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IMAGING VIGNETTE

Combined Use of OCT and IVUS in Spontaneous Coronary Artery Dissection

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SPONTANEOUS CORONARY ARTERY DISSECTION (SCAD) REPRESENTS A DIAGNOSTIC CHALLENGE (1,2). In this study, we used a combined imaging strategy, intravascular ultrasound (IVUS) and optical coherence tomography (OCT), in 8 patients with SCAD. The diagnosis of SCAD required the visualization of an intimomedial membrane with a double-lumen or intramural hematoma (Figs. 1, 2, and 3). Their mean age was 50 ± 10 years, 6 patients were female, and all presented with acute coronary syndromes. Angiographically, all patients had diffuse lesions (38 ± 23 mm), but only 1 showed a radiolucent flap. Both imaging techniques clearly depicted the true and false lumens (Figs. 1, 2, and 3). OCT was superior to IVUS in the identification of intimal ruptures and intraluminal thrombi (Table 1). OCT nicely depicted the false lumen/intramural hematoma, but its full extension could not be measured in some areas because of residual blood, shadowing, or insufficient penetration. On IVUS, the lumen-intimal interface was not as sharply delineated, but this technique enabled a more complete vessel visualization with significantly longer assessment of the diseased segment and larger false lumen areas (Table 1). In 5 cases, IVUS unraveled a characteristic heterogeneous pattern within the false lumen (Fig. 3). In 2 patients, the dissecting membrane had blurred trailing edges on OCT, whereas IVUS revealed a characteristic 3-layered appearance overhanging a darker thrombosed false lumen (Fig. 2). After stenting (n = 3), residual abluminal and distal hematomas were well detected with both techniques, but malapposed struts were more clearly visualized by OCT (Table 1). Our findings suggest that the combined use of OCT and IVUS provides valuable, unique, and complementary diagnostic insights on the pathophysiological substrate of SCAD.

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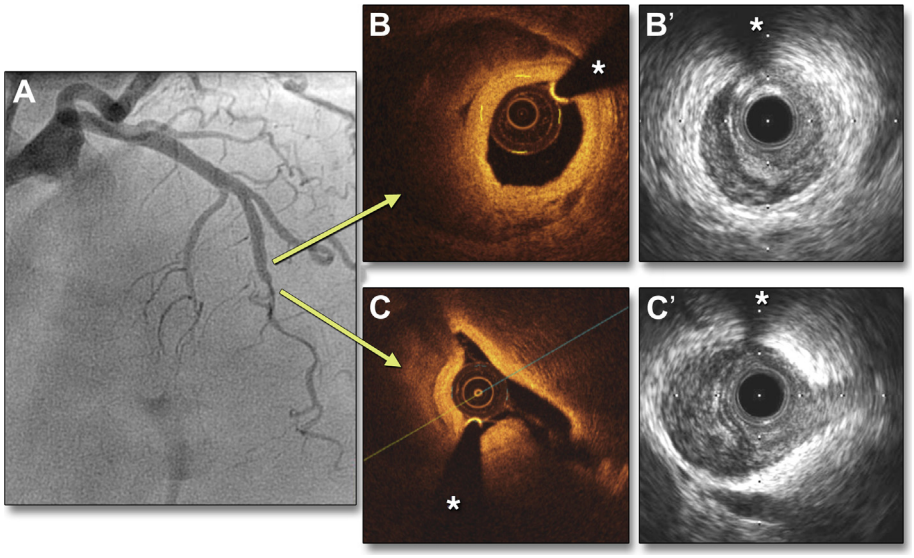

Figure 1. Combined Intravascular Imaging in a Patient With Suspected SCAD

(A) Angiographic image of a long lesion in the left anterior descending coronary artery suggestive of spontaneous coronary artery dissection (SCAD). The proximal aspect of the diseased segment shows an intimomedial membrane and a double lumen appearance by optical coherence tomography (OCT) **(B)** and intravascular ultrasound (IVUS) **(B')**. At this site, the complete vessel is visualized by both techniques, although thrombus in the false lumen is more clearly depicted by IVUS. **(C)** More distally, OCT detects a severely narrowed lumen and a side branch exit from the true lumen (4 o'clock position). The thickness of the intimomedial membrane is well visualized (5 to 11 o'clock position), but severe attenuation prevents visualization of dorsal structures. **(C')** IVUS displays the false lumen content better and detects the side branch take off from the true lumen (3 o'clock position). *Denotes wire artifact.

