MORPHOLOGY AND COMPOSITION OF ADVANCED CORONARY PLAQUES IN HISTOLOGY PREDICT THE DELINEATION OF THE OF NAPKIN RING SIGN IN CORONARY CT ANGIOGRAPHY

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Background: A plaque with a low attenuation core and a high attenuation rim has been termed napkin ring sign (NRS) in coronary CT angiography (CCTA). The NRS has been shown to be a highly specific yet poorly sensitive marker of advanced atherosclerotic lesions. We sought to identify histologic characteristics of advanced atherosclerotic lesions that predict the delineation of the NRS in CCTA.

Methods: We scanned 7 human donor hearts using a high resolution CT system (Lightspeed Discovery 750HD, GE Healthcare, Milwaukee) and a standard coronary CTA protocol. Histological slicing and stainings (HE and Movat’s Pentachrome) were performed in 1.5 mm increments of each major coronary artery. CT-data was co-registered with Histology. Lesions were classified according to the modified AHA classification.

Results: A total of 611 cross sections were co-registered. Advanced plaques (AHA types IV to VI) were present in 139 (23%) cross sections of which 33 (24%) demonstrated the NRS in CCTA. The napkin ring sign was more frequent in late fibroatheromas (61% NRS vs. 38% non-NRS, p<0.05), and associated with greater non-core plaque area (median 10.2 vs. 6.4 mm², p<0.01) and larger vessel area (median 17.1 vs. 13.0 mm², p<0.01). The area of the necrotic/lipid core tended to be larger in plaques with NRS (median 1.1 vs. 0.5 mm², p=0.05). Angiogenesis was more common in plaques with NRS (48% vs. 30%; p=0.06), whereas micro-calcifications were more common in plaques without NRS (27% vs. 46%; p=0.07). In a multivariate analysis, necrotic/lipid core area (OR=2.1), non-core plaque area (OR=1.7), and total vessel area (OR=0.9) were independent predictors of NRS delineation (all p<0.007).

Conclusion: Delineation of the NRS in coronary atherosclerotic plaques using CTA is independently linked to the size of the necrotic/lipid core and the non-core plaque as well as to the vessel area as measured in histology. As these features have been associated with advanced atherosclerotic and even rupture-prone lesions in histology, the napkin ring sign can possibly serve as a marker for the most advanced lesions in coronary CT angiography.