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Case Report

Serial endovascular assessment of polytetrafluoroethylene-covered stent: Capabilities and limitations of intravascular imaging modalities affected by a temporal factor

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ABSTRACT

A 47-year-old male who previously underwent coronary bypass graft surgery was transferred to our hospital for treatment of bare metal in-stent restenosis (ISR) of severely calcified left main (LM) coronary lesion. During a repeat coronary intervention, LM coronary perforation occurred after rotational atherectomy followed by balloon dilatation. Hemostasis was successfully achieved by implantation of a single polytetrafluoroethylene (PTFE)-covered stent. Although intravascular ultrasound (IVUS) and optical coherence tomography (OCT) were documented, any additional information was not obtained except stent expansion. Routine 6-month follow-up angiography revealed no findings of restenosis. Three representative imaging modalities, IVUS, OCT, and angioscopy were applied to visualize and differentiate any structures within the PTFE-covered stent. Intravascular findings included, (1) vascular structures outside the covered stent could be observed sufficiently by both IVUS and OCT at this time that could not be seen at all just after implantation, (2) neointimal hyperplasia distributed dominantly at both stent edges, and (3) in-stent micro thrombi still existed even 6 months after implantation. Intravascular findings of PTFE-covered stent may vary between the observational periods. Furthermore, vascular healing process of this special stent may be different from those of non-covered mesh stents.
<**Learning objective:** Even with the use of IVUS and OCT, it may be difficult to evaluate apposition of PTFE-covered stent just after implantation. However, it could be visualized as being sufficiently similar to the other common stents at 6-month follow-up. Unique longitudinal NIH distribution (bilateral edge dominant) was evaluated, and existence of micro thrombi within PTFE-covered stent even at 6 months.>

Introduction

Perforation of coronary arteries is a complication that is often encountered during percutaneous coronary intervention. With the advance of new devices and technologies, interventionalists attempt to treat more complex lesions, including more calcified or tortuous arteries, which increases the complication of perforation. The use of a polytetrafluoroethylene (PTFE)-coated stent in coronary perforation cases may stop the bleeding at perforation sites. This case report contains serial documentation using rare multi-intravascular imaging devices for PTFE-coated stents.

Case report

This case report involves a 47-year-old Japanese male who had previously undergone coronary bypass surgery. The patient did not have hereditary factors, or the risk factors of hypertension, dyslipidemia, and long-term smoking, causes of acute coronary syndrome. In the year after coronary bypass surgery, a bare metal stent (size unknown) was deployed from left main (LM) trunk to left circumflex artery because of angina. The patient was transferred to our hospital for treatment of left main in-stent restenosis after bare metal stent implantation, because sufficient

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lesion dilatation had not been achieved, due to severe coronary calcification of his LM lesion. His bypass graft was previously patent from left internal mammary artery to left anterior descending artery.

A repeat coronary intervention was performed for this calcified LM lesion. Immediately after balloon (non-compliant 3.25/15 mm, max 18 atm dilatation) dilatation following rotational atherectomy (burr 1.25 and 1.5 mm, max 200,000 rotation), coronary perforation occurred because of severe calcification and was treated with the tortuous lesion from LM to circumflex branch. Finally, hemostasis was achieved using a PTFE-covered stent (Jostent GraftMaster 3.0/18 mm, Abbott, Abbott Park, IL, USA) after prolonged compression by balloon (Fig. 1). Additional stent dilatation was performed using a non-compliant balloon at a high pressure of 30 atm. Intravascular ultrasound (IVUS) and optical coherence tomography (OCT) were documented to evaluate apposition of the PTFE-covered stent (Fig. 2). IVUS system was used, namely, Atlantis Pro-2 and Galaxy-2 system (Boston Scientific, Natick, MA, USA). Conventional IVUS images were acquired using a 40-MHz mechanically rotating IVUS catheter. OCT imaging was performed during occlusion of the proximal coronary artery with a compliant balloon (4Fr occlusion balloon catheter, Helios, Light Lab Imaging, Westford, MA, USA) and continuous flushing. The fluid flush comprised 1 part dextran 40 to 3 parts lactated Ringer's solution. However, vascular structures outside the stent were not adequately evaluated by either IVUS or OCT because PTFE tube might interfere with ultrasound beam or light penetration.

