MR portography using non-contrast-enhanced time-spatial labeling inversion pulse (Time-SLIP) -Comparison between 3T and 1.5T-

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PURPOSE;

Time-SLIP (time-spatial labeling inversion pulse) technique is an arterial spin labeling, in which the movement of labeled blood by an inversion recovery (IR) tag pulse within vessels is observed as an intrinsic contrast material after a certain inversion time (TI). Time-SLIP has high flexibility spatially and temporally, which makes it possible to enhance the selective vessel[1)]. Usefulness of Time-SLIP to depict the portal vein at1.5T-MRI has been reported[2)]; however, there is not many reports at 3T. The optimization of TI and gaining of blood signal intensity are interesting at 3T. The purpose of this study is to evaluate the visualization of MR portography by Time-SLIP using 3T MRI in comparison with that using 1.5T.

METHODS

Institutional review board approval and informed consent were obtained. MR examinations were performed at both a 3T-clinical imager (Vantage TitanTM 3T , Toshiba, Tokyo) and a 1.5-T clinical imager (EXCELART Vantage^{TM} XGV PPP powered by Atlas, Toshiba, Tokyo) using an Atlas SPEEDER body and an Atlas SPEEDER spine coil. Three-dimensional bSSFP was used with parameters as follows: TR=4.8 msec (3T), 5.0 msec (1.5T), TE =2.4 msec (3T), 2.5 msec (1.5T), TI_1 for fat suppression =190 msec, matrix=256 x 128, section thickness of 2.5 mm (with ZIP interpolation), parallel imaging factor=2.0, and field of view=40 x 20 cm.

Ten healthy volunteers (8 men, 2 women, mean age, 27.0 years; age range, 24-35 years) were enrolled for this study. MR portography was performed using Time-SLIP with TI of 900 to 2,500msec, in which a flow-in effect is obtained with a selective IR tag pulse placed on the liver obliquely.

Three observers evaluated the visualization of portal vein and the degree of the background signal suppression (i.e. hepatic parenchyma and hepatic veins) on source images. In the evaluation of the visualization of portal vein, three groups of branches were evaluated separately; 1) right lower branches (P5, P6), 2) right upper branches (P7, P8), 3) left branches, using three point grade; 3. 3T is superior to 1.5T, 2. 3T is equal to 1.5T, 1. 1.5T is superior to 3T. Background signal suppression was evaluated using 3 point grade as follows; 3. better suppression at 3T, 2. 3T is equal to 1.5T, 1. better suppression at 1.5T. Contrast-noise-ratio was calculated between the portal veins (right and left branches) and liver parenchyma, and between hepatic vein and liver parenchyma, using the following equation; CNR portal vein = (SI portal vein –SI liver)/SD portal vein. CNR hepatic vein = (SI hepatic vein – SI liver)/SD hepatic vein. (SI=signal intensity, SD=standard deviation) The Wilcoxon test and the paired *t*-test were used for statistical analysis.

RESULTS;

In subjective evaluation, visualization of portal vein at 3T was significantly superior to that of 1.5T in group 1 (average score 2.20 ± 0.53, $p<0.05$) and group 3 (average score 2.68± 0.47, $p<0.05$). Considerable binding artifacts near diaphragm interfered the visualization of group 2 right upper branches at 3T in some cases. CNR of 3T was significantly higher than that of 1.5T in all TI (9.91, 8.52, respectively, $p<0.05$). In the evaluation of the suppression of the liver parenchyma signals, 3T was superior at all TI (average score 2.48 ± 0.71, $p<0.05$) but 900 msec, at which 1.5T was superior because liver parenchyma would become almost null at 1.5T. Figure 2 shows changes of signals of liver parenchyma according to varying TIs. The liver parenchyma signal was lowest at TI=900 msec at 1.5T and TI=1300 msec at 3T. In the evaluation of the suppression of hepatic vein, 3T was superior to 1.5T at all TIs (average score 2.48 ±0.68, $p<0.05$), except at 900 msec.

DISCUSSIONS;

Time-SLIP using 3T-MRI clearly demonstrates the portal veins with higher CNR than that 1.5T. Background signal were considerably suppressed at 3T even using a long TI, because of longer T1 relaxation time of 3T than that of 1.5T. However, binding artifacts near the diaphragm may degrade image quality in some cases, which may be overcome by precise shimming. In conclusion, Time-SLIP portography using 3T provide high CNR and prolonged suppression of background signal, which may permit the evaluation of slow portal flow in patients with cirrhosis using employment of a longer TI.

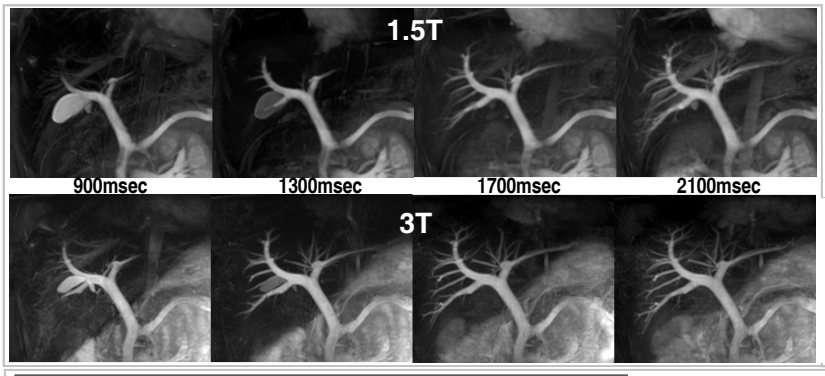

Fig.1 Comparison of MR portography by Time-SLIP in 3T and in 1.5T
3T clearly demonstrates portal vein even peripheral branches, and suppresses the signals of hepatic parenchyma and hepatic vein in longer TI.

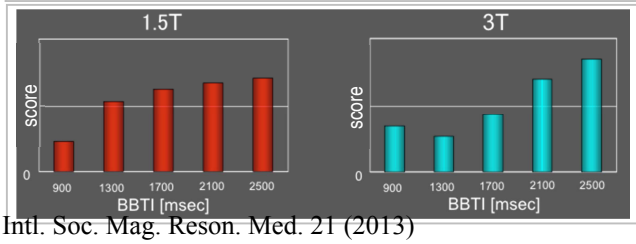

Fig.2 Changes of signal of hepatic parenchyma according to TIs.
In 1.5T, the signal was lowest at TI=900 msec, and then increased as TI prolonged. In 3T the signal was lowest at TI=1300 msec and then increased more rapidly as compared to 1.5T.

REFERENCES;
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