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Spin-spoiler: a novel arterial spin labeling technique without the need of subtraction

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Introdudction

Arterial Spin Labeling (ASL) has been successfully used for the visualization of the renal and coronary arteries without the need of a contrast agent [1,2]. The classical approach of ASL consists of the acquisition of two image datasets with and without a spatially selective labeling prepulse. The disadvantages of this methodology include the need for two acquisitions and image subtraction resulting in increased sensitivity to motion. Alternative techniques not requiring image subtraction have been proposed and successfully applied for renal and coronary angiography [3]. In this work we propose a novel ASL technique (Spin-Spoiler) without the need for image subtraction. It is based on the application of a spatially selective labeling pulse followed by a non-selective refocusing and a tip up pulse resulting in localized spin tagging and simultaneous background tissue suppression over a wide range of T1 values. We sought to evaluate this technique in a T1 phantom and in healthy subjects for selective renal artery visualization.

Methods

A novel ASL pre-pulse was implemented on a 3 T Achieva Gyroscan MR scanner (Philips Healthcare, Best, NL). The ASL pre-pulse consists of a pencil-beam excitation RF-pulse (+90x°) followed by a non-selective adiabatic refocusing RF-pulse (+180y°) and a block tip up RF-pulse (90x°). The +180y° refocusing RF pulse is symmetric with respect to both 90° pulses. After the pre-pulses a crusher gradient is applied to spoil the residual transversal magnetization (Fig. 1). This sequence maintains the Mz magnetization in the pencil beam volume while cancelling the Mz and Mxy magnetization in the surrounding tissues.

The Spin-Spoiler technique was validated in a T1-phantom and selective angiography was demonstrated for the renal arteries.

Results

Application of the Spin-Spoiler sequence in a T1-phantom demonstrates signal preservation in the labeling volume and good background tissue suppression over a wide T1 range (Fig. 2). Renal arteries were selectively visualized in a healthy volunteer. A projection angiogram of the renal arteries is shown in Fig. 3.

Conclusion

We demonstrate a new approach for non-contrast enhanced MR angiography with good background tissue suppression without the need of subtraction. Comparative studies are now warranted to demonstrate the clinical usefulness of this technique.

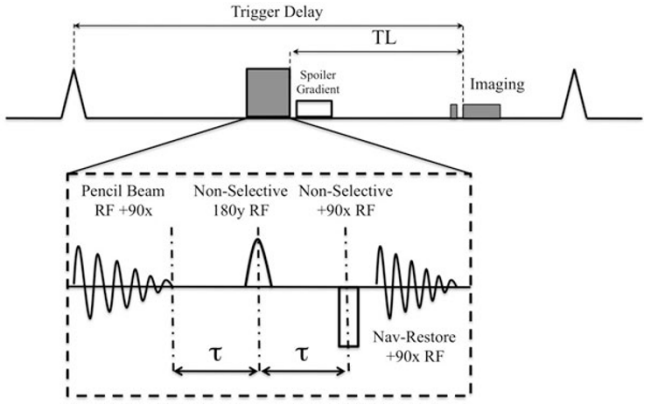

Figure 1
Schematic of the Spin-spoiler sequence.

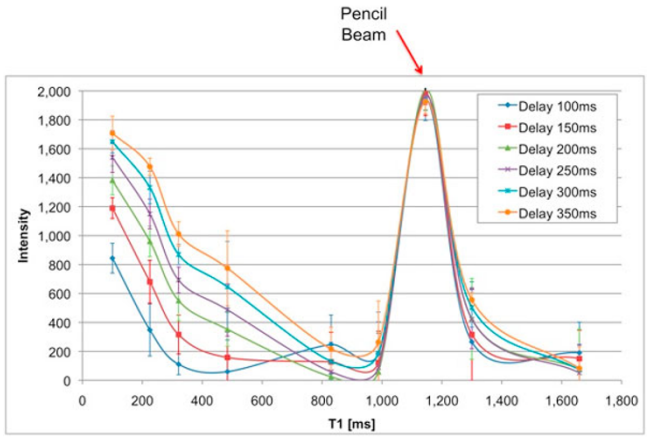

Figure 2
T1-Phantom validation for Spin Spoiler.

References

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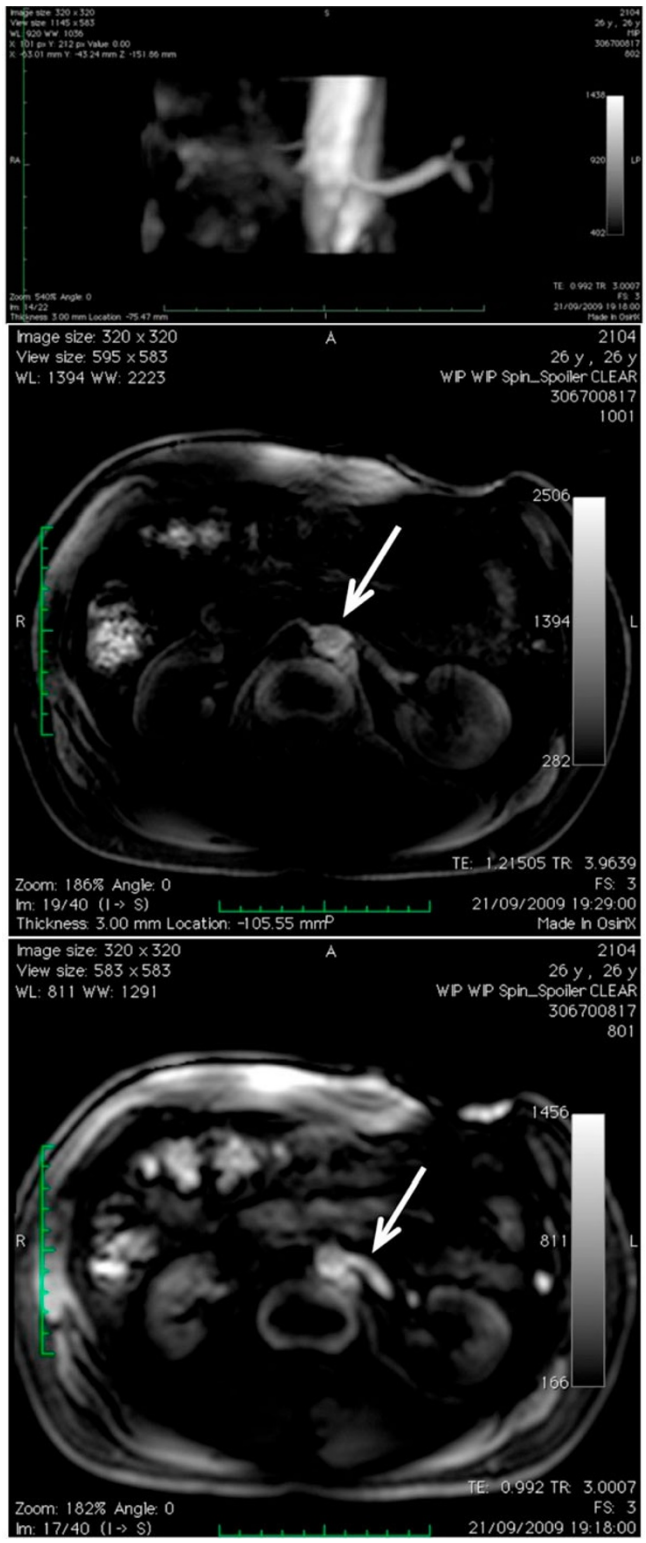

Figure 3
Renal Artery Angiogram in a healthy volunteer.