2D Spin-Labeling Coronary MR-Angiography with Cartesian and Radial k-Space Sampling

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Introduction

Recently, a 3D spin-labeling coronary MR-angiography (cMRA) technique was introduced for the selective visualization of the coronary arteries[1]. In spin-labeling cMRA, the blood in the ascending aorta is labeled using a spatially selective inversion pre-pulse. The labeled blood (with inverted magnetization) flows into the coronary arteries during a time delay between the labeling pulse and the imaging portion of the sequence. By means of subtraction of a second data set without the preceding labeling pulse, the coronary lumen is selectively visualized, while the signal of the surrounding stationary tissue appears almost completely signal suppressed. However, scanning time is prolonged due to the two data sets. In order to overcome the drawback of long scanning time, we investigated the value of a 2D spin-labeling cMRA approach with Cartesian and radial k-space sampling.

Materials and Methods

2D spin-labeling cMRA was performed in 8 healthy volunteers (5 female, 3 male; 27 ± 3 years) on a 1.5 T whole-body MR-system using a free-breathing navigator-gated and cardiac-triggered 2D steady-state free-precession (SSFP) sequence (TR/TE 5.9/2.9 ms, flip-angle 120°, matrix 384, spatial resolution 0.9x0.9x10.0 mm^3, acquisition time per RR-interval 117 ms, scanning time ~24 sec) with carterian and radial radial k-space sampling.
Objective image quality parameters such as SNR, CNR, maximal visible vessel length, and vessel border definition were analyzed.

Results

The left and right coronary system was visualized in 3 and 5 cases, respectively. Fig. 1a shows a representative image of the RCA obtained by 2D spin-labeling cMRA with radial k-space sampling. In addition, the corresponding coronary angiogram without subtraction is presented (Fig. 1b). Fig. 2 shows the coronary angiogram of the RCA and RCX with severe motion artifacts in phase encoding direction using Cartesian k-space sampling. For Cartesian and radial imaging the SNR of the coronary arteries was 23,7±9,7 and 34,3±13,7 ($p<0.05$) and the CNR between coronary artery and myocardium was 11,4±5,0 and 18,0±10,6 ($p<0.05$), respectively. The maximal visible vessel length using Cartesian (89,1±30,4 mm) and radial (104,3±35,2 mm) imaging did not differ significantly. The measured vessel sharpness was relatively low for both methods (27,9±5,7% and 38,5±6,6%; $p<0.05$).

Conclusion

2D spin-labeling cMRA allowed for selective visualization of the left and right coronary system within a minute. Radial k-space sampling proved to be superior with respect to motion artifact suppression compared to Cartesian imaging. In addition, significantly higher SNR, CNR, and vessel sharpness were found with radial k-space sampling.

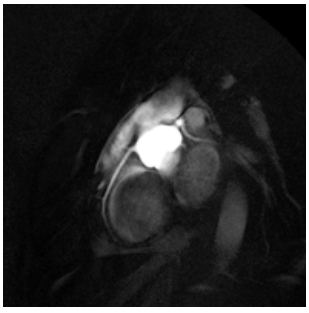

Fig. 1a:
2D spin-labeling cMRA with radial k-space sampling allowed for selective visualization of the RCA and the proximal portion of the RCX.

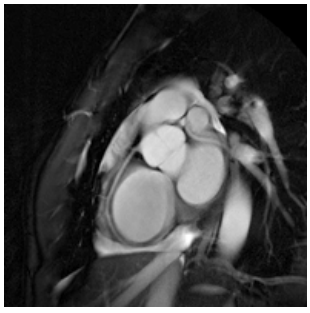

Fig. 1b:
Coronary angiogram without subtraction obtained from the same data set as in Fig. 1a.

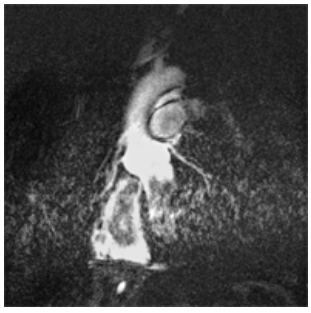

Fig. 2:
2D spin-labeling cMRA with Cartesian k-space sampling showed severe motion artifacts in phase encoding direction (right-left) in one case.

Reference

1. Stuber et al. MRM 2002