JACC: CARDIOVASCULAR IMAGING
VOL. 2, NO. 2, 2009

ISSN 1936-878X/09/$36.00
PUBLISHED BY ELSEVIER INC.

LETTERS TO THE EDITOR

Optical Coherence Tomography to Diagnose Under-Expansion of a Drug-Eluting Stent

We read with interest the manuscript by Kubo et al. (1) comparing vascular response after sirolimus-eluting stenting between patients with unstable and stable angina by optical coherence tomography (OCT). We agree with the authors regarding the contribution of OCT when post-stenting angiography proves ambiguous.

In the drug-eluting stent era, stent under-expansion remains a major predictor of subacute thrombosis and restenosis. Stent under-expansion is often underestimated by coronary angiography, especially with the smallest stent sizes. Previous studies showed the efficiency of intravascular ultrasound (IVUS) in the assessment of stent expansion. Furthermore, IVUS established a relationship between minimum stent area and a lower restenosis rate. We here report a case of drug-eluting stent restenosis linked to an initial under-expansion not diagnosed on angiography. OCT was performed to explain the mechanism of the restenosis and help in its management.

A 53-year-old man presented with acute coronary syndrome. He successfully underwent middle left anterior descending coronary artery angioplasty with a zotarolimus-eluting stent 3.0 × 24 mm. The initial angiographic result was encouraging.

Six months later, a new coronary angiogram, performed because of the occurrence of angina, showed a tight focal in-stent restenosis in the proximal segment (Fig. 1, panel A).

The OCT showed uniform neointimal proliferation in the stent without any uncovered struts (Fig. 1, panel Ax). It clearly diagnosed under-expansion of the stent against a calcified ring (Fig. 1, panel Ay), which was present upstream of the stent (Fig. 1, panel Az).

Angioplasty was performed with a noncompliant balloon (3 × 12 mm at 12 atm). The angiographic result seemed to be perfect (Fig. 1, panel B).

However, the OCT imaging demonstrated proximal stent rupture (Fig. 1, panel By) and the effect of balloon trauma on the neointima of the restenosis that is now shredded and split within the stent. The OCT diagnosed a coronary dissection extending upstream of the stent (Fig. 1, panel Bz). It did not reveal any modification in the distal segment of the stent (Fig. 1, panel Bx).

A new zotarolimus-eluting stent (3 × 18 mm) was then deployed, covering the dissection, and the good angiographic result was confirmed by OCT imaging (Fig. 1, panel C).

In this case, we would like to emphasize the successful use of OCT imaging to diagnose an under-expansion, to show the effect balloon trauma on the neointima, and to evaluate the result of a corrective intervention with more confidence than with angiography alone. Furthermore this observation emphasizes that the angiogram could be insufficient to accurately assess intrastent restenosis or post-intrastent restenosis treatment. Even IVUS rarely shows what OCT would about what happens to the neointima.

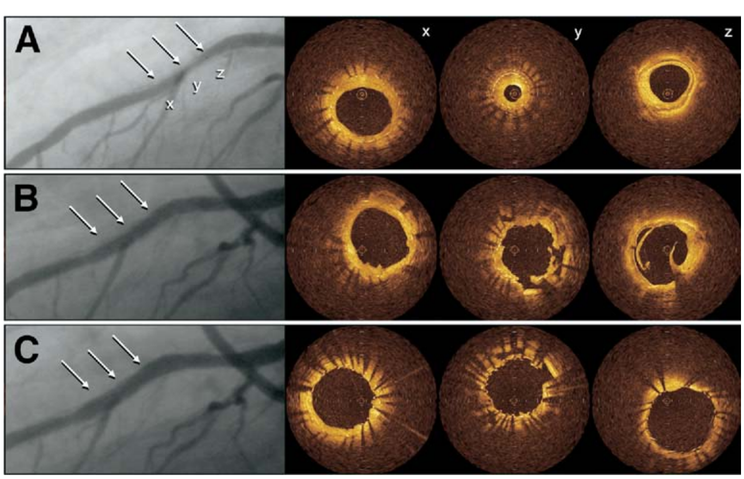

Figure 1. Under-Expansion of a Drug-Eluting Stent.

Coronary Angiograms **(left)** and OCT image **(right)** at distal **(x)**, target **(y)**, and proximal **(z)** sites. Balloon dilatation of underexpanded stent **(Ay)** resulted in neointimal shredding **(By)** which was adequately corrected by stent deployment **(Cy)**. OCT = optical coherence tomography.

