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Editorial

Editorial: Optical coherence tomography in endovascular intervention for renal artery stenosis

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Optical coherence tomography in peripheral intervention

Over the past decade, there has been a surge in optical coherence tomography (OCT) usage in coronary diagnostic and interventional procedures. High-resolution images from OCT provide a detailed analysis of coronary stent strut apposition, neointimal formation, thrombus attachment, as well as plaque characterization [1,2]. Tissue characterization of atherosclerotic coronary plaques with OCT was first carried out by comparing the OCT images to the matched histology using autopsy specimens. Each of the three major plaque types is characterized by a specific set of features: fibrous plaques appear as homogeneous, signal-rich regions; lipid plaques as signal-poor regions with diffuse borders; and calcified plaques as signal-poor legions with sharp borders [1].

Frequency domain (FD)-OCT systems have allowed clinicians to rapidly obtain high-resolution intravascular images over long arterial segments without the balloon occlusion unlike the formerly used time-domain OCT. This improvement in hardware has facilitated the clinical application of OCT in the management of coronary artery disease [2]. The foremost limitation of OCT is decreased tissue penetrance at the expense of its high resolution and need for intraluminal blood clearance. Recently, clinicians have started using OCT for peripheral artery disease appreciating the high-quality images free from blood artifacts [3]. While the coronary vessels can be rendered free of blood by a 12 to 15-cc bolus injection of contrast injected at a rate of 2–4 mL/s [2], larger size peripheral artery requires higher injection rates and volume of flush medium for adequate blood clearance compared to coronary imaging. We have to take care in dealing the patients with renal insufficiency. A case report from Stefano et al. demonstrated that OCT can provide the dimensions of a dissection (depth and length) as well as precise delineation of the most proximal edge of the dissection, information imperative to implementing proper treatment with repeat balloon angioplasty, and/or stenting after endovascular intervention for femoropopliteal disease [3]. Of note, OCT-based tissue/plaque characterization has yet to be established in peripheral artery disease through direct comparison of OCT images and histopathology. Morphological information by OCT before and after intervention in peripheral artery disease as an adjunctive endovascular imaging would help us to make treatment decisions whether additional stent placement is needed.

Renovascular hypertension from fibromuscular dysplasia and OCT assessments

Fibromuscular dysplasia (FMD) is an idiopathic, segmental, nonatherosclerotic disease of the musculature of arterial walls, leading to the narrowing of small and medium-sized arteries (most commonly renal arteries) and causing renovascular hypertension. FMD is the second most frequent cause of renal artery stenosis (RAS), which accounts for up to 10% of cases of renovascular hypertension, with the remainder caused mainly by atherosclerosis. FMD patients tend to be female and younger, with lower occurrence of atherosclerosis in other vessels. Histologically, medial dysplasia is the most common type of FMD which occurs as areas with a thinned medial wall layer alternating with thickened fibromuscular ridges containing collagen, and vessel wall ischemia appears to be of relevance for the development of FMD [4].

Besides physical examinations, renal artery ultrasound, captopril renography, magnetic resonance angiography, and computed tomographic angiography, intra-arterial digital subtraction angiography is the gold standard for exclusion or confirmation of RAS caused by FMD. The FMD lesion is typically truncal or distal and often shows ‘strings of beads’ appearance. Mizutani et al. report a case of OCT usage for visualization of intimal fibroplasia and medial hyperplasia that was indicative of FMD in young female hypertensive patient [5]. OCT showed that, especially in media, the inside was homogeneous and was of low intensity, which suggested FMD.

Treatment options are medical, endovascular [percutaneous transluminal renal angioplasty (PTRA)], and surgical. Invasive treatment should be considered when hypertension cannot be controlled with antihypertensive drugs as with the patient in this report and in patients with impaired renal function. PTRA has become the treatment of choice and normally yields good results, especially in unifocal disease and young patients. After PTRA, pressure gradients are normally completely abolished, and there is no indication for stent placement in most cases [6]. Indications for stenting of FMD lesions include severe procedural complications

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such as extensive dissection or persistent pressure gradient after repeated angioplasty [7]. Since OCT can clearly visualize achieved lumen area, vessel dissection, and thrombus formation after balloon angioplasty [2], it may help us to optimize PTRA for FMD. In a systematic review of FMD treatment [7], when 'cure' following revascularization for RAS due to FMD was defined as blood pressure less than 140/90 mmHg without treatment, cure rate was reported in only 36% of the procedures. It was also reported that the blood pressure outcome was strongly influenced by patient age. Further study is warranted to assess early and long-term outcome following OCT-guided optimization of PTRA for RAS.

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Toshiro Shinke (MD, PhD, FJCC)*
Kobe University Graduate School of Medicine, Division of Cardiovascular Medicine, Department of Internal Medicine, 7-5-1, Kusunoki-cho, Chuo-ku, Kobe, Hyogo 6500017, Japan

*Corresponding author. Tel.: +81 78 382 5846;
fax: +81 78 382 5859
E-mail address: shinke@med.kobe-u.ac.jp (T. Shinke).

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