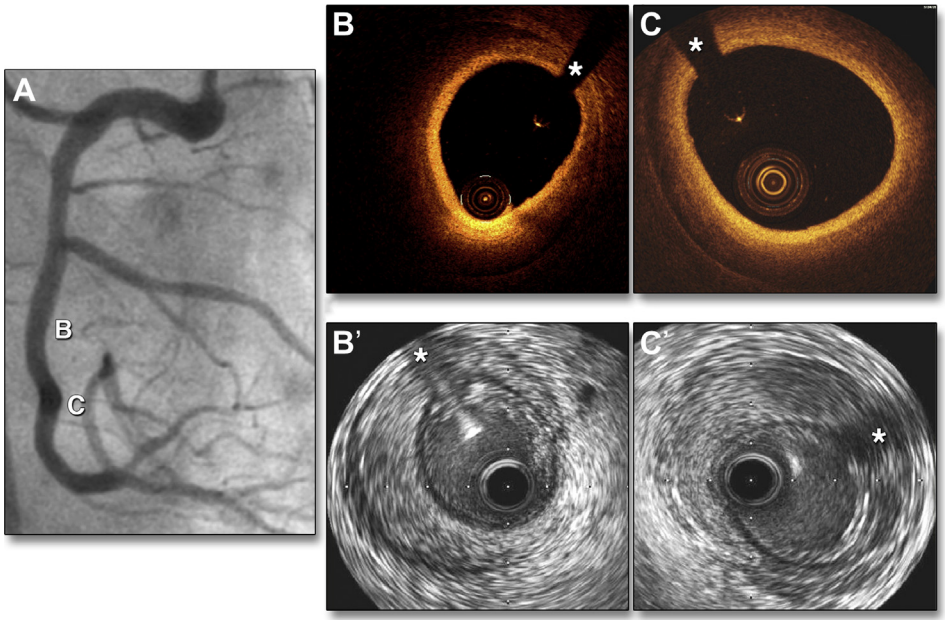

Figure 2. Combined Intravascular Imaging in a Patient With Normal Angiography Findings

(A) Angiographically silent spontaneous coronary artery dissection (SCAD). **(B, C)** Optical coherence tomography: images of intramural hematoma. The external elastic lamina is poorly visualized. **(B', C')** Intravascular ultrasound. Intramural hematoma with homogeneous **(B')** and heterogeneous **(C')** content. Notice the 3-layered membrane overlying the false lumen and the complete visualization of the external elastic lamina. *Denotes wire artifact.

