High Resolution Myocardial Perfusion Imaging at 3T: Comparison to standard 1.5T perfusion studies and diagnostic accuracy in patients with suspected CAD

K. Strach[1], C. Meyer[1], D. Thomas[1], C. Schmitz[2], H. H. Schild[1], and T. Sommer[1]

[1]Radiology, University of Bonn, Bonn, NRW, Germany, [2]Cardiosurgery, University of Bonn, Bonn, NRW, Germany

Background: Recently, 3T has been shown to significantly increase signal-to-noise-ratio (SNR) of myocardial rest perfusion studies in healthy volunteers when compared to 1.5T. However, the benefits of 3T with respect to image quality compared to 1.5T as well as diagnostic accuracy for the detection of coronary artery disease (CAD) have not been evaluated, yet.

Purpose: To evaluate 1) high resolution myocardial rest perfusion in healthy volunteers (group 1) at 3T compared to a standard approach at 1.5T, and 2) the technical feasibility and diagnostic accuracy of 3T high resolution myocardial stress perfusion in patients with suspected CAD (group 2).

Methods:

All perfusion studies were performed using a T1-weighted saturation-recovery segmented k-space gradient-echo sequence combined with parallel imaging (Gd-DTPA 0.05 mmol/kg BW).

Study group 1 consisted of 26 healthy volunteers (14 males, 12 females; mean age: 26 +/- 4 years; range: 18 - 33 years) with low likelihood of CAD (<5% Diamond & Forrester) receiving 1) a high resolution rest perfusion scan at 3T (in-plane resolution 1.8 x 2.1 mm^2, pixel size 3.78 mm^2, slice thickness 8 mm, TE/TR/α 3.7/1.8 ms/15°, SENSE factor 3; Achieva 3T, Philips Medical Systems) and 2) a standard perfusion approach at 1.5T (in-plane resolution 2.9 x 3.4 mm^2, pixel size 9.86 mm^2, slice thickness 8 mm, TE/TR/α 3.7/1.8 ms/ 20°, SENSE factor 2; Intera 1.5T, Philips Medical Systems). Both rest studies were performed in random order on two separate days (interval: 24 to 72 hours). Contrast enhancement ratio [CER = (myocardial peak signal - myocardial baseline signal / myocardial baseline signal)] was assessed for high resolution and standard scans. Image quality was evaluated by two observers on a four point grading scale (4: excellent, 1: non-diagnostic) with respect to homogeneity of myocardial enhancement, blurring and presence of artifacts.

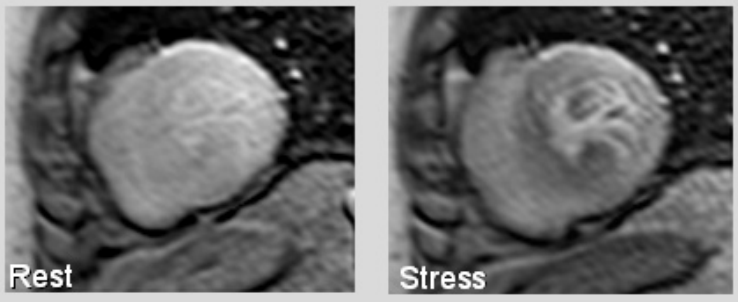
Study group 2 consisted of 60 patients (38 males, 22 females; mean age: 59 +/- 10 years) with suspected CAD scheduled for X-ray coronary angiography. Patients underwent a high resolution stress (adenosine 140 µg/kg BW over 6 min) and rest perfusion study at 3T (interval: 30 min) with equivalent Gd-DTPA concentration and scan parameters as for healthy volunteers at 3T. Perfusion studies were qualitatively assessed for stress-induced hypoperfusion by two experienced observers. Hemodynamically significant coronary artery disease was defined as luminal diameter stenosis $\geq$ 70% in conventional coronary angiography.

Results:

Study group 1: Contrast enhancement ratio of high resolution rest perfusion studies at 3T was slightly higher compared to the standard approach at 1.5T (1.31+/-0.32 vs. 1.14+/-0.34, $p<0.01$). Image quality was significantly improved for high resolution perfusion imaging at 3T compared to 1.5T (3.03+/-0.43 vs. 2.37+/-0.39, $p<0.01$)

Study group 2: Sensitivity, specificity and accuracy of high resolution perfusion studies at 3T for the detection of significant coronary artery disease was 89% (n=32/36), 79% (n=19/24), and 85% (n=51/60), respectively.

Conclusion: 1) MR myocardial perfusion imaging at 3T permits significantly improved spatial resolution allowing for a 60% reduction of pixel size. 2) High resolution perfusion at 3T provides significantly improved image quality compared to a standard approach at 1.5T. 3) 3T perfusion studies are also feasible in patients with suspected CAD in a clinical setting and yield promising results for the detection of significant coronary artery stenosis.



Stress-induced perfusion deficit in the septal and inferior myocardium. X-ray coronary angiography revealed a proximal occlusion of a dominant RCA.