Gadofosveset Trisodium-Enhanced Steady State Free Precession Magnetic Resonance Angiography of Left Atrium and Pulmonary Veins

M. Wagner[1], P. Asbach[1], A. Huppertz[2], M. Taupitz[1], C. Warmuth[1], B. Hamm[1], and A. Lembcke[1]

[1]Radiology, Charité, Universitätsmedizin Berlin, Berlin, Germany, [2]Imaging Science Institute Charité Berlin - Siemens, Berlin, Germany

Purpose: Pulmonary vein isolation by means of catheter ablation is a new therapeutic modality for patients with symptomatic atrial fibrillation. Due to the complex anatomy preprocedual imaging of left atrium and pulmonary veins is helpful for planning catheter intervention. With the advent of electrocardiogram-gated and respiratory-gated 3D steady state free precession (SSFP) sequences covering the entire heart (whole-heart MR angiography, MRA) it has become possible to visualize cardiac vascular anatomy with high spatial resolution [1]. However, native whole-heart MRA was only of limited value for depiction of left atrium and pulmonary veins [2]. Intravascular contrast media with their uniform and prolonged enhancement of the blood pool appear to be well applicable for whole-heart MRA. The hypothesis for this study was that the intravascular contrast agent gadofosveset trisodium significantly improves image quality of whole-heart MRA and hereby allows high resolution MRA of left atrium and pulmonary veins.

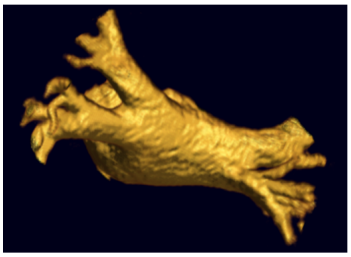

Fig.1: 3D reconstruction of the left atrium from gadofosveset trisodium-enhanced SSPF MRA

Materials and Methods: 15 consecutive patients were included in a prospective study investigating the value of gadofosveset trisodium for whole-heart MRA. The study was approved by the local ethical committee. All patients were examined on a 1.5 Tesla MR scanner (Magnetom Avanto, Siemens Healthcare, Erlangen, Germany) using a dedicated cardiac 32-element phased-array coil. Trigger delay and acquisition interval per heartbeat were determined for each patient to ensure acquisition of whole-heart SSFP MRA during the cardiac resting phase. Whole-heart SSFP MRA was acquired during free breathing using prospective real-time adaptive motion correction (TR, 3.76 ms; TE, 1.6 ms; FOV ranging between 320 x 260 mm and 320 x 320 mm; matrix, 256 x 230 to 256 x 173; number of slices, 144 – 160; flip angle, 90 degrees; bandwith, 592 Hz/pixel; reconstructed spatial resolution, 0.7 x 0.6 x 0.8 mm; gating window of 4.0 mm, tracking factor of 0.45). Noncontrast MRA was performed using a T2-preparated SSFP sequence with a frequency-selective fat saturation prepulse. Gadofosveset trisodium (Vasovist®, Bayer Schering Pharma, Berlin, Germany) was administered as intravenous injection (0.03 to 0.04 mmol Gd/kg body-weight). Subsequently, an inversion recovery 3D SSFP sequence (TI, 230-240 ms) was performed.

Results: There was no significant difference in terms of SNR between gadofosveset trisodium-enhanced SSFP MRA and noncontrast SSFP MRA (10.8 + 3.7 vs. 10.4 + 2.6, $p > 0.05$). The CNR between left atrial blood and myocardium was significantly higher for gadofosveset trisodium-enhanced SSFP MRA compared with noncontrast SSFP MRA (17.4 + 5.6 vs. 11.5 + 3.8, $p < 0.05$). Image quality with regard to visualization of left atrium and proximal pulmonary veins was rated significantly higher for gadofosveset trisodium-enhanced SSFP MRA (Figure 1, Figure 2, Table 1). 2 patients had poor image quality of noncontrast and gadofosveset trisodium-enhanced SSFP MRA due to irregular breathing patterns with a navigator efficiency of less than 30%.

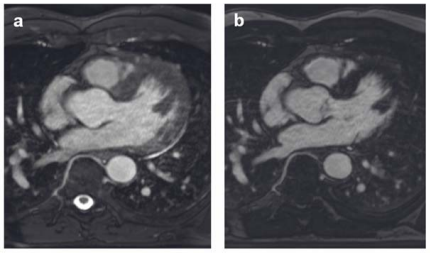

Fig. 2: Representative images of noncontrast SSFP MRA (a) and gadofosveset-enhanced SSPF MRA (b)

	non-contrast SSFP MRA	contrast-enhanced SSFP MRA
Excellent image quality	0	7
Good image quality	3	5
Moderate image quality	10	1
Poor image quality	2	2

Tab.1: Image quality scores of noncontrast SSFP MRA and gadofosveset trisodium-enhanced SSPF MRA

Conclusions: In patients with regular breathing pattern gadofosveset trisodium-enhanced SSFP MRA allows detailed visualization of left atrium and pulmonary veins and therefore appears to be suitable for preprocedural imaging before image-guided catheter interventions.

References:

[1] Sakuma H, Ichikawa Y, Suzawa N, et al. Assessment of coronary arteries with total study time of less than 30 minutes by using whole-heart coronary MR angiography. Radiology. 2005;237:316-321.

[2] Allgayer C, Zellweger MJ, Sticherling C, et al. Optimization of imaging before pulmonary vein isolation by radiofrequency ablation: breath-held ungated versus ECG/breath-gated MRA. Eur Radiol. In press

Acknowledgements: The study was supported by Bayer Schering Pharma, which provided the MR imaging contrast agent and financial support for conducting the study.