Transcatheter Intraarterial First-Pass Perfusion (TRIP)-MRI Monitoring of Chemoembolization

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Introduction: Transcatheter arterial chemoembolization (TACE) is widely used for treatment of liver cancer. However, the optimum embolic endpoint remains unknown because conventional DSA monitoring is hampered by an inability to target reproducible endpoints and no means of intra-procedural feedback regarding alterations to tumor perfusion. Interventional radiology DSA procedure suites with integrated MRI scanners (termed MR-IR suites) can potentially gather immediate functional information regarding alterations to tumor perfusion during TACE. **TR**anscatheter **I**ntraarterial first-pass **P**erfusion (**TRIP**)-MRI may permit iterative perfusion measurements at the time of therapy. Using a clinical MR-IR unit, we tested the hypothesis that TRIP-MRI can detect immediate reductions in liver tumor perfusion during TACE.

Methods: This prospective IRB-approved study assessed 10 patients with unresectable hepatocellular carcinoma (HCC) who underwent 13 sessions of TACE therapy within a Siemens Miyabi MR-IR unit. Each patient was first selectively catheterized under DSA guidance and moved to an adjacent 1.5T wide-bore Espree scanner for TRIP-MRI. After baseline TRIP-MRI measurements, patients underwent DSA-guided superselective TACE. Patients were immediately returned to MRI for repeat TRIP-MRI perfusion measurements. TRIP-MRI parameters: saturation recovery GRE, TR/TE = 2.4/1.2ms, 10-14 slices sampled for 40s post-intraarterial (IA) injection of 4-10mL 20% Gd contrast (Magnevist, Berlex), 192x128 matrix, 300-340mm FOV. We measured voxel-wise signal enhancement curves to produce baseline-to-peak area-under-the-curve (AUC) and maximum-up-slope (MUS) maps for whole tumor region-of-interest (ROI) semi-quantitative perfusion measurements. Functional embolic endpoints were reported as the % reduction in overall tumor AUC and MUS from baseline. We compared reductions in AUC and MUS measurements following TACE using a paired *t*-test, α=0.05.

Results: All patients completed the study. TRIP-MRI image series clearly depicted segmental liver enhancement reflective of superselective catheter position. Representative images are depicted in **Figs. 1** and **2.** Each figure includes a) delayed-phase IA contrast-enhanced (CE) anatomic images; b) TRIP-MRI images before and after TACE; and c) corresponding AUC and MUS maps. **Fig. 1** also shows a representative first-pass TRIP-MRI tumor enhancement curve. TRIP-MRI detected significant reductions in AUC and MUS perfusion for all tumors (n=18, p<0.007) with AUC and MUS reductions of 74.6%±24.8% and 56.8%±28.2% (mean±SD) respectively. There was a wide variability in functional embolic endpoints given that AUC reduction ranged from 4% to 97% and MUS reduction ranged from 9% to 87%.

Conclusions: TACE can be successfully monitored using an MR-IR unit. TRIP-MRI can detect HCC perfusion reductions during TACE, which could potentially be used as a functional embolic endpoint. Future MR-IR studies should compare clinical outcomes to immediate intra-procedural changes in TRIP-MRI tumor perfusion measurements.

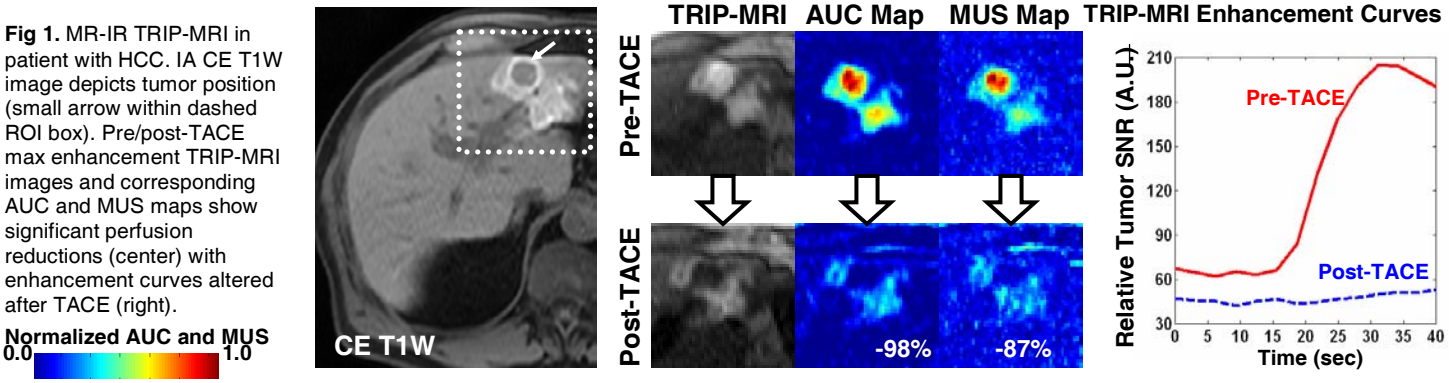

Fig 1. MR-IR TRIP-MRI in patient with HCC. IA CE T1W image depicts tumor position (small arrow within dashed ROI box). Pre/post-TACE max enhancement TRIP-MRI images and corresponding AUC and MUS maps show significant perfusion reductions (center) with enhancement curves altered after TACE (right).

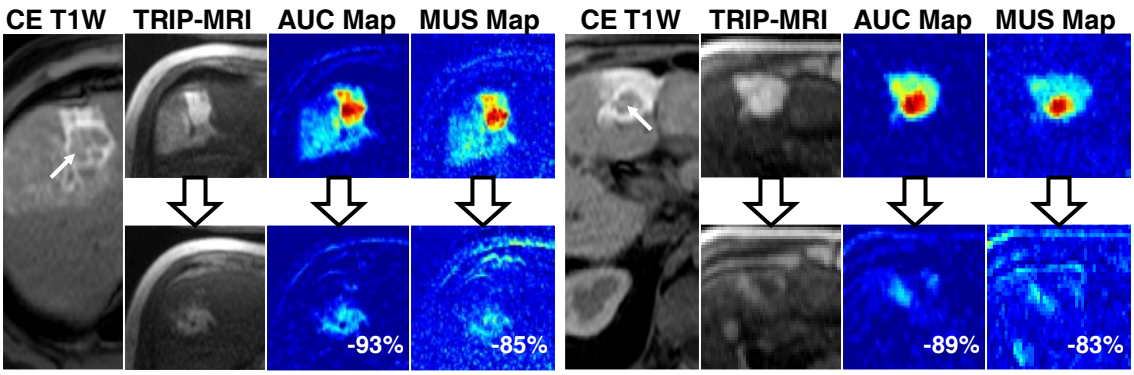

Fig 2. MR-IR TRIP-MRI in two different patients with HCC (left and right). IA T1W CE images depict tumor position (small arrows). Max enhancement TRIP-MRI images and corresponding AUC and MUS maps demonstrate significant perfusion reductions following TACE (top = pre- and bottom = post-TACE).