TIME-SLIP NON-CONTRAST MR HEPATIC ARTERIOGRAPHY: COMPARISON WITH CONTRAST-ENHANCED CT ARTERIOGRAPHY

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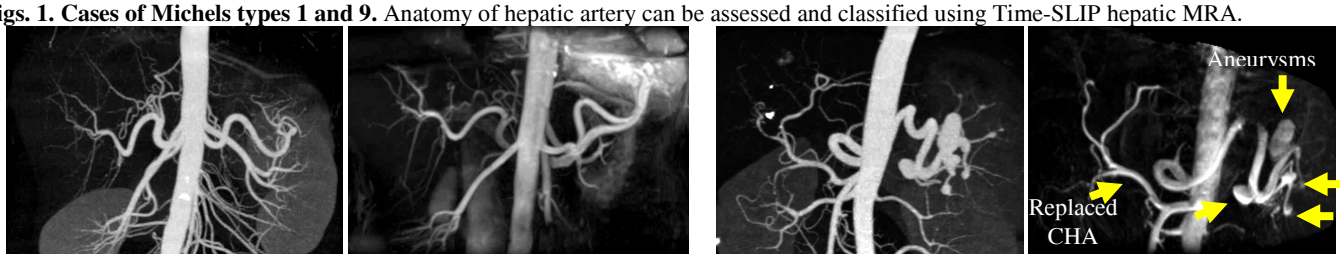
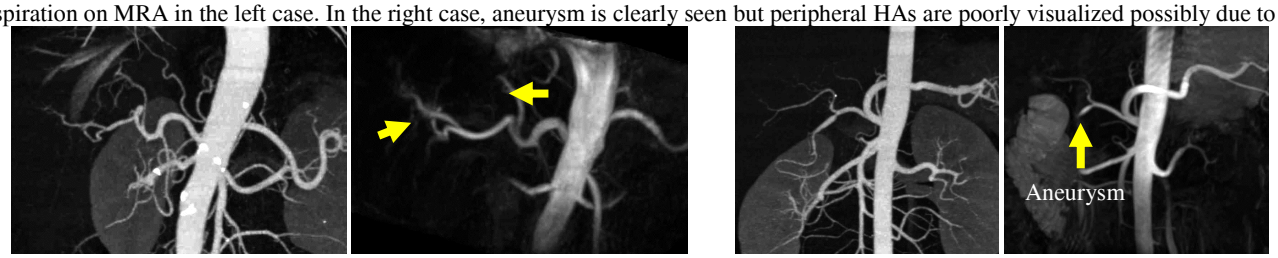
Introduction: The assessment and classification of anatomy of hepatic artery (HA) is an essential step for both diagnosis and management of various diseases in the upper abdomen. Development of non- invasive imaging techniques for this purpose is an urgent problem because of recent recognition of nephrogenic systemic fibrosis and high rate of renal dysfunction coexisting with liver diseases. In addition, anatomical surveillance of HA is required for healthy candidates in living donor liver transplantation. On the other hand, improvements of non-contrast MR angiographic techniques have been reported recently, especially at 3T-MRI because of its high blood labeling capability. One of these techniques is time-spacial labeling inversion pulse (Time-SLIP). However, to date, we have no report on application of this technique for hepatic arteriography at 3T units. The purpose of this study was to evaluate non-contrast MR hepatic arteriography (MRA) using Time-SLIP at 3T in comparison with contrast-enhanced CT arteriography (CTA).
Materials and Methods: This study comprised 102 patients (61 men & 41 women, mean 63.4 years) who were suspected to have malignant tumor in the liver, bile duct (BD), or pancreas, all of whom underwent MRI at a 3T scanner (Titan 3T, Toshiba Medical Systems, Otawara, Japan) and contrast-enhanced CTA. Non-contrast hepatic MRA were obtained with Time-SLIP (3D-true SSFP with resp. trigger, STIR TI:230ms, scan time: 5-7min). Time-SLIP pulse was applied as selective and non-selective composite black blood inversion pulses with BBTI time of 1500ms. BBTI was set according to the preliminary results using 5 healthy volunteers. Overall visualization of HA was independently scored by two abdominal radiologists on a 4-point scale (1: common HA, 2: proper HA, 3: right and left HAs, 4: branches of right and left HAs). Scores of 3 or 4 were assessed to be clinically acceptable. In Addition, visualization of right, left, and segment 4 HAs was scored on a 4-point scale (1: not visualized, 2: partially, 3: totally, 4: totally and well). Anatomy was classified using Michels classification. Patients' backgrounds, irregular respiration, HA narrowing, aortic arteriosclerosis, cardiomegaly, and visualization of bile duct, fluid, portal vein, and IVC, and artifacts, were recorded on a 4-point scale and their effects on visualization on MRA were assessed. HA visualization was compared with CTA. Presence of arterial encasement indicating vascular invasion were recorded.
Results: Mean scores for overall, RHA, LHA, and A4 were 3.6, 3.5, 3.4, and 2.5 on MRA and 3.9, 3.9, 3.7 and 3.0 on CTA. MRA was acceptable in 95.1% (97/102) and assigned as excellent in 64.7% (66/102). HA was classified as the same on MRA and CTA except for 5 patients with poor MRA visualization (figs. 1). Multivariate analyses revealed significant correlations between poor visualization on MRA and age in overall and LHA ($p<0.05$), arteriosclerosis in overall, RHA, and LHA (<0.01), irregular respiration (<0.001) (figs. 2), HA narrowing (<0.0003), or cardiomegaly (<0.03) in all the scores. MRA was superior to CTA in 3 patients, and inferior to in 29 (28.4%). Agreements between the observers were almost perfect ($\kappa > 0.8$). Encasement was observed in 2 patient with BD cancers, 9 with pancreas cancer, and 1 with HCC. Stenosis was observed more severely on MRA than CTA (Figs. 3). In some patients, visualization of bile duct increased anatomical information (figs. 3).
Conclusion: Hepatic artery can be assessed and classified by non-contrast Time-SLIP-MRA and is comparable to CTA in majority of patients.

