Optical Coherence Tomography and Drug-Eluting Stents

Optical coherence tomography (OCT) is a low-penetration imaging technique with 10 µm to 15 µm resolution that can be used to view atherosclerotic plaque. Unlike intravascular ultrasound (IVUS), OCT can identify inflammatory cells (macrophages) in plaque. Time-domain OCT (TD-OCT) and the newer frequency-domain OCT (FD-OCT) have similar resolution and penetration, but FD-OCT has more lines per frame and faster pullback speed and frame rate, resulting in better images. Luca Di Vito, MD, PhD, San Giovanni Hospital, Rome, Italy, discussed assessment of atherosclerotic plaque and drug-eluting stents (DES) with OCT.

Pre- and Post-DES Assessment

OCT signal analysis depends on signal attenuation and backscattering to visualize the edge sharpness and texture of plaques. An important use for OCT is to identify vulnerable plaque such as thin-cap fibroatheroma (TCFA), characterized by a thin fibrous cap with a large lipid core, micro-vessels, and inflammatory cells. Vulnerable plaque may undergo rupture that in turn can cause thrombus formation. OCT can distinguish between red (high attenuation) and white (low attenuation) thrombi that are respectively composed by red blood cells and platelets.

OCT is useful for assessing stent deployment and can identify intrastent and edge dissection, tissue prolapse, and intra-stent thrombus. Dr. Di Vito's group assessed 21 patients who had experienced type IVa myocardial infarction (MI) and 29 controls with FD-OCT before and after percutaneous coronary intervention (PCI) [Porto I et al. *Circ Cardiovasc Interv* 2012]. Pre-PCI assessment demonstrated that TCFA was significantly associated with type IVa MI (p=0.017). Post-PCI analysis demonstrated significantly more frequent intra-stent thrombus (p=0.04) and intra-stent dissection (p=0.03) in type IVa MI patients versus controls. Multivariate analysis showed an association between type IVa MI and TCFA (OR, 29.79; 95% CI, 1.36 to 32.08; p=0.008), intra-stent thrombus (OR, 5.55; 95% CI, 1.24 to 24.86; p=0.025), and intra-stent dissection (OR, 5.33; 95% CI, 1.16 to 24.34; p=0.031). There was no association between type IVa MI and presenting thrombus, ruptured plaque, or plaque tissue prolapse.

Prof. Di Vito concluded that TCFA, intra-stent thrombus, and intra-stent dissection are independent predictors of type IVa MI. Plaque-derived or friable thrombotic debris cause type IVa MI. Tissue prolapse through stent struts probably does not cause embolic events. Importantly, 2 of the 3 predictors of type IVa MI were not identified before PCI.

Prof. Di Vito also explored the use of OCT for assessing the new-generation bioresorbable vascular scaffold (BVS) DES. So far, BVS results were similar to results for other DES. Prof. Di Vito concluded that conventional and new-generation DES can be assessed by OCT. These studies show that analysis of pre- and post-PCI OCT images can improve PCI outcomes.