Initial Results of Free-Breathing Balanced Fast Field Echo Whole Heart MR Angiography

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Introduction: Free breathing coronary MRA is usually obtained in double oblique orientation targeted on the right or left coronary artery system. Coronary MRA covering the wohle heart with transverse slices would offer advantages including distal segment and branch vessel visualization, comparability to CTA, advanced 3D-reconstructions and simplified scan planning.

Purpose: Evaluation of a new free breathing coronary MR angiography technique covering the whole coronary artery tree in one data set acquisition.

Material and Methods: 5 healthy volunteers and 20 patients with suspected or known CAD were examined with 1) a navigator (NAV) gated and corrected free-breathing 3D balanced gradient echo (BTFE) sequence covering the whole heart (WH-MRA) (TR = 5.4, TE = 2.7, SENSE factor = 2, 160 slices, 0.75 mm reconstructed slice thickness, in-plane resolution = 0.99 x 0.99 mm², scan time 14 min (50% NAV efficiency) and 2) 16-slice-CT angiography (CTA). Additionally, the right or the left coronary artery system was imaged with a vessel targeted 3D BTFE MRA sequence (TR = 5.6 ms, TE = 2.8 ms, 20 slices of 1.5 mm reconstructed slice thickness, in-plane resolution = 0.99 x 0.99 mm², scan time = 6 min (50% NAV efficiency)). Subjective image quality (4 point scale, 1=very good) and objective image quality parameters including vessel sharpness, vessel diameter, SNR and CNR were calculated for WH-MRA and BTFE-MRA. Vessel visibility and accuracy for detection of stenoses larger than 50% within the proximal and mid coronary artery segments were compared to X-ray coronary angiography (XA), which was considered the goldstandard.

Results: WH-MRA demonstrated good to very good image quality (average 1.6) and a percentage of evaluable segments of 100% in healthy volunteers. In patients, 115/155 (74%) segments could be evaluated, 33 segments were not evaluated because of insufficient image quality and 7 segments because of stentartifacts; average image quality was 2.7. Using the targeted BTFE sequence, 74/88 (84%) of segments could be evaluated, in 7 segments the image quality was insufficient, 2 were not evaluated because of stentartifacts, average image quality was 1.9. In CTA, 125/155 (81%) segments were evaluated, 20 were not evaluated because of severe calcifications, 5 because of stentartifacts and 5 because of insufficient image quality, average image quality was 1.6. Vessel sharpness was superior with BTFE-MRA compared to WH-MRA in patients (40% vs. 36%). Vessel diameters did not differ significantly between WH-MRA and BTFE-MRA. SNR and CNR were significantly reduced for the WH-MRA when compared to BTFE (SNR: 12 vs. 26.4 CNR 7.4 vs. 15.4). Considering only the evaluable segments, diagnostic accuracy for the detection of CAD was 82% for WH-MRA, 79% for BTFE and 89% for CTA. When non-evaluable segments were included, diagnostic accuracy for the detection of CAD was 61% for WH-MRA, 67% for BTFE and 73% for CTA.

Conclusions: We successfully demonstrate the use of WH-MRA for coronary visualization in healthy subjects. The technique facilitates visualization of more distal segments and side branches as well as a simplification of the scan planning procedure in comparison to targeted MRA and offers 3D reconstruction possibilities comparable to CTA. In patients, subjective/objective image quality and accuracy for detection of CAD was inferior to BTFE-MRA and CTA, mainly due to the lower percentage of evaluable segments.

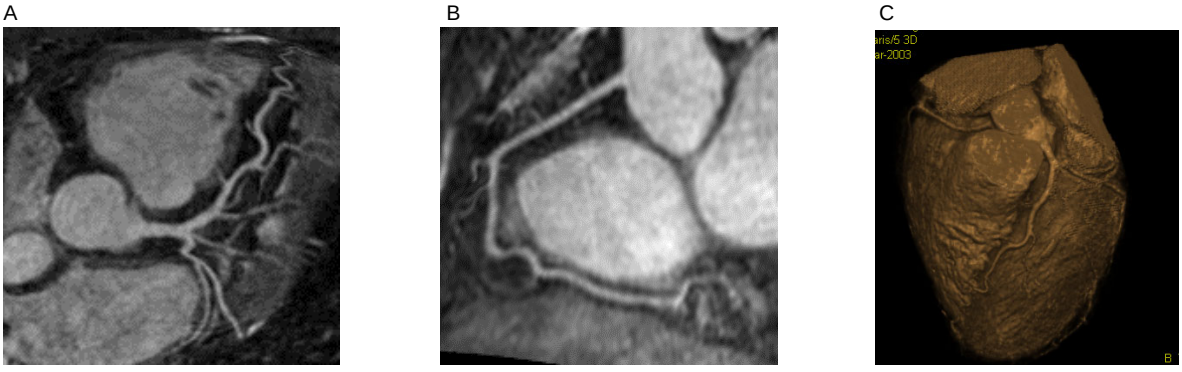

Figure: Whole Heart MR- Angiography of healthy volunteer. A: left coronary system, B: right coronary system, C: surface shaded display 3D reconstruction