Pascal Motreff, MD
***Geraud Souteyrand, MD**

*CHU Clermont-Ferrand
Department of Cardiology
BP 69
63000 Clermont-Ferrand
France
E-mail: gsouteyrand@chu-clermontferrand.fr

doi:10.1016/j.jcmg.2008.11.008

REFERENCE

1. Kubo T, Imanishi T, Kitabata H, et al. Comparison of vascular response after sirolimus-eluting stent implantation between patients with unstable and stable angina pectoris, a serial optical coherence tomography study. J Am Coll Cardiol Img 2008;1:475–84.

REPLY

Developments of drug-eluting stent and intravascular coronary imaging have dramatically changed interventional cardiology. The case reported by Drs. Motreff and Souteyrand demonstrated the contribution of optical coherence tomography (OCT) to precise diagnosis during coronary intervention.

In the past decade, intravascular ultrasound (IVUS) has played an important role in understanding failure and optimizing outcome in stent treatment. However, due to its relatively low resolution, IVUS does not provide detailed structural information. The OCT uses advanced photonics and fiberoptics to obtain images and tissue characterization on a microscopic scale. The resolution of the OCT is 10 to 20 μm, which is approximately 10 times higher than that of IVUS. Compared with conventional imaging modalities, OCT has a superior ability to visualize stent malapposition, tissue protrusion, and vessel injury after stenting as well as thin tissue coverage of individual stent struts at follow-up (1). Nevertheless, the clinical relevance of these small, detailed features identified by OCT has not been determined yet. Assessment for the clinical reliability of OCT guidance in coronary intervention warrants further investigation.

An inherent limitation of OCT is the need to occlude coronary artery by balloon catheter and to flush Ringer's lactate solution for image acquisition. The coronary occlusion limits evaluation of left main or ostial lesions of the major coronary arteries. And the time constraint imposed by blood flow interruption limits assessment of long coronary segments. To overcome the vessel occlusion blood removal technique, an alternative method based on nonocclusive infusion of isosmolar contrast media has been proposed as a safe and effective method (2). The newly proposed method simplifies the previous complex occlusive technique, leading to a marked reduction of procedural time.

Recently, the second-generation OCT system has been shown to be an enabling technology with 15 to 50 times faster image acquisition rate than that of the currently available OCT system. This capability is made possible by a new detection method called Fourier-domain OCT, frequency-domain OCT, or spectral-domain OCT. In combination with a short, nonocclusive saline flush and rapid spiral pullback, the higher frame rates generated by second-generation OCT enable imaging of the 3-dimensional microstructure of long segments of coronary arteries (3). Moreover, the use of this method facilitates the acquisition of spectroscopic and polarization data for tissue characterization. When the second-generation OCT system is fully exploited, it might provide new insights into the treatment of coronary artery disease.

Takashi Kubo, MD, PhD
***Takashi Akasaka, MD, PhD**

*Department of Cardiovascular Medicine
Wakayama Medical University
811-1 Kimiidera
Wakayama, 641-8509
Japan
E-mail: akasat@wakayama-med.ac.jp

doi:10.1016/j.jcmg.2008.12.001

REFERENCES

1. Kubo T, Imanishi T, Kitabata H, et al. Comparison of vascular response after sirolimus-eluting stent implantation between patients with unstable and stable angina pectoris, a serial optical coherence tomography study. J Am Coll Cardiol Img 2008;1:475–84.
2. Prati F, Cera M, Ramazzotti V, et al. Safety and feasibility of a new non-occlusive technique for facilitated intracoronary optical coherence tomography (OCT) acquisition in various clinical and anatomical scenarios. EuroIntervention 2007;3:365–70.
3. Tearney GJ, Waxman S, Shishkov M, et al. Three-dimensional coronary artery microscopy by intracoronary optical frequency domain imaging. J Am Coll Cardiol Img 2008;1:752–61.

Seeing or Hearing to Believe, or Both?

I have read with great interest the insightful editor's page of the September issue of *iJACC* (1) which states that physicians will be imagers, with imaging becoming a mainstay of physical examination, diminishing the need for relying on stethoscopes. "Only seeing will be believing!" and thus, the traditional models of teaching will change subsequent to this cultural change.

I cannot help but respectfully disagree with this vision of imaging technology possibly being the bridge of interaction between 2 human beings, one of whom is exposing his/her body and mind with all their imperfections, miseries, fears, and hopes to another who must use all his/her senses in an orchestrated manner to conceptualize illness and deliver personalized care. I picture an environment in which the cardiovascular examination of a patient is worthless unless the "pre-condition" of a bedside hand-held echocardiogram has been previously obtained. The concept is much more worrisome in light of the existing corporative "push" of technology use by for-profit-driven entities. Furthermore, how does this imaging future apply to less-fortunate nations and patients who do depend on their physician's auscultatory and physical exam competence for their well-being? And what will happen to the time spent face-to-face