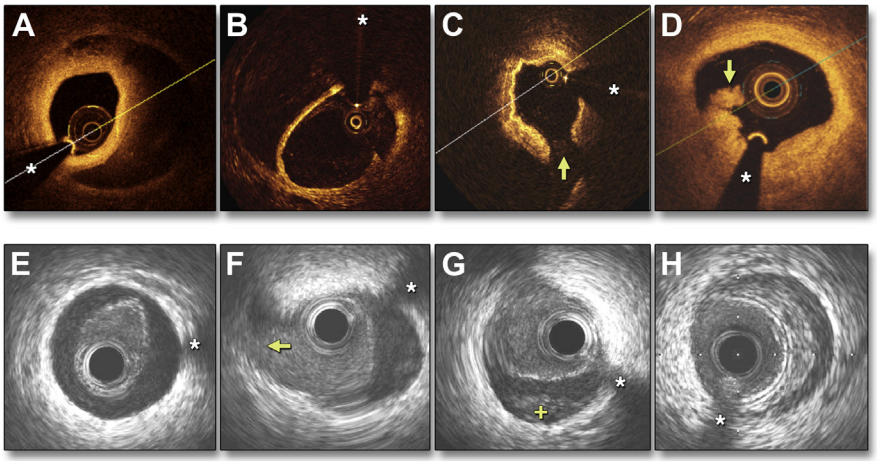

Figure 3. Representative Intracoronary Images From Different Patients

Optical coherence tomography (OCT) images. **(A)** Double lumen with a thick intimomedial membrane. **(B)** Double lumen with a thin intimal membrane. **(C)** Intimal rupture **(arrow)**. **(D)** Intracoronary thrombus protruding into the true lumen **(arrow)**. Intravascular ultrasound (IVUS) images. **(E)** Elliptical, echogenic, true lumen fully detached from the outer vessel wall. **(F)** Double lumen with a side branch **(arrow)** emerging from the true lumen. **(G)** Double lumen with false lumen thrombosis **(+)**. **(H)** Intramural hematoma. Notice the 3-layered appearance of the intimomedial membrane and the layered, crescent-shaped, intramural hematoma. Overall, the intimomedial thickness was better measured with OCT due to the better near-field resolution. However, this was challenging in 2 cases in which the dissection trailing edge progressively faded off into an underlying hematoma; IVUS, however, clearly displayed the true thickness of the flap. The true lumen tended to be smaller than the false lumen, and some segments showed an elliptical morphology suggestive of extrinsic compression. *Denotes wire artifact.

Table 1. OCT/IVUS

OCT/IVUS Patient #	Adequate Image Quality, Length, mm	Complete Visualization of False Lumen, Length, mm	Rupture Site Identification	True Lumen Minimal Area, mm^2	False Lumen Maximal Area, mm^2	Minimal True/False Lumen ratio
1+	40/NA	20/NA	Yes/no	1.00/NA	9.0/NA	0.1/NA
2	22/76	6.0/28.3	Yes/no	1.39/2.2	4.2/9.1	0.5/0.3
3	31/53	12/40.4	Yes/yes	0.97/1.9	4.3/6.7	0.5/0.3
4	37/97	18.4/32	Yes/no	0.95/2.4	4.6/5.2	0.2/0.5
5	50/63	18/25.9	Yes/yes	1.80/2.3	3.7/5.7	0.4/0.6
6	49/20	16.0/12.3	No/no	0.74/1.5	4.5/7.9	0.2/0.2
7	101/100	39.0/90.8	Yes/no	4.48/6.2	16.0/17.4	0.5/0.5
8	48/30	6.6/16.9	No/no	2.69/2.4	7.4/9.7	0.4/2.2
	48 ± 25/63 ± 31	17 ± 11/35 ± 26*	6/2	1.8 ± 1.3/2.7 ± 1.6	6.4 ± 4.4/8.8 ± 4.1*	0.4 ± 0.2/0.4 ± 0.1

Values are presented in pairs (OCT/IVUS). OCT was performed with time domain (n = 3) or frequency domain (n = 5) systems. OCT measurements were performed using proprietary software. IVUS imaging was performed with mechanical catheters and measured with validated system. Special care was taken to ensure adequate matching, but eventually some differences among techniques resulted from measurements obtained at different sites as the result of shadowing/attenuation on OCT. Minimal (185 ± 64 μm vs. 191 ± 63 μm) and maximal (409 ± 131 μm vs. 349 ± 68 μm) thickness of the intimomedial membrane was similar on OCT and IVUS. However, the intimal tear was better recognized by OCT, whereas IVUS allowed a longer and deeper analysis of the diseased coronary segment. *$p < 0.05$ (OCT vs. IVUS).
IVUS = intravascular ultrasound; OCT = optical coherence tomography; + = quantitative data not available.

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