Long-Term Risk Prediction and Detection of Aortic Stenosis From AI-Quantified Multisite Calcification on Noncontrast CT: An AI-CVD Analysis of MESA

Original Research | MESA and Framingham Offspring Study

Background and objective

Aortic stenosis (AS) may remain clinically silent until severe, while cardiac remodeling and fibrosis can begin earlier. This study evaluated whether artificial intelligence-derived cardiovascular phenotypes from noncontrast cardiac CT are associated with incident AS and can support long-term risk prediction and disease detection.

Methods

The prediction analysis included 5,520 MESA participants who underwent baseline noncontrast cardiac CT. Incident AS was identified through adjudicated events and Exam 6 echocardiography. Associations were assessed using multivariable Cox models. A random survival forest prediction model was internally validated with nested cross-validation. A separate detection model was developed among 1,857 MESA Exam 6 participants with paired CT and echocardiography and externally evaluated in the Framingham Heart Study.

Results

Over a median 16.7 years of follow-up, 157 participants developed AS. Aortic valve calcium (AVC) showed the strongest association with incident AS (hazard ratio per standard-deviation increase, 4.34; 95% CI, 3.33-5.66). At 10 years, the AI-CVD model incorporating age, sex, AVC, mitral valve calcium, and thoracic aortic calcification achieved an AUROC of 0.973, compared with 0.809 for the clinical model; corresponding AUPRC values were 0.256 and 0.024. The detection model achieved an AUROC of 0.946, sensitivity of 87.8%, and specificity of 94.5% in external evaluation.

Conclusions

AI-derived calcification phenotypes from noncontrast CT were associated with incident AS and improved prediction performance over routinely measured clinical factors in this study. A separate imaging-based model also showed strong external detection performance. Further validation is needed to establish clinical implementation and impact.

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