Usefulness of 3D OCT to Diagnose a Noncircumferential Open-Cell Stent Fracture

A 56-year-old woman underwent a primary percutaneous coronary intervention: after thrombus aspiration, a 3.5 × 15-mm dual-therapy stent (Combo, OrbusNeich Medical, Fort Lauderdale, Florida) was directly implanted at nominal pressure in the proximal right coronary artery. Because of nonuniform balloon expansion during stent implantation, we performed enhanced stent imaging (ESI), which showed a slight stent underexpansion, post-dilated with a 3.5 × 12-mm noncompliant balloon inflated at 14 atm. Although a good angiographic result and an intact stent appearance seen on fluoroscopy, the stent profile at final ESI showed a clear gap in the mid-stent portion and a marked contour radiopacity attenuation more proximally, both suspicious for stent fracture (SF). These findings were not clearly distinguishable on the first ESI, performed after stent implantation to assess expansion, perhaps because of a blurry image. For a better diagnosis definition, intravascular optical coherence tomography (OCT) was performed. Conventional 2-dimensional (2D) OCT ruled out strut malapposition or dissection and showed segments with and without circumferential strut distribution. Because of uneven strut allocation of the open-cell stent on cross-sectional images, the lack of circumferential struts (Figures 1b and 1c) was not diagnostically conclusive for SF, and 3-dimensional (3D) vessel reconstruction was considered. The latter detected only 1 area with strut architecture misalignment and partial breakage of stent linkage, leading to non-coverage of a relatively large vessel wall (Figure 1), corresponding to the ESI profile discontinuity in the mid-stent portion. The fractured area on 3D OCT corresponded to cross sections with the lack of circumferential struts; however, other 2D slices with this pattern did not correspond to fractured areas on 3D OCT (Figure 1). The procedure was terminated after 3D OCT, and the patient was discharged on aspirin and prasugrel, with the indication to perform 1- and 6-month noninvasive stress testing and 1-year coronary angiography and OCT to guide subsequent management.

Because SF can remain undiagnosed with conventional imaging modalities, subclinical SF occurs more frequently than reported. Detection and management of SF are important due to the associated higher risk of in-stent restenosis, stent thrombosis, and aneurysm formation. This is particularly relevant considering the current trends to shorten dual-antiplatelet therapy after implantation of the newest types of stents, such as the Combo device, which is intended to accelerate vessel endothelialization through an antibody surface coating binding circulating endothelial progenitor cells. The present case highlights the possible roles for ESI and 3D OCT rendering in screening and confirming, respectively, stent fracture. Although the lack of circumferential struts on 2D OCT has been previously regarded as SF, this criterion should not be applied to confirm SF with open-cell platforms. Indeed, although with 2D OCT rendering...
transverse OCT, an intact closed-cell design stent produced circumferential strut images, open-cell stents showed various strut patterns, depending on the position and inclination of a cross-sectional cut (1). Thus, although 3D OCT has not been used as an imaging modality in clinical practice until now, this technology may be helpful to conclusively diagnose SF of new metal stents, to estimate the area of the lesion that is not covered, and to guide optimal therapeutic and follow-up strategies.

In conclusion, the present report demonstrates the potential of ESI to suggest SF after stent implantation, a suspicion that may be confirmed by 3D OCT.

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REFERENCES

Impact of In-Stent Tissue Type on Periprocedural Myocardial Infarction and 2-Year Clinical Outcomes After Treatment of Coronary Artery Restenosis

The development of neoatherosclerosis characterized by lipid core, in-stent thin-cap fibroatheroma (TCFA), calcification, and intimal rupture contribute to development of late stent failure (1,2). We assessed the impact of optical coherence tomography (OCT)-detected TCFA and intimal rupture on the occurrence of periprocedural myocardial infarction (MI) and 2-year major adverse cardiac events (MACE).

From August 1, 2008 to June 1, 2012, 518 patients with in-stent restenosis (ISR) underwent target lesion revascularization at the Asan Medical Center, Seoul, Korea. After excluding the patients with hemodynamic instability, inability of the OCT catheter to cross the tight stenosis, the presence of left main or saphenous vein graft lesions, acute MI, vessel size >4 mm, total stent length >40 mm, pre-dilation before OCT examination, or an angiographically visible thrombus, pre-procedural OCT images were available in 152 patients (41 bare-metal stents [BMS] and 111 drug-eluting stents [DES]). Periprocedural MI was defined as post-procedural peak creatine kinase myocardial band (CK-MB) >15 ng/ml (>3 times the upper limit of normal). OCT image was obtained by occlusive (LightLab Imaging, Westford, Massachusetts) or nonocclusive (DragonFly catheter and C7XR, LightLab Imaging) technique. Calcific or lipidic intima, TCFA, intimal rupture, and thrombi were previously described (2,3).

All values were expressed as the median value (interquartile range [IQR]) or counts and percentages and compared by nonparametric Mann-Whitney or chi-square statistics. Multivariable analysis included the variables (p < 0.2) such as age, male sex, DES, unstable angina, stent duration, in-stent TCFA, intimal rupture, and thrombi.

The patient age was 64.0 (56.3 to 69.0) years, and 80% were men. Clinical presentation was stable angina in 77% and unstable angina in 23%. The stent duration was 52.8 (17.5 to 86.9) months (IQR: 14.0 to 70.0) months in DES vs. 116.4 (IQR: 58.6 to 148.7) months in BMS; p < 0.001). Peak CK-MB level before the procedure was normal in all patients. Table 1 summarizes pre-procedural OCT findings.

ISR was treated with DES in 62%, cutting balloon in 26%, and other types of balloon in 12%. The patients with (vs. without) in-stent TCFA had a higher post-procedural peak CK-MB (2.0 [IQR: 1.0 to 5.0] vs. 1.4 [IQR: 0.8 to 2.2] ng/ml; p = 0.012) and more frequent periprocedural MI (13% vs. 2%; p = 0.010). Moreover, the patients with (vs. without) intimal rupture showed a higher post-procedural peak CK-MB (2.0 [IQR: 0.9 to 4.1] vs. 1.3 [IQR: 0.9 to 2.4] ng/ml; p = 0.017) and more frequent periprocedural MI (13% vs. 3%; p = 0.015). Stent duration (r = −0.360), fibrous cap thickness (r = −0.176), and length of in-stent TCFA (r = 0.331) significantly correlated