Three-Dimensional Stress Cardiac Magnetic Resonance Perfusion Imaging for the Detection of Coronary Artery Disease

R. Manka[1], C. Jahnke[2], S. Kozerke[1], V. Vitanis[1], G. Crelier[1], R. Gebker[2], B. Schnackenburg[2], P. Boesiger[1], E. Fleck[2], and I. Paetsch[2]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Zurich, Switzerland, [2]German Heart Institute Berlin

Introduction:

Adenosine stress cardiac magnetic resonance (CMR) first pass perfusion is highly accurate for the detection of myocardial ischemia. However, current two-dimensional multi-slice acquisitions have limited spatial coverage of the heart and, thus, do not allow complete visualization of myocardial ischemic burden. The purpose of this study was to evaluate a new dynamic three-dimensional (3D) perfusion scan technique exploiting data correlation in k-space and time with joint sensitivity-encoding (k-t SENSE) and determined its value for the detection of coronary artery disease (CAD).

Methods:

130 patients with known or suspected CAD underwent a 3.0 Tesla CMR examination using 10x k-t SENSE (1,2) (TR/TE/flip angle: 1.8ms/0.7ms/15°, saturation prepulse delay: 150 ms, partial Fourier acquisition, voxel size: 2.3x2.3x5.0 mm³). Perfusion scans were obtained under adenosine stress (140 µg/kg/min for 6 min; 0.1mmol/kg Gd-DTPA) and at rest. Quantitative invasive coronary angiography defined significant CAD as ≥50% luminal narrowing. For visual analysis, 3D CMR perfusion scans were classified as pathologic if ≥1 segment showed an inducible perfusion deficit (>25% transmurality). Overall image quality of stress and rest 3D CMR perfusion scans was graded on a scale between 1 and 4 (1= nondiagnostic, 2= poor, 3= good, 4= excellent).

Results:

Visual analysis of 3D CMR perfusion resulted in a sensitivity, specificity and diagnostic accuracy of 91.3, 70.5 and 81.5%, respectively. Sensitivity for the detection of single, double and triple vessel disease was 90.2%, 95.0% and 87.5%. The mean visual score of 3D-CMR perfusion imaging was 3.4 ± 0.6 during adenosine stress and 3.5 ± 0.6 at rest (p=ns) (Figure 1).

Conclusions: Dynamic 3D-CMR stress perfusion imaging proved to be a robust method providing high image quality and high diagnostic accuracy for the detection of significant CAD in a routine clinical referral population.

References:

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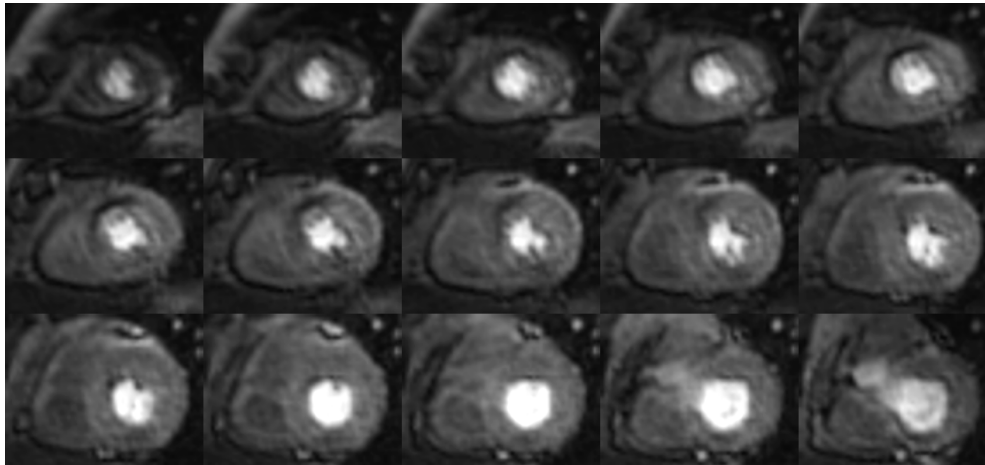
Figure 1:
Consecutive slices of a dynamic 3D-CMR stress perfusion scan; apical (top left) to basal (bottom right). Anterior-anteroseptal hypoperfusion from apical to equatorial slices.