Diagnostic performance of computed tomography- and magnetic resonance-derived myocardial stress perfusion assessments for the diagnosis of haemodynamically significant coronary artery disease

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Background: The noninvasive assessment of haemodynamically significant coronary artery disease (CAD) using dynamic stress myocardial perfusion imaging by computed tomography (CT-MPI) and cardiac magnetic resonance imaging (CMR-MPI) may aid in correct patient selection for elective invasive coronary angiography.

Purpose: To evaluate the diagnostic performance and incremental value of CT-MPI and CMR-MPI versus cardiac computed tomography angiography (CCTA) alone in the diagnosis of haemodynamically significant CAD using fractional flow reserve (FFR) and quantitative coronary angiography (QCA) as the reference standard.

Methods: Stenosis severity by CCTA and dynamic stress myocardial perfusion by CT (visual CT-MPI and quantitative relative myocardial blood flow (CT-MBF)) and CMR (visual CMR-MPI and semiquantitative myocardial perfusion reserve index (CMR-MPRI)) were assessed in patients with stable angina pectoris. CCTA stenosis =50% was considered obstructive. Optimal thresholds for CT-MBF and CMR-MPRI were defined by area under the receiver-operating characteristics curve (AUC) analysis. Haemodynamically significant CAD was defined as FFR <0.80 or QCA diameter narrowing =80% if FFR was not performed. Odds ratios and diagnostic performance for the diagnosis of haemodynamically significant CAD were determined.

Results: A total of 218 vessels from 93 patients were assessed. Vessel/territorial odds ratios for CCTA stenosis =50%, visual CT-MPI, CT-MBF =0.72 mL/min/gram, visual CMR-MPI, and CMR-MPRI =1.06 for the diagnosis of haemodynamically significant CAD were all highly significant, also after adjustment for age and gender (all p<0.001). The AUC (95% confidence interval (CI)), sensitivity (95% CI), and specificity (95% CI) for CCTA: 0.79 (0.72-0.85), 0.82 (0.68-0.91), and 0.76 (0.69-0.82, respectively; for visual CT-MPI: 0.64 (0.56-0.72), 0.47 (0.34-0.61), and 0.79 (0.72-0.85, respectively; for CT-MBF: 0.86 (0.81-0.92), 0.84 (0.77-0.89), and 0.89 (0.83-0.93), respectively; for visual CMR-MPI: 0.84 (0.77-0.90), 0.79 (0.67-0.88), and 0.88 (0.82-0.92), respectively; for CMR-MPRI: 0.71 (0.64-0.79), 0.53 (0.38-0.66), and 0.89 (0.82-0.94), respectively. Head-to-head, CCTA, CT-MBF and visual CMR-MPI outperformed visual CT-MPI (all p<0.01), and CT-MBF and visual CMR-MPI outperformed CMR-MPRI (all p<0.01). CT-MPI and CMR-MPI yielded significant incremental diagnostic value over CCTA in the diagnosis of haemodynamically significant CAD (see figure). Combined CCTA+CT-MPI and CCTA+CMR-MPI versus CCTA alone resulted in significantly increased specificity from 0.76 to =0.95 (all p<0.001), albeit with a significant decrease in sensitivity from 0.82 to =0.69 (all p<0.05).
Conclusions: CCTA and stress myocardial perfusion assessments by CT and CMR diagnose haemodynamically significant CAD. Both CT-MPI and CMR-MPI provide incremental diagnostic value compared with CCTA alone and can accurately rule out haemodynamically significant CAD.