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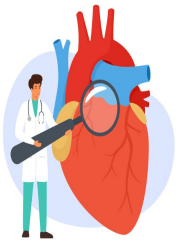
Predicting Cardiovascular Risk in Patients Undergoing Coronary CT Angiography



Coronary computed tomography angiography (CCTA) is commonly used to investigate chest pain and guide treatment decisions for coronary artery disease (CAD). However, it often identifies individuals without significant CAD, whose management and prognosis remain uncertain. The Oxford Risk Factors And Non-invasive imaging (ORFAN) study aimed to assess the role of coronary inflammation, measured by the perivascular fat attenuation index (FAI) Score from CCTA, in predicting cardiovascular risk. This study also evaluated the effectiveness of an artificial intelligence (AI)-assisted algorithm, AI-Risk, in predicting future cardiac events based on factors including FAI Score and traditional risk factors. By analysing data from a large cohort of patients undergoing CCTA, the study sought to improve risk stratification and guide clinical management for individuals with or without visible atherosclerosis.

Insights from a Multicentre Longitudinal Cohort Study

The multicentre longitudinal cohort study involved 40,091 consecutive patients who underwent clinically indicated CCTA across eight UK hospitals. These patients were followed up for major adverse cardiac events (MACE) such as myocardial infarction, new-onset heart failure, or cardiac death for a median of 2.7 years. A subgroup of 3,393 patients from two hospitals with longer follow-up (median 7.7 years) was further analysed.

The study had three main objectives:

- To evaluate the risk profiles and event rates among patients undergoing CCTA as part of routine clinical care in the UK National Health Service (NHS).
- To investigate whether coronary arterial inflammation, measured using the perivascular fat attenuation index (FAI) Score from CCTA, plays a role in driving cardiac mortality or MACE in patients with or without CAD.
- To externally validate the performance of an AI-risk prognostic algorithm, which integrates FAI Score, coronary plaque metrics, and clinical risk factors, in predicting future cardiovascular events in a UK population.

The first objective was assessed using the entire cohort of 40,091 patients (Cohort A), while the latter two objectives were evaluated in a nested longitudinal study within Cohort B, comprising 3,393 patients.

Data collection involved extracting patient information, including demographics and clinical outcomes, from local resources and nationwide databases using ICD-10 codes. The presence of obstructive CAD on CCTA was defined according to established criteria. CCTA scans were transferred to a central laboratory for analysis, and the FAI Score for each coronary artery was generated using specialised software. The AI-Risk algorithm incorporated FAI Score, plaque burden, and traditional risk factors to predict the 8-year risk of a fatal cardiac event for each patient.

Additionally, patients were classified into risk categories based on AI risk. To assess the impact of AI-Risk classification on clinical decision-making, a prospective real-world evaluation survey was conducted in four NHS Hospitals involving 744 consecutive patients undergoing CCTA for investigation of chest pain. Analytical procedures included computing FAI Score and AI-Risk using specialised medical devices, as well as assessing the extent and severity of coronary stenosis. The AI-Risk classification system categorised patients into low or medium risk, high risk, and very high risk based on their AI-Risk scores and FAI Scores.

Enhanced Risk Stratification and Management with FAI Score and AI-Risk Algorithm

Between January 4, 2010, and March 31, 2021, a total of 44,800 CCTA scans were conducted across eight hospitals in the UK. After accounting for individuals who opted out of NHS Digital or lacked local CCTA reports, the resulting ORFAN Cohort A consisted of 40,091 individuals, reflecting the ethnically diverse UK population. In Cohort A, 9.1% were classified as very high risk (QRISK3 ≥20%), while 25.6% fell into the high-risk category (QRISK3 between 10 and 19%). Notably, only 18.9% of patients demonstrated obstructive CAD necessitating further investigation or intervention. Throughout a median follow-up of 2.7 years, patients with obstructive CAD exhibited significantly elevated risks for MACE and cardiac mortality, even after adjusting for various factors like age, sex, cardiovascular risk factors, medications, and medical history.

In the subsequent Cohort B, comprising 3,393 patients with a median 7.7-year follow-up, the FAI Score proved to be a robust predictor of cardiac mortality and MACE across all coronary territories, irrespective of the presence of obstructive CAD. This predictive ability persisted even after adjusting for traditional risk factors and the extent of coronary atherosclerosis. The performance of the AI-Risk algorithm was validated in Cohort B, showing strong alignment between predicted and observed events. The AI-Risk classification effectively stratified patients into risk categories, with those classified as very high risk exhibiting significantly elevated risks for cardiac mortality and MACE compared to those in the low to medium-risk category, regardless of CAD status.

Compared to QRISK3, the AI-Risk classification system significantly reclassified patients for both cardiac mortality and MACE over a 10-year period, particularly in patients without obstructive CAD. The addition of AI-Risk to QRISK3 and CAD-RADS 2.0 notably improved prognostic performance. In a real-world evaluation survey involving 744 participants, the implementation of AI-Risk classification led to substantial changes in management recommendations for 45% of patients, including initiation or adjustment of statin treatment and consideration of additional therapies beyond statins. This comprehensive study underscores the utility of FAI Score and the AI-Risk algorithm in predicting cardiovascular events, emphasising their potential to refine risk stratification and inform clinical decision-making in patients undergoing CCTA.

Refining Risk Assessment in Patients Undergoing CCTA: Insights into Inflammatory Risk and Predictive Modelling

This study highlights that among individuals undergoing CCTA, only a third of future major adverse cardiac events (MACE) occur in those with obstructive coronary artery disease (CAD), indicating the need to identify high-risk individuals without obstructive CAD. Using the perivascular fat attenuation index (FAI) Score to measure inflammation in any coronary artery, the study found that a quarter of individuals without obstructive disease had significantly elevated inflammatory risk, translating into a tenfold higher risk for cardiac mortality or MACE over a 10-year period. The number of inflamed coronary vessels correlated with an increased risk of adverse events.

The AI-Risk algorithm, incorporating FAI Score, coronary atheroma extent, and traditional risk factors, effectively predicted cardiac mortality and MACE over 10 years, regardless of coronary atherosclerosis presence. Since the adoption of CCTA as a primary investigation for chest pain, the majority of patients, especially those without obstructive CAD, are often returned to primary care without further evaluation, indicating a gap in risk assessment and management. The study suggests that CCTA can serve as a preventative tool by identifying at-risk individuals, even in the absence of obstructive CAD.

The findings underscore the importance of targeting anti-inflammatory treatments to patients with coronary artery inflammation, potentially improving treatment allocation compared to systemic markers like high-sensitivity C-reactive protein assays. While the QRISK3 model underperformed in predicting outcomes compared to AI-Risk, possibly due to training differences, the AI-Risk classification system significantly improved risk stratification, particularly in patients without obstructive CAD.

In summary, measuring coronary inflammation from routine CCTA, along with AI-assisted risk prediction tools, can refine risk stratification and guide the precise use of preventative treatments, including anti-inflammatory therapies, in patients undergoing CCTA.

Source: The Lancet

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Published on : Wed, 12 Jun 2024