

Non-contrast-enhanced MR Arteriography with Balanced Steady-State Free-Precession Sequence and Time-Spatial Labeling

Inversion Pulses: Comparison of Imaging with Flow-in and Modified Flow-out Methods

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PURPOSE: The ability of non-contrast-enhanced MR angiography with flow-in method to depict the hepatic artery has been demonstrated with the combined usage of a respiratory-triggered three-dimensional (3D) balanced steady-state free-precession (bSSFP) sequence and a time spatial labeling inversion pulse¹. This method is suitable for visualization of the right hepatic artery (RHA) and left hepatic artery (LHA), but, at branches distal to the RHA and LHA, the visualization is insufficient. The contrast between the tagged blood and background is highest when selection of the inversion delay time (TI) is near the null point for the background. On the other hand, long TI is suitable for peripheral vessel delineation but the overlong TI deteriorated vessel-to-liver contrast owing to background signal recovery. The flow-out method uses both a nonselective inversion recovery pulse and a tagging pulse. The selective tagging pulse selectively restores the magnetization in the tagged region to its original value, depicting the tagged blood as a bright-blood signal. Long TI of the selective tagging pulse in flow-out method is favorable for peripheral vessel visualization to maintain background signal suppression using the nonselective inversion recovery pulse. The aim of this study was to compare and evaluate images of non-contrast-enhanced MR arteriography acquired with two different methods, the flow-in and modified flow-out methods using the selective tagging pulse with long TI.

METHODS: Thirteen healthy volunteers were examined using respiratory-triggered 3D bSSFP with flow-in method and modified flow-out method at a 3T MR unit (Vantage, Toshiba Medical Systems Co, Otawara, Japan). A respiratory triggered 3D bSSFP imaging sequence with fat saturation was performed with the following parameters: TR/TE/FA=4.3msec/2.2msec/120°, slice thickness=1.5mm, number of slices=50, acceleration factor=2. Application of the tagging pulse in the flow-in method was as follows: selective inversion-recovery pulse was placed on the abdomen, which could cover the splenic and the superior mesenteric veins, and TI=1,600msec was used. The flow-out method was as follows: nonselective inversion recovery pulse inverts all magnetization in the region using TI=1,400msec. The one tagging pulse was placed on the descending aorta as much as possible and avoided the hepatic parenchyma, the splenic and the superior mesenteric veins. The TI was 1,700msec. For quantitative analysis, vessel-to-liver contrast (Cv-l) was measured. Visualization quality was scored on a four-point scale for assessments of the RHA, LHA, arterial branch of segment 8 (A8), and arterial branch of segment 4 (A4).

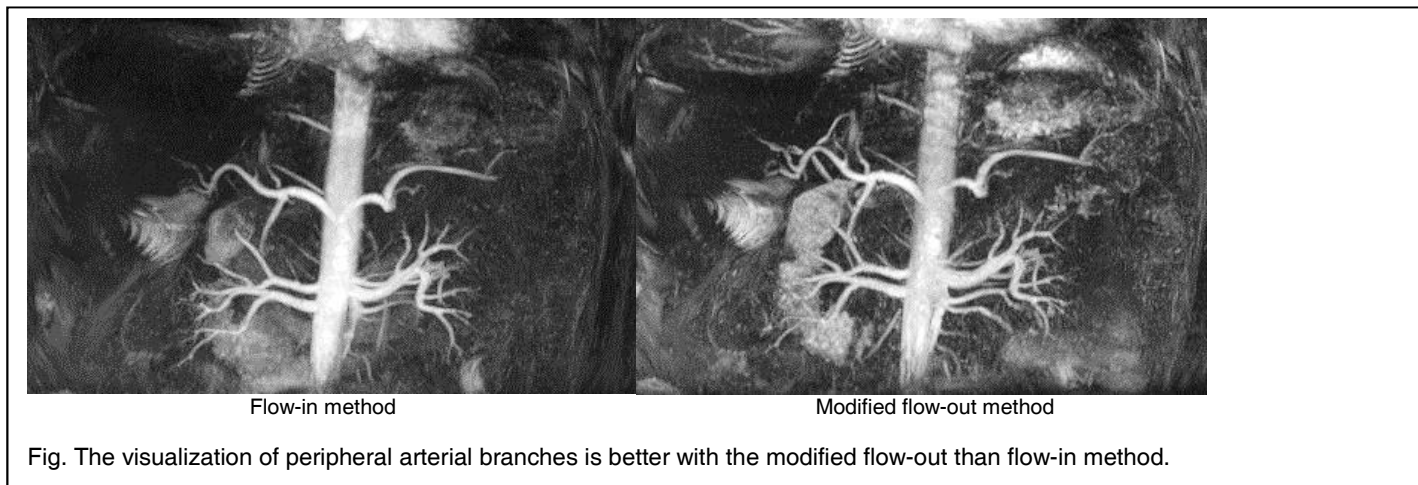
RESULTS: Table showed quantitative and qualitative results. The Cv-l of the RHA was higher with the modified flow-out than flow-in method.

With the modified flow-out method, visual scores of the RHA, LHA, A8, and A4 were better than with the flow-in method.

CONCLUSIONS: Non-contrast-enhanced MR arteriography with the modified flow-out method improved the visualization of the intrahepatic artery in comparison with the flow-in method.

| | Modified flow-out method | Flow-in method |
|----------------------|--------------------------|----------------|
| Ca-l | 0.58 ± 0.16 | 0.48 ± 0.23 |
| Visualization scores | | |
| RHA | 3.8 ± 0.4 | 3.7 ± 0.9 |
| LHA | 3.5 ± 0.7 | 3.2 ± 0.8 |
| A8 | 3.3 ± 0.8 | 3.0 ± 0.9 |
| A4 | 3.0 ± 0.8 | 2.4 ± 0.8 |

Table Quantitative and qualitative results in two methods



REFERENCE

1. Shimada K, Isoda H, Okada T et al. Non-contrast-enhanced hepatic MR angiography with true steady-state free-precession and time spatial labeling inversion pulse: optimization of the technique and preliminary results. *Eur J Radiology* 70:111-117, 2009.