Prognostic value of a novel artificial intelligence-based coronary computed tomography angiography-derived ischemia algorithm for patients with suspected coronary artery disease

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Introduction: Coronary computed tomography angiography (CCTA) has emerged as the first-line, non-invasive imaging tool to detect coronary artery disease (CAD) in patients with low to intermediate pre-test probability of CAD. However, CCTA cannot directly assess the presence of ischemia, which may lead to further downstream testing. A novel artificial-intelligence (AI)-based algorithm, comprising a machine-learned method that leverages atherosclerosis and vascular morphology features to determine vessel-level coronary ischemia from CCTA images, may be useful in this regard.

Purpose: We aimed to investigate the prognostic value of the AI-based ischemia algorithm for clinical events among symptomatic patients with suspected CAD referred for CCTA.

Methods: The AI-based ischemia algorithm was calculated by analysts blinded for patient characteristics and clinical outcomes using CCTA data from patients with suspected CAD who underwent clinically indicated CCTA at a large tertiary care center from February 2007 to December 2016. The primary endpoint was the composite of death, myocardial infarction (MI), and unstable angina pectoris (uAP) throughout a median follow-up of 8.1 years (IQR 6.0-9.6). Secondary endpoints were the association between the AI-based ischemia algorithm and the primary endpoint among patients with no/non-obstructive (i.e. ≤50%) CAD vs. obstructive (i.e. >50% stenosis) CAD in CCTA.

Results: 1574 patients were evaluated by the AI-based ischemia algorithm and 1540 were analyzable. Patients with positive AI-based ischemia findings (30.4%, n=468) had a significantly higher crude rate of the primary endpoint as compared to patients with negative AI-based ischemia findings (69.6%, n=1072) (HR 2.37, 95% CI 1.80-3.11, p<0.001), driven by higher rates of all endpoint composites (death: HR 1.48, 95% CI 1.13-2.22, p=0.007; MI: HR 5.42, 95% CI 3.10-9.49, p<0.001; uAP: HR 6.76, 95% CI 3.01-15.20, p<0.001). Results were consistent after adjusting for clinical confounders (age, sex, diabetes mellitus, smoking, hypertension, dyslipidemia, BMI>25 kg/m2, CAD family history) (primary endpoint: HR 1.66, 95% CI 1.24-2.22, p=0.001). Positive AI-based ischemia findings were associated with a significantly higher rate of the primary endpoint among patients with no/non-obstructive CAD in CCTA (n=1001/1487) (HR 2.56, 95% CI 1.53-4.27, p<0.001), but not among those with anatomically obstructive CAD in CCTA (n=486/1487) (HR 1.08, 95% CI 0.70-1.66, p=0.715).

Conclusions: A novel AI-based CCTA-derived ischemia algorithm was associated with a 1.7-fold increased adjusted rate of long-term death, MI, or uAP. This AI-based ischemia algorithm may be helpful to improve risk stratification, especially among patients with normal/non-obstructive CCTA.

Kaplan-Meier curves for the primary endpoint (death, MI, uAP) from: A) patients with no/non-obstructive CAD (≤50% stenosis) in CCTA, and B) patients with obstructive CAD (>50% stenosis) in CCTA.