The natural history and prediction of 10-year plaque progression on serial coronary CT angiography

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Background: Several studies have shown that plaque subcomponents such as low-attenuation or non-calcified plaque volume from coronary CT angiography (CCTA) are associated with the occurrence of major adverse cardiovascular events. However, it remains unknown how plaque morphology progresses over the long-term. Furthermore, it is unknown which plaque characteristics put patients at increased risk of plaque progression which would require more intensive image-guided follow-up. This study investigated the natural history and predictors of long-term coronary plaque progression in a serial CCTA cohort of patients with suspected coronary artery disease (CAD).

Methods: In this follow-up study, 539 patients from an earlier published CCTA cohort (Diemen, 2021) were invited for repeat CCTA imaging per-protocol, regardless of symptoms. A total of 299 patients underwent follow-up CCTA imaging with a median scan interval of 10.2 [8.7-11.2] years. Patients who underwent coronary artery bypass grafting (CABG) between baseline and follow-up imaging were excluded. All scans were analyzed using artificial intelligence-guided quantitative CCTA (AI-QCT). Revascularized vessels were excluded. Quantitative plaque volumes (total, low-density, non-calcified and calcified plaque) depicted by AI-QCT were divided by the total vessel volume to represent percent atheroma volume (PAV). PAV progression was calculated subtracting baseline PAV from follow-up PAV. The association of the plaque components with PAV progression was evaluated in a multivariate linear regression model adjusted for clinical risk characteristics (age, sex, hypertension, hypercholesterolemia, diabetes, BMI, smoking, family history of CAD and statin use).

Results: In total, 274 patients without CABG were used for the serial analysis, mean age was 57 years, 42% were women. At baseline, median PAV was 2.5% [IQR 0.7-8.1], which increased to 6.1% [IQR 1.2-12.9] at follow-up (Figure). The mean PAV progression was 0.4±0.5% per year. Adjusted for clinical risk characteristics and other plaque volumes, baseline percent non-calcified plaque volume (NCP) was the only plaque volume associated with PAV progression (0.5% PAV progression increase per % increase in baseline non-calcified plaque volume).

Conclusion: Using an unique long-term serial CCTA cohort undergoing per-protocol repeat imaging with a 10-year scan interval, we found that coronary plaque burden more than doubled. Interestingly, the amount of non-calcified plaque volume at baseline was the only predictor for disease progression.