Non-contrast-enhanced hepatic MR arteriography with two-dimensional parallel imaging and short tau inversion recovery methods to shorten acquisition time without image quality deterioration

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Introduction

Non-contrast-enhanced MRA methods, 3D true steady-state free-precession (SSFP) combined with time-spatial labeling inversion pulse (T-SLIP), enabled selective visualization of the hepatic artery during free breathing without an exogenous contrast agent. However, the acquisition took up to 10 minutes, which was overlong for clinical use. Shortening of the acquisition time is feasible by using the parallel imaging (PI) method, although concurrent decrease in SNR may exacerbate the image quality. One of the solutions to this problem is larger reduction of the background signal. In this study, we used short tau inversion recovery (STIR) method in combination with a T-SLIP for larger background signal suppression to compensate signal decrease induced by 2D-PI. The aim of the study is to evaluate the feasibility of a non-contrast-enhanced hepatic MR arteriography using 2D-PI and STIR methods for the shortening the acquisition time without image quality.

Materials and methods

Twenty-four healthy volunteers were examined in this study. 3D SSFP imaging combined with a T-SLIP was conducted using 1D or 2D-PI and fat suppression by chemical shift selective (CHESS) or STIR methods. Three groups of different scan conditions were assigned and compared: group A (1D-PI factor 2 and CHESS), group B (2D-PI factor 2x2 and CHESS), and group C (2D-PI factor 2x2 and STIR). Three image groups, that is, group A (PI factor 2x1), group B (PI factor 2x2), and group C (PI factor 2x2 and STIR), were assigned and compared. For quantitative analysis, artery-to-liver contrast of the right hepatic artery was quantified. Quality of artery visualization and overall image quality which was based on the degree of motion artifact and background signal suppression, were scored using four-point and three-point scales.

Results

The mean scan time was 9.5+/-1.0min (mean+/-standard deviation), 5.9+/-0.8min, and 5.8+/-0.5min in groups A, B, and C, respectively, and was significantly shorter in groups B and C than in group A ($P<0.01$). The artery-to-liver contrast was significantly better in group C than in groups A and B ($P<0.01$). The scores for artery visualization and overall image quality were worse in group B than in groups A and C. The differences were statistically significant ($P<0.05$) regarding the arterial branches of segments 4 and 8. Between group A and group C, which had similar scores, there were no statistically significant differences.

Conclusion

Shortening of the acquisition time for selective hepatic artery visualization without deterioration of the image quality was feasible by combination of true SSFP, T-SLIP, STIR and PI methods. It enabled strong signal suppression of the background, additionally, shorter acquisition time may decrease patients' burden. (Fig. 1).

Figure 1. Coronal MIP images of a 23-year-old male acquired with in group A (a), group B (b), and group C (c). "Apparent" signal suppression of the background, especially the liver parenchyma, is best in group C (PI factor 2x2 and STIR), which resulted in superior visualization of peripheral arterial branches.

(a) (b) (c)