showed severe stenosis in the left SFA, and endovascular therapy (EVT) after loading dual antiplatelet (DAPT) of aspirin 100mg/day and cilostazol 200mg/day was performed. Through a contralateral approach from the right CFA with a 6-Fr guiding sheath (Destination; Terumo Co., Shizuoka, Japan) and following intra-arterial injection of unfractionated heparin, the severe stenosis was crossed using a 0.014-inch guide wire (Agosal; Asahi Intec Co., Hanoi, Vietnam). Zilver (7.0 mm diameter × 80 mm long) was implanted and balloon angioplasty (Bandicoot, 6.0 mm × 40 mm; Kaneka Medix Co., Osaka, Japan) for post-dilatation was added. Final angiogram showed sufficient stent dilatation and no complications occurred in perioperative period. ABI of the left leg improved to 0.72 and his symptom disappeared. Follow-up angiography at 6 months after EVT confirmed patency of the Zilver. Angioscopy (Vecmova NEO; FiberTech, Tokyo, Japan) showed that stent struts were fully covered by proliferating neointima without thrombus (Fig. 1).

Two cases of DES

A 62-year-old woman visited our hospital due to left leg pain at rest and ulcer in the hallux. Her left side of ABI was 0.68. Angiography showed total occlusion in the left SFA and she underwent EVT after loading DAPT, aspirin 100mg/day and clopidogrel 75mg/day. Through a contralateral approach from the right CFA with a 6-Fr guiding sheath (Destination; Terumo Co., Shizuoka, Japan) and following intra-arterial unfractionated heparin, the severe stenosis was crossed with a 0.014-inch guide wire (Treasure X; Asahi Intec Co., Hanoi, Vietnam) under the support of a microcatheter (CX-I; COOK Japan Co., America). Zilver PTX (7.0 mm × 120 mm) was then implanted after balloon angioplasty (X-TREME, 3.0 mm × 120 mm; Japan Medtronic Co., Italy). Additional balloon angioplasty (X-TREME, 7.0 mm × 80 mm) was performed for post-dilatation. Final angiogram showed good results. Her ABI of the left leg improved to 1.17 and symptom completely disappeared. Follow-up angiography at 6 months indicated patency of Zilver PTX. Angioscopy showed heterogeneous neointimal coverage in the stent segment. At the in-stent proximal site, stent struts were clearly visible and neointimal coverage was not seen. By contrast, thick neointima completely covered stent and the struts were invisible at the mid and distal segments of the stent (Fig. 2).

The second case is a 71-year-old man presented with claudication...
in the left leg. ABI was 0.65 in the left leg. Angiography showed severe stenosis at the ostium and distal end of left SFA, and he received DAPT (aspirin 100mg/day and clopidogrel 75mg/day). A 0.035-inch guide wire (Radifocus™; Terumo) was passed over the severe stenosis. Zilver PTX (6.0 mm \( \times \) 120 mm) was implanted and post-dilatation was archived by balloon angioplasty (X-TREMETM, 5.0 mm \( \times \) 20mm). At perioperative state, his ABI of the left leg improved to 0.96 and symptom disappeared. Six-month angiography showed focal stenosis at the proximal stent segment and diffuse stenosis at the distal one. Angioscopy found mingled proliferation of thin and thick neointima as heterogeneous artery healing in the stent segment. Angiographic late loss corresponded to thick neointima on angioscopy (Fig. 3).

Discussion

We demonstrated angioscopically vascular healing response of Zilver and Zilver PTX in the SFA. Heterogeneity of neointimal growth was observed in Zilver PTX, whereas Zilver showed homogenous healing at 6 months of their implantation.

Zilver, peripheral BMS, is a self-expanding stent, while available coronary stents including BMS are balloon-expandable. Metal composition and stent platform are considerably different between peripheral and coronary BMSs. In general, vessel (or stent) diameter and lesion (or stent) length affecting healing response after stenting quite differ between SFA and coronary artery. However, sufficient neointimal coverage of peripheral BMS had been nearly achieved at the 6-month follow-up as well as coronary BMS. Probably, neointimal proliferation of BMS is earlier than that of DES regardless of location of the vessel.

By contrast, Zilver PTX stent as peripheral DES showed heterogeneous neointimal growth in comparison with Zilver stent. There was a case having visible stent struts and thick proliferating tissue associated with restenosis. Extremely thin and thick neointima were found within the same segment, and excessive wound healing mingled with delayed healing according to our angioscopic findings. Regarding vascular healing response, some differences between various coronary DESs and BMSs were pointed out based on angioscopic examinations. Coronary angioscopic evaluation at 6 months revealed that uneven neointimal proliferation is more remarkable in paclitaxel-eluting stent than in bare-metal stents.5) The phenomenon as heterogeneous healing of Zilver PTX was considered similar with coronary PES. The common content of Zilver PTX and PES is only the drug releasing from DESs. Therefore, it is speculated that heterogeneous healing may be specific effect of paclitaxel.

Vascular healing response after stenting cannot be concluded by angioscopic observation in a few cases, because not only stent type but also patient characteristics operate on that.
However, partially delayed neointimal coverage and heterogeneous healing of Zilver PTX was more remarkable than those of Zilver.

Disclosure

The authors have nothing to disclose.

References