

CLINICAL RESEARCH: CORONARY ARTERY DISEASE

The Dynamic Nature of Coronary Artery Lesion Morphology Assessed by Serial Virtual Histology Intravascular Ultrasound Tissue Characterization

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Objectives: We used virtual histology intravascular ultrasound (VH-IVUS) to investigate the natural history of coronary artery lesion morphology.

Background: Plaque stability is related to its histological composition.

Methods: We performed serial (baseline and 12-month follow-up) VH-IVUS studies and examined 216 nonculprit lesions (plaque burden $\pm 40\%$) in 99 patients. Lesions were classified into pathological intimal thickening (PIT), VH-IVUS-derived thin-capped fibroatheroma (VH-TCFA), thick-capped fibroatheroma (ThCFA), fibrotic plaque, and fibrocalcific plaque.

Results: At baseline, 20 lesions were VH-TCFAs; during follow-up, 15 (75%) VH-TCFAs "healed," 13 became ThCFAs, 2 became fibrotic plaque, and 5 (25%) VH-TCFAs remained unchanged. Compared with VH-TCFAs that healed, VH-TCFAs that remained VH-TCFAs located more proximally (values are median [interquartile range]) (16 mm [15 to 18 mm] vs. 31 mm [22 to 47 mm], $p = 0.013$) and had larger lumen (9.1 mm^2 [8.2 to 10.7 mm^2] vs. 6.9 mm^2 [6.0 to 8.2 mm^2], $p = 0.021$), vessel (18.7 mm^2 [17.3 to 28.6 mm^2] vs. 15.5 mm^2 [13.3 to 16.6 mm^2]; $p = 0.010$), and

plaque (9.7 mm² [9.6 to 15.7 mm²] vs. 8.4 mm² [7 to 9.7 mm²], p = 0.027) areas; however, baseline VH-IVUS plaque composition did not differ between VH-TCFAs that healed and VH-TCFAs that remained VH-TCFAs. Conversely, 12 new VH-TCFAs developed; 6 late-developing VH-TCFAs were PITs, and 6 were ThCFAs at baseline. In addition, plaque area at minimum lumen sites increased significantly in PITs (7.8 mm² [6.2 to 10.0 mm²] to 9.0 mm² [6.5 to 12.0 mm²], p < 0.001), VH-TCFAs (8.6 mm² [7.3 to 9.9 mm²] to 9.5 mm² [7.8 to 10.8 mm²], p = 0.024), and ThCFAs (8.6 mm² [6.8 to 10.2 mm²] to 8.8 mm² [7.1 to 11.4 mm²], p < 0.001) with a corresponding decrease lumen areas, but not in fibrous or fibrocalcific plaque.

Conclusions: Most VH-TCFAs healed during 12-month follow-up, whereas new VH-TCFAs also developed. PITs, VH-TCFAs, and ThCFAs showed significant plaque progression compared with fibrous and fibrocalcific plaque.

Key Words: atherosclerosis • coronary disease • intravascular ultrasound • virtual histology

Abbreviations and Acronyms

DC = dense calcium

EEM = external elastic membrane

FF = fibrofatty

FT = fibrotic tissue

IVUS = intravascular ultrasound

NC = necrotic core

PIT = pathological intimal thickening

P&M = plaque and media

TCFA = thin-capped fibroatheroma

ThCFA = thick-capped fibroatheroma

VH-IVUS = virtual histology intravascular ultrasound

VH-TCFA = virtual histology intravascular ultrasound–derived thin-capped fibroatheroma

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