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Correlation between in vivo near-infrared spectroscopy and optical coherence tomography detected lipid-rich plaques with post-mortem histology

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Classifications: Intravascular ultrasound, optical coherence tomography, other imaging modalities

Short title: Correlation of LRPs by NIRS, OCT, and histology

A 67-year-old female presented with an acute anterior STEMI and underwent percutaneous coronary intervention of the mid-left anterior descending (LAD) coronary artery. Following successful implantation of two drug-eluting stents with TIMI III flow, multimodality imaging using near-infrared spectroscopy with intravascular ultrasound (NIRS-IVUS) and optical coherence tomography (OCT) was performed in the LAD and right coronary artery (RCA) in the setting of an imaging study (A1 and B1).

The NIRS-chemogram of the LAD and RCA showed two lipid-rich plaques (LRPs). The 4mm segment with the maximum amount of lipid (maxLCBI_{4mm}) was 488 in the LAD and 309 in the RCA, respectively (Panel A2 and B2). Matched OCT and IVUS of the NIRS-detected LRPs of the LAD and RCA showed a fibroatheroma with a fibrous cap thickness of approximately 300µm and a plaque burden of 76% in the LAD and a fibroatheroma with a fibrous cap thickness of approximately 350µm and a plaque burden of 40% in the RCA (A3 and B3). Of note, the calcification challenges the lipid-detection by OCT and should not be misinterpreted as lipid (arrow).

The further course was uneventful until day 5 when the patient suffered from pulseless electrical activity. Immediate cardiopulmonary resuscitation was unsuccessful and an autopsy was performed confirming a ventricular myocardial rupture with cardiac tamponade as the immediate cause of death. The previously imaged vessels were further examined by histology (Verhoeff-van Gieson Stain) and showed two LRPs, confirming the previous assessment by in-vivo intracoronary imaging (A3 and B3).

This cardiovascular flashlight uniquely confirms the good concordance between NIRS, OCT and postmortem histopathology for lipid detection but also illustrates challenges in the differentiation between lipid and calcium.

Figure legend

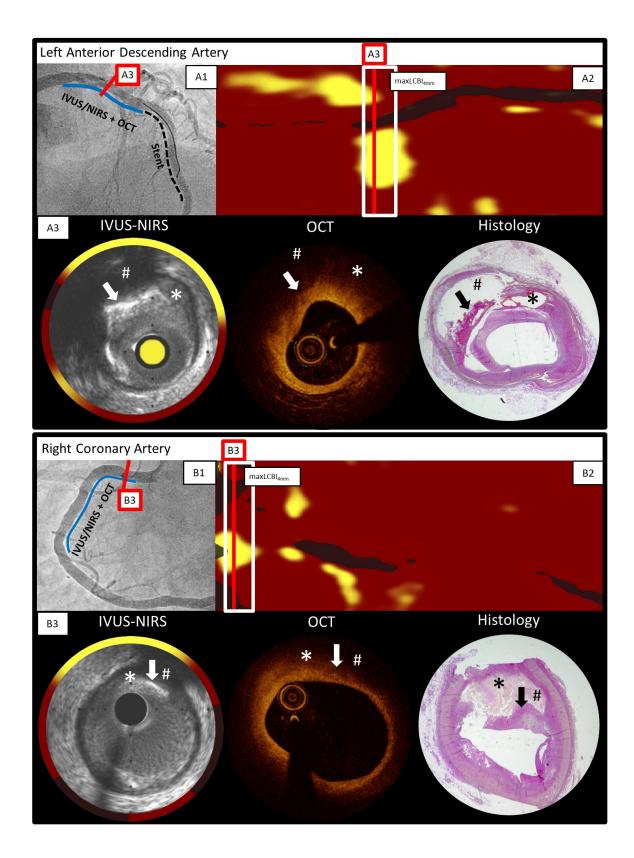
A1 and B1: Angiography of LAD and RCA, respectively.

A2 and B2: NIRS-chemogram of LAD and RCA, respectively. The red line indicates where lipid accumulation was maximal according to chemogram and matching with OCT and post-mortem histology was performed.

A3 and B3: Matched IVUS-NIRS, OCT and post-mortem histology cross-sections. The asterisk marks the lipid pool. The arrow points to the calcium to confirm appropriate matching. Histopathology specimen confirmed NIRS-detected lipid behind the calcium, which could not be detected by OCT (hashtag).

B3 histopathology cross-section: The calcific tissue is not clearly demarcated by histology and can only be estimated (arrow). The fibrous cap is ruptured during the fixation process, pretending a much bigger plaque burden than in IVUS and OCT and the lumen contour remains elusive.

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