TIME-SLIP MR HEPATIC ARTERIOGRAPHY USING 3T-MRI

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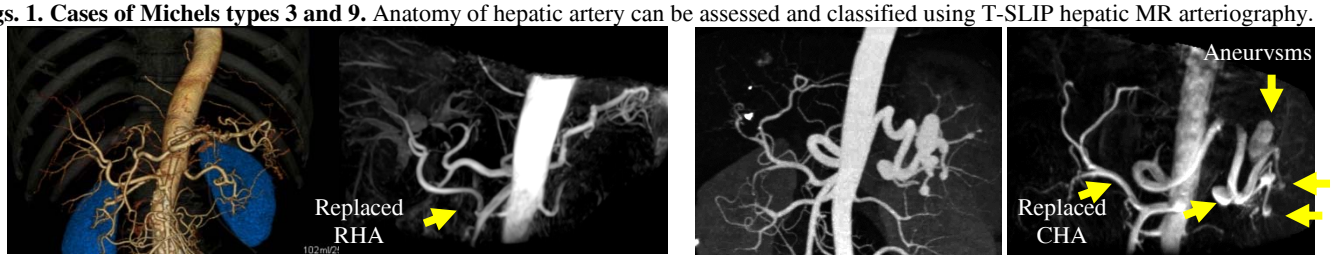
Introduction: The assessment and classification of anatomy of hepatic artery (HA) is an essential step for both diagnosis and management of various diseases in the upper abdomen. Development of non- invasive imaging techniques for this purpose is an urgent problem because of recent recognition of nephrogenic 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 (T-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 develop and assess T-SLIP hepatic MR arteriography for assessment and classification of anatomy of HA.

Materials and Methods: This study comprised 101 patients (m:59, f:42, mean: 65.0 yrs) 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, Ohtawara, Japan). Non-contrast hepatic MR arteriography were obtained with T-SLIP (3D-true SSFP with resp. trigger, STIR TI:230ms, scan time: 5-7min). T-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, cardiac enlargement, and visualization of BD, fluid, portal vein, and IVC, and artifacts, were recorded on a 4-point scale and their effects on HA visualization were assessed. In 41 patients, HA visualization was compared with CE-CTA. Presence of arterial encasement indicating vascular invasion were recorded.

Results: Mean scores for overall, right, left, and A4 were 3.4, 3.4, 3.3, and 2.5. T-SLIP was acceptable in 90% (91/101). 76 were classified as Michels Ⅰ, 4 were Ⅱ, 7 were Ⅲ, 1 was Ⅳ, 1 was Ⅴ, 2 were Ⅶ, and 1 was Ⅷ (Figs. 1). It could not be done in 9 patients because of poor visualization. Agreements between the observers were almost perfect ($\kappa > 0.8$). Multivariate analyses revealed significant correlations between poor visualization and age ($p<0.005$), irregular respiration (<0.0005), HA narrowing (<0.05), arteriosclerosis (<0.001), cardiac enlargement (<0.05), or artifacts (<0.05). Overall visualization of T-SLIP was inferior to CE-CTA in 15 patients, in whom severe irregular respiration, HA narrowing, arteriosclerotic change, and cardiac enlargement were found in 4, 4, 5, and 5 patients (figs.2). Encasement was observed in 1 of 7 patients with BD cancers and 5 of 5 with pancreas cancer. Stenoses were observed more severely on T-SLIP than CE-CTA (Figs. 3). In some patients, visualization of bile duct increased anatomical information (Figs. 3).

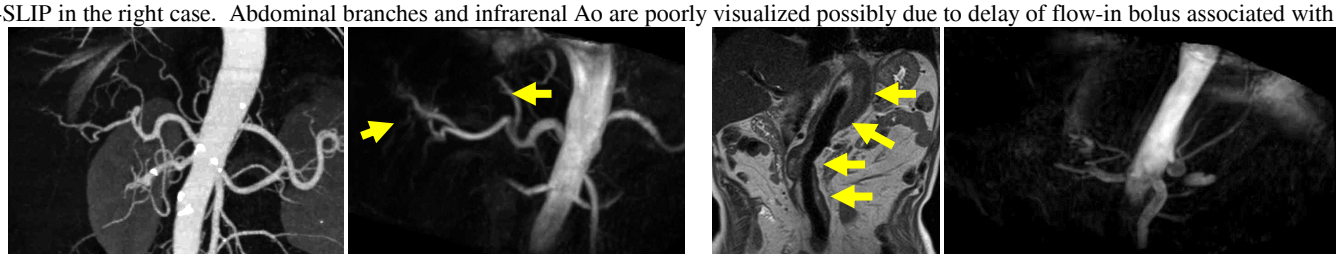
Conclusion: Hepatic artery can be assessed and classified by non-contrast MRA using T-SLIP at 3T with exception of small proportion of patients.

Figs. 1. Cases of Michels types 3 and 9. Anatomy of hepatic artery can be assessed and classified using T-SLIP hepatic MR arteriography.



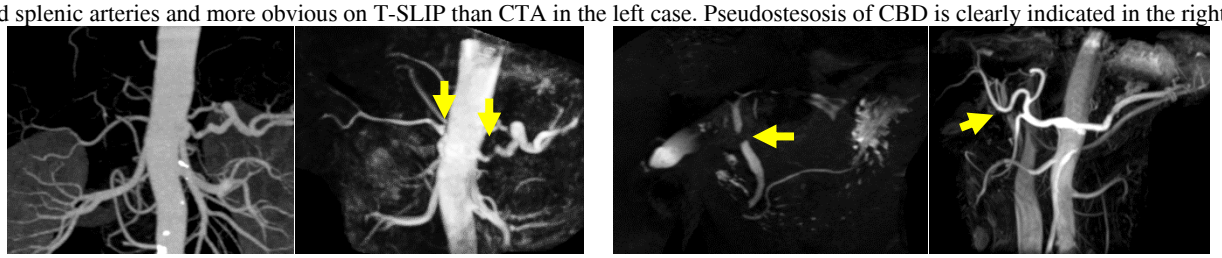
Type 3 CE-CTA T-SLIP-MRA Type 9 CE-CTA (not included in study population) T-SLIP-MRA

Figs. 2. Cases of irregular respiration and abdominal aortic aneurysm. Peripheral HAs are seen larger in diameters due to irregular respiration on T-SLIP in the right case. Abdominal branches and infrarenal Ao are poorly visualized possibly due to delay of flow-in bolus associated with AAA.



CE-CTA T-SLIP-MRA Coronal T2WI T-SLIP-MRA

Figs. 3. Cases with arterial encasement due to pancreatic cancer and visualization of bile duct. Arterial encasement is clearly seen common hepatic and splenic arteries and more obvious on T-SLIP than CTA in the left case. Pseudostesosis of CBD is clearly indicated in the right case.



CE-CTA T-SLIP-MRA MRCP T-SLIP-MRA