Transcatheter Intraarterial Perfusion MRI is an Intra-procedural Imaging Biomarker to Predict Survival during Chemoembolization of Hepatocellular Carcinoma

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Introduction: Hepatocellular carcinoma (HCC) is the third most common cause of cancer death worldwide. With established survival benefits, transcatheter arterial chemoembolization (TACE) is widely accepted as the first-line therapy for intermediate-stage unresectable HCC [1]. Intra-procedural imaging biomarkers predictive of overall survival (OS) during TACE could potentially further enhance the benefits of TACE, as intra-procedural prognostic factors could be used to guide the selection of optimal therapeutic endpoints at the time of treatment. Transcatheter Intraarterial Perfusion (TRIP)-MRI, using catheter-directed intraarterial contrast injections, offers an objective approach to monitor intra-procedural tumor perfusion changes during TACE in a combined clinical MR/X-ray DSA unit [2, 3]. Recent clinical studies have suggested that chemoembolization endpoints can affect treatment outcome [4] and indicated that intra-procedural perfusion changes measured by TRIP-MRI can predict tumor necrosis imaging response to TACE [5]. In this study, we tested the hypothesis that TRIP-MRI monitored tumor perfusion changes during TACE can predict OS in patients with unresectable HCC.

Methods: In this prospective IRB-approved study, 51 consecutive HCC patients underwent TACE procedures within a Siemens MiYabi MR-DSA suite. Each patient was catheterized under DSA guidance and transferred to a 1.5T Siemens MAGNETOM Espree MR scanner for baseline TRIP-MRI measurements. After moving back to DSA suite, patients undergo DSA-guided TACE. Patients were then returned to MRI for repeat TRIP-MRI. 3D or 4D TRIP-MRI were performed using 2D saturation-recovery spoiled-gradient-echo (GRE) sequence (TR/TE/TI = 2.4/1.2/90 ms, 10-14 slices, 8mm thickness), or 3D GRE sequence (TR/TE = 4.0/1.7 ms, 24-28 slices, 5mm thickness), respectively. Other common parameters included: 15° flip angle, 192×128 matrix, 380-450 mm FOV, 670 Hz/pixel BW, and GRAPPA acceleration factor 2. Dynamic images were acquired for 35 sec after intraarterial injection of 5 or 10 mL 20% Gd-DTPA contrast (Magnevent, Berlex). Imaging parameters were chosen to provide a relatively linear relationship between signal intensity and tissue contrast agent concentration. Tumor regions-of-interest in the central slice of each tumor were drawn on TRIP-MRI image series to generate time-intensity and tissue contrast agent concentration. The authors wish to acknowledge grant support from NIH R01 CA126809, R01 CA134719, and P41 RR008079.

Results: Fifty patients had TRIP-MRI monitored TACE successfully performed and were eligible for the analysis. The 25th, 50th, and 75th percentiles of intra-procedural perfusion percentage reduction were 31.5%, 51.1%, and 68.1%. At the time of analysis, 26 of the total 50 patients have deceased. The median OS was 45.7 months (95% CI, 5.6-85.8 months). Patients with 35-85% intra-procedural tumor AUC reductions (n = 32) showed significantly improved median OS compared to patients with AUC reductions outside this range (n = 18) (46.9 [95% CI, not available] versus 10.6 [95% CI, not available], P = 0.012). The cumulative survival rates in the 35-85% and < 35 or >85% tumor perfusion reduction during TACE adjusted for CLIP score.

Fig 1. Overall survival (OS) of HCC patients with 35-85% and < 35 or >85% tumor perfusion reduction during TACE adjusted for CLIP score.