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QUANTITATIVE THREE-DIMENSIONAL CARDIOVASCULAR MAGNETIC RESONANCE MYOCARDIAL PERFUSION IMAGING IN SYSTOLE AND DIASTOLE AT 3.0 T

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Introduction Two-dimensional (2D) perfusion-CMR has been shown to have greater diagnostic accuracy than single-photon emission CT but remains limited by a lack of complete myocardial coverage. Three-dimensional (3D) whole-heart myocardial perfusion CMR addresses this limitation and has recently been shown to be clinically feasible. However, the feasibility and potential clinical utility of quantitative 3D perfusion measurements, as already shown with 2D-perfusion-CMR and positron emission tomography, has yet to be evaluated. The purpose of this study was to establish the feasibility of quantitative 3D-perfusion-CMR to detect coronary artery disease (CAD). Additionally, as 3D-perfusion-CMR offers the opportunity to select the phase of acquisition, a secondary objective was to determine differences between systolic and diastolic estimates of myocardial blood flow (MBF).

Methods 35 patients underwent 3D-perfusion-CMR (Philips 3T Achieva TX) with data acquired at both end-systole and mid-diastole (figure 1). Systolic and diastolic perfusion images were analysed in separate reporting sessions in random order. Image quality (0=non-diagnostic, 1=poor, 2=adequate and 3=excellent) and the

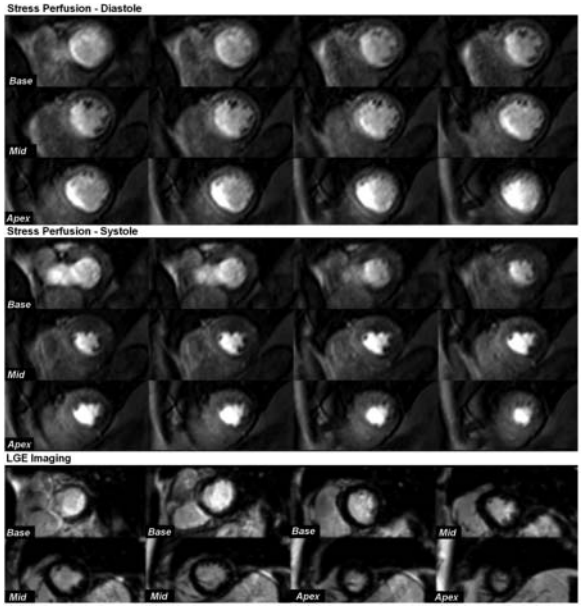

Figure 1

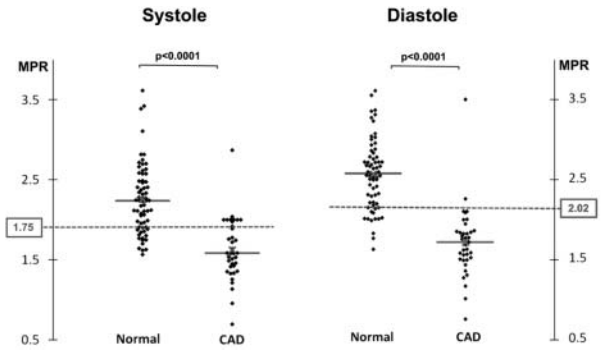

Figure 2

occurrence of artefact related to respiratory-motion, k-t reconstruction or dark-rim artefact (0=none, 1=mild, 2=moderate and 3=severe) were scored. MBF and myocardial perfusion reserve (MPR) were estimated on a per patient and per territory basis by Fermi function deconvolution. CAD was defined as luminal stenosis ≥70% on quantitative coronary angiography.

Results 38 coronary territories had significant CAD. MPR had a high diagnostic accuracy for the detection of CAD, in both systole and diastole (area under curve: 0.92 vs 0.94; p=0.41) (figure 2). At rest, systolic and diastolic MBF estimates were similar—in both normal and diseased territories (no CAD: 1.24±0.15 vs 1.25 ±0.15 ml/g/min, p=0.27; CAD 1.24±0.15 vs 1.26±0.14 ml/g/min, p=0.20). At stress, diastolic MBF estimates were significantly greater than systolic estimates (no CAD: 3.21±0.50 vs 2.75 ±0.42 ml/g/min, p<0.0001; CAD: 2.13±0.45 vs 1.98±0.41 ml/g/min, p<0.0001). The diastolic/systolic stress MBF ratio was significantly reduced in territories with CAD (CAD: 1.08±0.06 vs no CAD: 1.17±0.11; p<0.0001). Systolic acquisition had a higher overall image quality score (median 3 vs 2, p=0.002) and was less prone to artefact than diastolic acquisition (median artefact score: 0 vs 1; p<0.0001). In particular, there was a greater frequency of dark-rim artefact in diastole compared to systole (19 vs 9 patients).

Conclusions We have shown that quantitative 3D-perfusion-CMR is feasible and can be used to detect CAD with high diagnostic accuracy. Image quality and less artefact, make systole the preferred phase for acquisition in 3D-perfusion-CMR. Finally, there were significant differences in systolic and diastolic MBF estimates and therefore the phase of acquisition should always be stated in future quantitative studies.