Follow-up coronary angiography, IVUS, OCT, and angioscopy were obtained at 6 months. There was no ISR at the PTFE-covered stent by coronary angiography (Fig. 1). Although vascular structures outside of a PTFE-covered stent could not be observed by IVUS or OCT just after implantation, they could be visualized and differentiated at 6-month follow-up (Fig. 2). PTFE membrane was clearly observed at baseline, however it became difficult to differentiate from surrounding tissue at 6-month follow-up. Representative frames of bilateral stent edges and mid-portion observed by OCT and angioscopy are shown in Fig. 3. Longitudinal neointimal hyperplasia (NIH) distribution detected by OCT demonstrated a unique pattern. NIH was dominantly distributed at both stent edges. In contrast, neointimal coverage around the stent mid-portion was thin. According to angioscopy, the middle of the PTFE-covered stent was almost NSC [1] (angioscopic images of Neointimal Stent Coverage) Grade 0 (no neointima found on stent struts) or partially Grade 1 (struts were visible under the thin neointima). Furthermore, several subclinical micro thrombi were observed in mid lesion of PTFE-covered stent by OCT (Fig. 4).

Proprietary offline software (Light Lab Imaging) was used to delineate the lumen contours of each cross-sectional image. Lumen, stent, and neointimal thickness mean areas and volumes were calculated every 5 frames along the entire stented segment. Standard definitions of cross-sectional area and volume measurements were applied as previously reported [2–4].

We analyzed the OCT imaging inside a PTFE-covered stent using proprietary offline software. We calculated every 5 frames (total of 720 Struts at 56 frames). The details about lumen profile are shown in Table 1. According to our data, there were 96% (688/720) well apposed embedded covered struts. Although there was no malapposed strut, 3% (24/720) of uncovered struts existed.

Fig. 5 shows the average NIH thickness at every frame from the proximal lesion to distal lesion of the PTFE-covered stent. NIH thickness of bilateral edges looked thick compared with that of middle portion.

Discussion

This case report is unique because serial assessment by several representative intravascular imaging modalities is available to evaluate PTFE-covered stent. Interesting observations in this case can be summarized as the following: (1) just after implantation of PTFE-coated stent, PTFE was clearly visible as "light band" by IVUS or OCT, and vascular structure beyond PTFE could not be evaluated at all; (2) at 6-month follow-up, this "light band", suggesting PTFE, could not be clearly differentiated anymore, and vascular structures including intima and peri-stent tissue could be evaluated sufficiently, similar to other common stents; (3) unique longitudinal NIH distribution was evaluated (bilateral edge

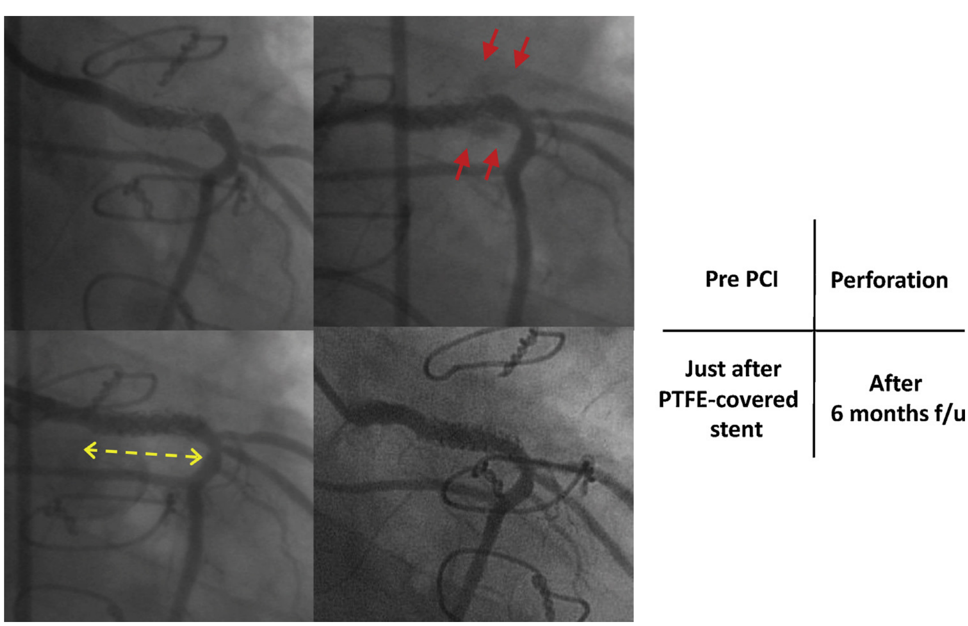

Fig. 1. A repeat coronary intervention was performed for left main lesion with severe calcification. After rotational atherectomy (burr 1.5 mm) and plain old balloon angioplasty, coronary perforation occurred. Red arrows show perforation site of left main lesion. As a result, a polytetrafluoroethylene (PTFE)-covered stent was implanted from left main lesion to proximal of left circumflex artery. Yellow arrows show range of PTFE-covered stent. After 6-month follow-up angiography, there was no in-stent restenosis in PTFE-covered stent. PCI, percutaneous coronary intervention.