Editorial

Coronary CT Angiography in 2025: Long-Term Evidence, Artificial Intelligence, and the Photon-Counting Era

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Coronary CT Angiography (CCTA) has become established as a first-line test in the evaluation of chest pain, supported by robust evidence of prognostic impact, advances in Artificial Intelligence (AI), and technological evolution with photon-counting CT. Publications in 2025 reposition CCTA as a central platform for risk stratification and therapeutic guidance in coronary artery disease.

The 10-year follow-up of the SCOT-HEART trial represents a major milestone in this process. Among 4,146 patients with stable chest pain randomized to standard care with or without CCTA, there was a sustained reduction in death from coronary heart disease or nonfatal myocardial infarction in the CCTA-guided group (HR 0.79; 95% CI 0.63–0.99).[1] Although revascularization rates did not differ between groups, the use of preventive therapies was more intensive and consistently maintained over time in the CCTA arm. These findings demonstrate that the direct identification of atherosclerosis leads to more aggressive preventive interventions, with durable effects on clinical outcomes, establishing CCTA as a disease-modifying tool in chronic coronary syndromes.

Complementing this perspective, the DISCHARGE trial evaluated outcomes in 3,561 individuals with stable chest pain and an intermediate pretest probability of Coronary Artery Disease (CAD), randomized to CCTA or invasive coronary angiography.[2] After 3.5 years of follow-up, quality of life and angina reduction were similar between strategies. Women had worse baseline status but experienced greater relative improvement in some domains. Thus, while SCOT-HEART confirms benefits in hard clinical endpoints, DISCHARGE demonstrates that CCTA-based evaluation does not result in worse outcomes compared with invasive angiography, reinforcing its role as the guideline-recommended initial diagnostic test.

In the field of artificial intelligence, 2025 marks the transition of CCTA toward a tool for personalized medicine. The Consensus Statement from the QCI Study Group, published in Nature Reviews Cardiology, recommends routine use of AI-assisted quantitative plaque analysis to guide preventive treatment.[3] The document proposes initiating pharmacologic therapy whenever plaque is present and intensifying treatment when plaque volume exceeds the age- and sex-adjusted 70th percentile. This shift moves clinical decision-making away from traditional risk scores toward imaging-derived biomarkers.

The review by Irannejad *et al*. in the International Journal of Cardiovascular Imaging details the current state of AI applications in CCTA, including automated arterial segmentation, plaque quantification, derivation of functional indices, and predictive models for adverse events.[4] Key challenges remain, including external validation, model transparency, and seamless integration into clinical workflows.

Direct evidence of AI algorithm performance is provided by the study of Maaniitty *et al*., published in the Journal of the American Heart Association.[5] In 1,772 patients with suspected CAD, a CCTA-derived ischemia algorithm demonstrated moderate to substantial agreement with a hybrid CCTA/PET reference standard ($\kappa \approx 0.61$) and similar prognostic performance, with a C-index of approximately 0.73 for death, myocardial infarction, or unstable angina over seven years of follow-up. These findings suggest that AI-enhanced tomographic strategies may serve as simpler and more cost-effective alternatives to hybrid imaging approaches.

On the hardware front, photon-counting CT represents a transformative advance. The review by Shiyovich *et al*. in JACC: Cardiovascular Imaging highlights substantial technological gains, including higher spatial resolution, reduced artifacts, and improved assessment of stents and calcified plaques.[6] Although largely based on observational studies, the evidence points to progressive adoption of this technology in specialized centers, expanding CCTA's ability to integrate anatomic assessment, plaque characterization, and, in the future, myocardial perfusion and late enhancement imaging.

The clinical translation of these benefits is demonstrated by Nakashima *et al*. in the Journal of Clinical Medicine.[7] In a matched cohort of 820 patients, photon-counting CT (PCCT) outperformed conventional CT in diagnostic accuracy for significant stenosis, plaque characterization, and appropriate referral for invasive coronary angiography, particularly in scenarios with heavy calcification. These results indicate that advances in photon-counting technology translate into greater precision in clinical care.

Taken together, these lines of evidence—prognostic impact, AI-driven therapeutic stratification, and next-generation hardware—support a new paradigm in which Coronary CT not only diagnoses disease but also guides long-term prevention and management. CCTA is approaching a unified platform for precision medicine in atherosclerosis.

Keywords

Tomography; Coronary Angiography; Coronary Artery Disease

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The challenge ahead lies in integrating these advances into validated clinical algorithms, incorporating them into guidelines, and disseminating them into everyday practice. The year 2025 may represent the point at which coronary CT moved beyond its traditional anatomic role to become a central axis of therapeutic decision-making in coronary artery disease.

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