

# The 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

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## Introduction

The aim of our study is to delineate the hepatic arteries selectively by using respiratory-triggered three-dimensional (3D) true steady-state free-precession (SSFP) sequence with time spatial labeling inversion pulse (T-SLIP) and describe the optimization of this protocol. Conventional flow-based MR angiography techniques without contrast agent have not been used successfully for artery delineation of the upper abdomen. True SSFP is based on a gradient-echo sequence which can obtain relatively high signal-to-noise ratio without the use of contrast agent. But, this technique alone could not acquire selective delineation of the hepatic artery. T-SLIP is a kind of arterial spin labeling which can provide quantitative and selective inflow information by placing the inversion pulse at any place independent of the imaging area before data acquisition and suppress background signal.

## Materials and methods

Twenty-one healthy volunteers were examined in this study. A respiratory-triggered 3D true SSFP combined with T-SLIP was performed (Fig. 1). Among several key factors that affect the image quality of this protocol, most important one is the inversion time (TI). Therefore, according to the difference of TI, four image groups, that is, group A (TI of 800 ms), group B (TI of 1000 ms), group C (TI of 1200 ms) and group D (TI of 1400 ms) were made and compared to detect the optimal TI for the hepatic artery visualization. Statistical analyses were performed after the quantitative and qualitative evaluation.

## Results and discussion

Selective and high contrast visualization of the hepatic arteries was acquired in twenty cases using 3D SSFP imaging combined with T-SLIP. Regarding the hepatic artery delineation, the change of image quality was observed in most of subjects according to the difference of TI (Fig. 2a-d). Vessel-to-liver contrast decreased in group D (TI of 1400 ms) due to background signal recovery. As to the qualitative evaluation, there were statistically significant differences between group A and other groups ( $p$ -value  $< 0.01$ ) and between group B and C ( $p$ -value  $< 0.05$ ). In group C (TI of 1200 ms), both vessel-to-liver contrast and the image quality score were highest, and TI of 1200 ms was thought to be optimal.

## Conclusion

The MR angiographic technique using respiratory-triggered 3D true SSFP with T-SLIP enabled the selective visualization of the hepatic arteries without exogenous contrast agent or breath hold.

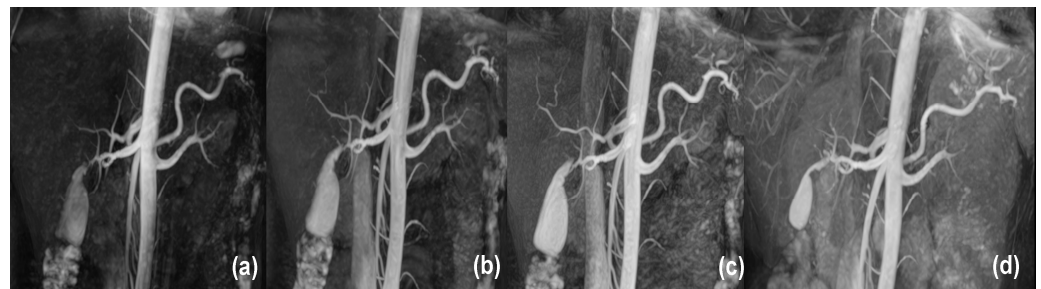


Figure 1. true SSFP with time-SLIP Figure 2. (a) Group A (TI of 800 ms), (b) Group B (TI of 1000 ms), (c) Group C (TI of 1200 ms), (d) Group D (TI of 1400 ms). Background signal makes a recovery with time. At the same time, the signal of intrahepatic vessels tends to increase with time.