

What is the utility of OCT in detecting an unsuspected calcified coronary lesion?

A 76-year-old, physically active woman with multiple comorbidities presented with a history of progressive exertional angina within the last 6 months, which had become very limiting for her daily activity performance. Results of a nuclear stress test demonstrated inferolateral perfusion defect consistent with ischemia and hyperdynamic left ventricle (LV) function (ejection fraction 80%). Her medical history was relevant for insulin-dependent diabetes, hypertension, hyperlipidemia, chronic renal insufficiency (baseline creatinine of 1.6 mg/dL), and a strong family history of coronary artery disease.

Coronary angiography was performed via the right radial approach and showed severe stenosis involving the mid-left circumflex artery (Figure 1), with nonobstructive disease in the other coronary territories. Ventriculography showed hyperdynamic LV systolic function (ejection fraction 80%), with evidence of LV hypertrophy and elevated end-diastolic pressure (22 mm Hg). Due to significant renal dysfunction, the procedure was staged for contrast-induced nephropathy prophylaxis and clopidogrel loading.

The procedure was performed via a left radial approach using a 6-F CLS 3.5 catheter (Boston Scientific Corporation, Natick, MA). An attempt was made to interrogate the lesion with intravascular ultrasound (IVUS); however, the lesion was unable to be crossed. Subsequent attempts with a small balloon also failed to cross the lesion. As a result, rotational atherectomy was performed using a 1.5-mm burr, with prolonged ablation time (up to 7 minutes). After balloon dilatation with a non-compliant balloon, IVUS (Figure 2) and optical coherence tomography (OCT) (Figure 3) images were obtained, which consistently showed a severe and long calcified lesion. Calcium was recognized on OCT by a nonhomogeneous plaque component with low reflectivity and low attenuated areas (due to good light depth penetration into

calcium) as opposed to IVUS, without shadowing behind, with well-defined sharp margins (Figure 3A through D). Subsequently, a 2.75- X 23-mm everolimus-eluting stent was deployed at high pressure. An excellent angiographic result (Figure 4) was achieved and confirmed by IVUS and OCT images, both demonstrating excellent, appropriately sized stent expansion (Figure 5). Interestingly, OCT showed areas of minimal incomplete stent apposition and proximal edge dissection not identified by IVUS.

This case illustrates that severe undilatable calcified lesions are frequently missed by angiography, as confirmed by IVUS and OCT. Approximately 25% of severely calcified lesions are completely missed by angiography.¹ This severely calcified lesion, with a concentric ring of calcium, required precise preparation with rotational



Figure 1. Baseline coronary angiography showing the presence of severe stenosis involving the mid-left circumflex artery (arrow).

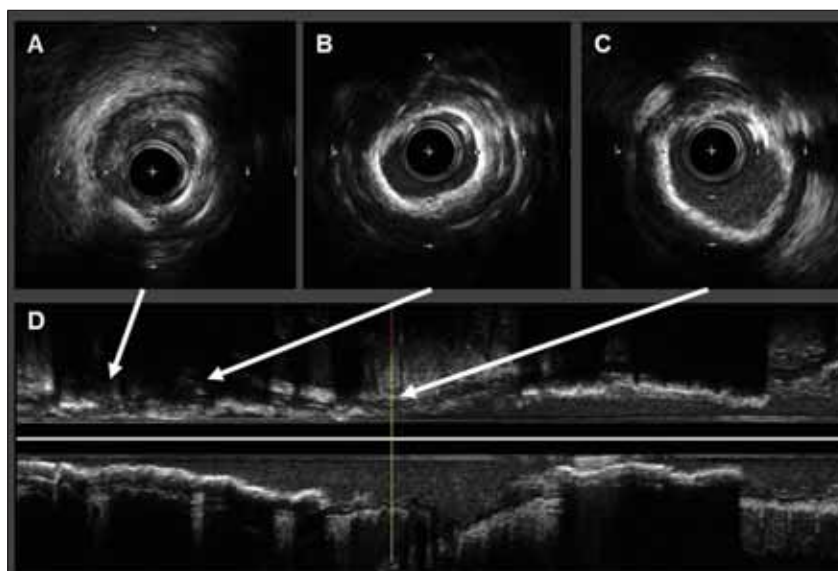


Figure 2. Intravascular ultrasound (IVUS) performed after rotational atherectomy and balloon dilatation of the mid-left circumflex artery. IVUS shows severe vessel calcification in the cross-sectional views (A-C) and long-run view (D), with a circumferential ring of calcium (C) (IVUS runs from left to right, corresponding from distal to proximal). The arrows indicate the corresponding cross-sectional IVUS images with the long-run IVUS view.

