Impact of fat saturation in slice-selective inversion-prepared 3D SSFP renal MRA

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Abstract
The impact of additional fat saturation (SPIR,spectral presaturation inversion recovery) on vessel visualization was investigated in a slice-selective inversion-prepared 3D steady-state free-precession (SSFP) renal MR angiography (MRA) sequence. In 10 patients with suspected renovascular disease, a navigator-gated cardiac-triggered slice-selective inversion-prepared 3D SSFP sequence was performed with and without fat suppression. SNR, CNR and vessel sharpness were analyzed. Results were compared with contrast-enhanced MRA (CE-MRA) as the reference method. Using additional fat saturation, a significantly higher SNR and CNR can be achieved. Vessel sharpness was comparable for both sequences. Hence, fat saturation should be routinely used using this approach.

Introduction
Recently, a slice-selective inversion-prepared free-breathing 3D SSFP renal MRA sequence has been introduced allowing for selective visualization of the renal arteries without the use of contrast medium. Using this approach, a slice-selective inversion pre-pulse is used to suppress signal from the renal parenchyma and veins while high-contrast visualization of the renal arteries including the distal subsegmental branches is enabled. Breathing and pulsation artifacts are suppressed by navigator-gating and ECG-triggering, respectively. In this study we investigated the impact of additional fat-saturation (SPIR) on vessel visualization and contrast.

Materials and Methods
10 patients (mean age 46 years) were investigated on a 1.5 Tesla MR system (Intera, Philips, Best, The Netherlands). Renal MRA was performed using a previosly described navigator-gated cardiac-triggered 3D SSFP sequence (TR/TE 3.8/1.9ms, flip-angle 85°, TI 325ms, spatial resolution $1.1x1.1x2.0mm^3$, acquisition time approximately 2min) combined with a slice-selective inversion pre-pulse for selective renal MRA (1). The sequence was performed without and with an additional SPIR pre-pulse for fat suppression. SNR and CNR as well as vessel contour sharpness of both sequences were compared. In all patients, contrast-enhanced MRA was performed as the reference method in order to compare clinical findings. Statistical significant differences ($p<0.05$) between both sequences were analyzed using non-parametric *Wilcoxon* test.

Results
The use of additional fat saturation by means of a SPIR pre-pulse resulted in significantly improved SNR (23.2 vs. 19.1, $p<0.05$) and CNR (20.4 vs. 16.6, $p<0.05$). Vessel contour sharpness was similar for both sequences. All stenotic lesions seen in 3D SSFP imaging were confirmed by CE-MRA. In addition to accurate and sharp vessel delineation, slice-selective inversion-prepared 3D SSFP imaging allows for flow assessment inside the vessel.

Conclusion
The application of an additional fat-saturation in slice-selective inversion-prepared 3D SSFP renal MRA leads to significantly improved SNR and CNR.

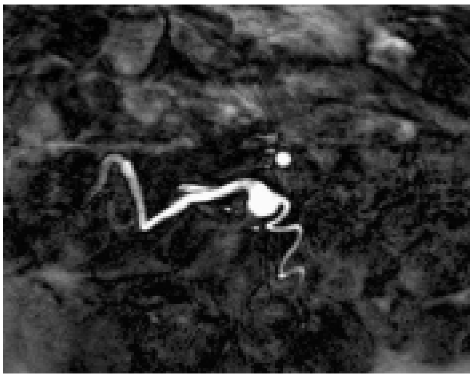
Fig. 1a

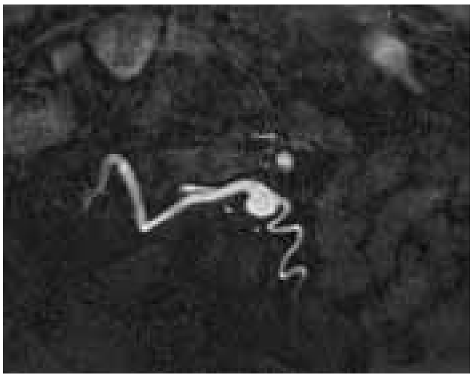
Fig. 1b

Fig. 1a: Multi-planar reformatted image of a 52 year-old female patient using standard slice-selective inversion-prepared 3D SSFP renal MRA. Note the pronouced artifacts ariving from the fatty tissue.
Fig. 1b: The same patient was investigated using an addition fat saturation (SPIR). Contrast between the renal arteries and the sourrounding fatty tissue is increased. In addition, artifacts were significantly reduced.
Fig. 2: Summary of the objective image quality parameter. (SNR and CNRvessel-kidney, CNRvessel-fat for the 3D SSFP sequence without and with additional SPIR pulse

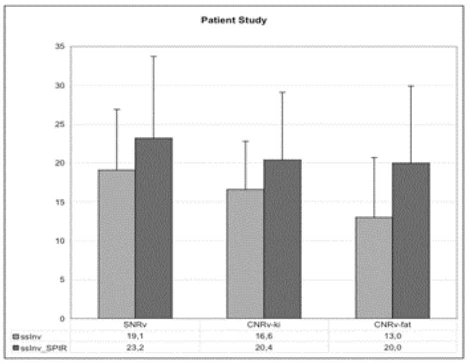

Fig. 2

References:
1. Katoh et al. ISMRM 2004