

Renal Artery MRA with Time-SLIP: Comparison Between a 3-T System Incorporating Multi-phase Transmission and a 1.5-T System

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Purpose

Time-Spatial Labeling Inversion Pulse (Time-SLIP) is a non-contrast-enhanced MRA technique employing an IR pulse. The Time-SLIP technique permits blood vessels to be selectively visualized, and its usefulness in renal artery MRA has already been established in 1.5-T systems. It also has the advantage of not requiring the use of contrast medium. Theoretically, the SNR of a 3-T system should be twice as high as that of a 1.5-T system, and a 3-T system incorporating Multi-phase Transmission can achieve high image uniformity and provide high-quality images of the trunk. However, the optimal scan conditions and clinical imaging capabilities of Time-SLIP have not yet been evaluated in sufficient detail. At our institution, we have recently begun to employ Time-SLIP using a 3-T MRI system incorporating Multi-phase Transmission with two channels and four ports in clinical practice. The present study was conducted to investigate the optimal scan conditions and vascular visualization capabilities of Time-SLIP. The renal arteries, for which Time-SLIP is typically employed as a non-contrast-enhanced MRA technique, were selected as the imaging target, and the clinical usefulness of a 3-T system incorporating Multi-phase Transmission was evaluated.

Methods

A 1.5-T MRI system (EXCELART Vantage™ Powered by Atlas, Toshiba Medical Systems Corporation, Japan) and a 3-T MRI system (Vantage Titan™ 3T, Toshiba Medical Systems Corporation) were used. The study group included 10 healthy volunteers (8 men and 2 women; average age 48 years) and 10 patients (7 men and 3 women; average age 66 years). Imaging was performed using the 3D TrueSSFP sequence with respiratory gating. The scan conditions for the 1.5-T system were TR/TE = 5/2.5 ms, FA = 120°, slice thickness = 2 mm, slab thickness = 72 mm, and IR tag thickness = 200 mm. The scan conditions for the 3-T system were TR/TE = 4.8/2.4 ms, with all other settings the same as for the 1.5-T system. The optimal imaging conditions were determined by measuring the signal intensities of the renal artery, renal cortex, renal medulla, and fat at different phases of the respiratory cycle, BBTI values, and TI values for STIR. Vascular visualization capabilities were evaluated visually by two radiologists. In addition, ROIs were set in the renal parenchyma and the renal artery, and CNR measurements were obtained.

Results

A BBTI of 1500 ms or longer was needed to visualize the renal arteries out to their peripheral branches. The BBTI required for the renal parenchyma to reach the null point was 25% longer in the 3-T system than in the 1.5-T system. With regard to visualization capabilities, 50% of the renal arteries could be visualized out to their third-level branches using the 3-T system, which was superior to the result obtained for the 1.5-T system. The 3-T system was also found to have a higher CNR.

Discussion

The 3-T system showed superior vascular visualization capabilities, with effective suppression of the signals of renal parenchyma and fat in renal artery imaging. This suggests that Multi-phase Transmission, which improves B₁ field homogeneity, is effective in non-contrast-enhanced MRA. In renal artery MRA with Time-SLIP, the renal arteries were visualized out to their peripheral branches at a BBTI of 1500 ms. In the 1.5-T system, the signal of the renal parenchyma passed the null point at a BBTI of 1500 ms, and as a result, the background signals increased and contrast was reduced. In the 3-T system, the T₁ of the renal parenchyma was extended, and as a result, the null point of the renal parenchyma matched the BBTI. The background signals were therefore suppressed and higher vascular contrast was achieved. Although extension of the T₁ normally leads to a reduction in the SNR, it is advantageous in non-contrast-enhanced MRA with Time-SLIP. In a 3-T system, which features high vascular visualization capabilities, this helps to ensure the clear depiction of vascular structures and the accurate evaluation of renal artery stenosis.

Conclusion

The results of this study indicate that a 3-T MRI system incorporating Multi-phase Transmission has superior vascular visualization capabilities in non-contrast-enhanced renal artery MRA with Time-SLIP and is therefore of great clinical usefulness.

References

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- 2) Kanazawa H and Miyazaki M, ISMRM 2002, p140

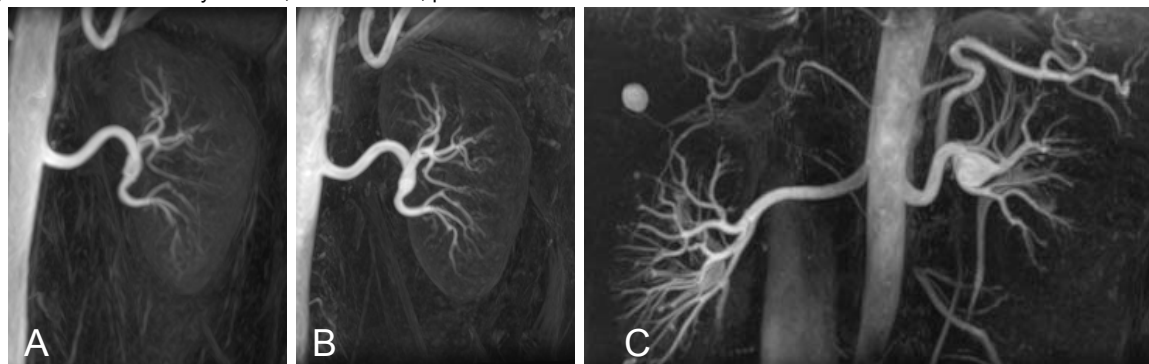


Fig.1) (A) left renal artery of healthy volunteers. (1.5T) (B) left renal artery of healthy volunteers. (3.0T) (C) left renal artery saccular aneurysm. (3.0T).