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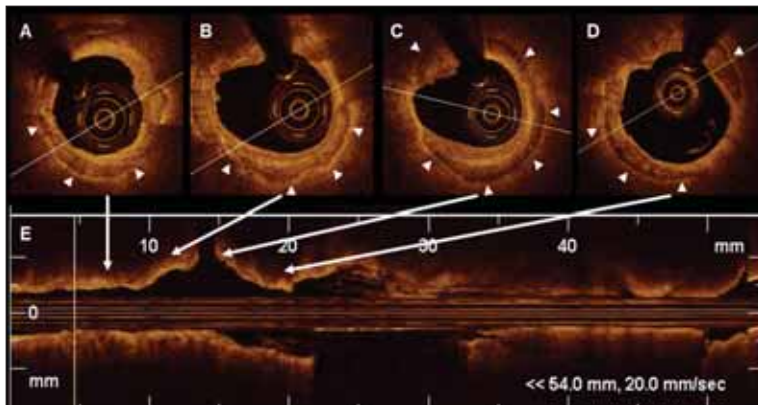


Figure 3. Optical coherence tomography (OCT) of the mid-left circumflex artery after rotational atherectomy and balloon dilatation. OCT showing the cross-sectional views (A-D) and long-run view (E) (from left to right, corresponding from distal to proximal). Severe vessel calcification is shown in great detail in the axial views. Calcium is recognized by a heterogeneous plaque component with low reflectivity, low attenuation, and sharp edges (indicated by white arrowheads in axial views). The arrows indicate the corresponding cross-sectional OCT images with the long-run OCT view.

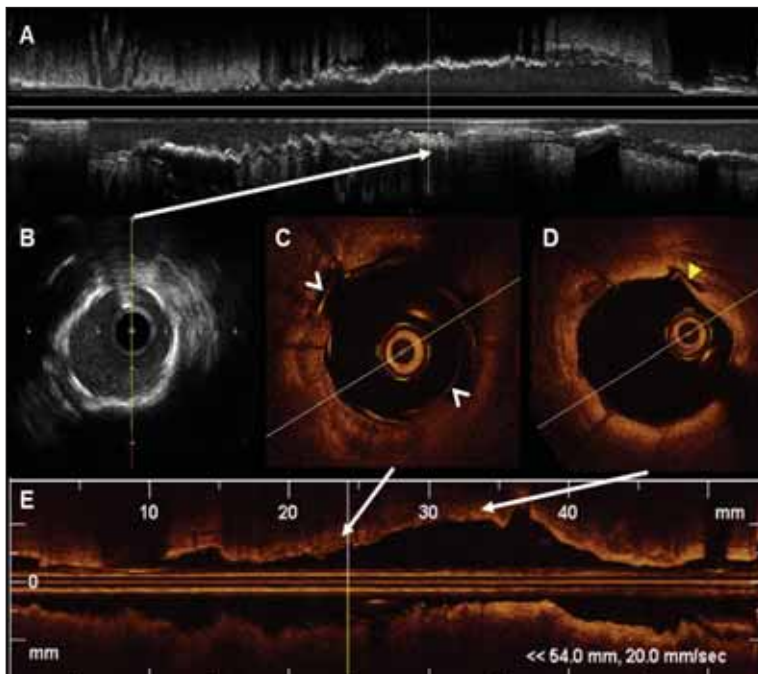


Figure 5. IVUS and OCT results after stenting. IVUS images demonstrate adequate stent expansion and apposition (A, B). OCT imaging shows areas of incomplete strut apposition to the vessel wall (C; white arrows) and an area of minimal proximal edge dissection (D; yellow arrowhead). Both IVUS and OCT long-run views run from distal to proximal, from left to right. The arrows indicate the corresponding cross-sectional OCT/IVUS images with the long-run OCT/IVUS view.



Figure 4. Final angiographic result after stenting of the mid-left circumflex artery.

atherectomy, which otherwise could lead to stent underexpansion and further complications.

In this case, OCT appears to be particularly useful in precisely defining the vessel size and, in great detail, the severity and distribution of calcium,² which helped to guide our strategy for percutaneous coronary intervention. Kume et al recently reported OCT as being more accurate than IVUS in assessing calcification area, with better correlation to histological examination than IVUS in a series of 33 examined cadavers.³ OCT also allows for determining, in a detailed manner, the appropriateness of stent expansion and apposition and the presence of stent-edge dissection with greater resolution than IVUS. ■

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3. Kume T, Okura H, Kawamoto T, et al. Assessment of the coronary calcification by optical coherence tomography. *EuroIntervention*. 2011;6:768-772.