Figs. 1. Cases of Michels types 1 and 9. Anatomy of hepatic artery can be assessed and classified using Time-SLIP hepatic MRA.



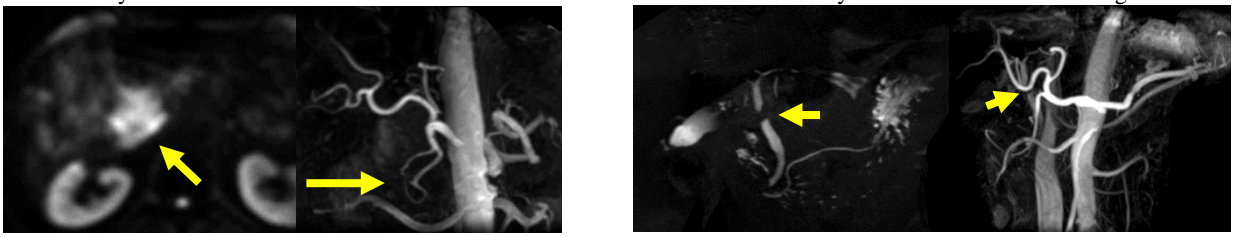
Type 1 CTA Time-SLIP-MRA Type 9 CTA Time-SLIP-MRA

Figs. 2. Cases of irregular respiration and median arcuate ligament syndrome. Peripheral HAs are seen larger in diameters due to irregular respiration on MRA in the left case. In the right case, aneurysm is clearly seen but peripheral HAs are poorly visualized possibly due to MALS



CTA Time-SLIP-MRA CTA Time-SLIP-MRA

Figs. 3. Cases with arterial encasement due to pancreatic cancer and visualization of bile duct. Posterior invasion is suspected on DWI. Arterial encasement is clearly seen in PSPDA on MRA in the left case. Pseudostesosis of CBD is clearly indicated on MRA in the right case.



DWI Time-SLIP-MRA MRCP Time-SLIP-MRA