

Pre-treatment hepatic arterial mapping with MRI in cirrhotic patients with hepatocellular carcinoma (HCC)

Iva Petkovska¹, Manojkumar Saranathan¹, Thomas Hope¹, Brian Hargreaves¹, Umar Tariq¹, and Shreyas Vasanawala¹
¹Radiology, Stanford University, Stanford, CA, United States

Purpose: Assessment of hepatic arterial anatomy prior to transcatheter arterial chemoembolization (TACE) is critical [1,2]. Here we assess the quality of the vascular roadmap from high spatiotemporal resolution contrast-enhanced angiographic and arterial phase MR images of cirrhotic patients with HCC and compare with findings on catheter angiogram as a gold standard.

Methods: After IRB approval we retrospectively identified 21 consecutive cirrhotic patients with HCC scanned with a dual-echo SPGR acquisition and a view shared 2-point Dixon reconstruction (Differential Sub-Sampling with Cartesian Ordering, DISCO [3]); 29 lesions with imaging findings concerning for HCC and size 10 mm or larger were identified. Imaging parameters were: TE₁/TE₂/TR 1.2/2.4/4.3 ms, 15° flip, 3mm thick, matrix 320x224, parallel imaging acceleration 2 (phase direction) x 2.5 (slice direction). Following contrast injection (single dose of gadolinium administered at 2.5 mL/s), 5-7 phases were acquired in a 20-28s breath-hold, yielding a 4s temporal frame rate. Visibility of the common (CHA), proper (PHA), right (RHA) and left (LHA) hepatic arteries and segmental branches (SB, overall delineation through liver) was graded on a 5 point scale (1-not seen, 2-poor delineation due to low signal intensity and/or marked blurring, 3-moderate enhancement and/or blurring, 4- high signal intensity and slight blurring and 5-high signal and no blurring). Visualization of tumor feeding vessels (TFV) and donor vessel to feeders (DV) was graded on a 5 point scale (1-absent, 2-probably absent, 3-indeterminate, 4-probably present and 5-present [Fig.2, 4]). Grading scores were grouped in analyses as acceptable (3-4-5) or unacceptable scores (1-2). Variant arterial anatomy and presence of an extra-capsular tumor feeding branch was documented. 14/29 lesions had catheter angiogram (TACE) done within 2 months of MRI and served as a gold standard to determine concordance of identified donor vessel to embolized segmental vessel feeding the tumor, presence of an extra-capsular branch and variant arterial anatomy; 95% confidence intervals for sensitivity and specificity were calculated.

Results: Acceptable visibility of the CHA and PHA in 21 (100%, 95%CI: 0.84-1), RHA and LHA in 20 (95%, 95%CI: 0.77-0.99) and SV in 18 cases (86%, 95%CI: 0.65-0.95) was seen (Fig.1). Tumor sizes were 10-54 mm (median 16mm). Acceptable visualization of TVF and DV was seen in 19/29 lesions (66%, 95%CI: 0.5-0.8), (Fig.3). DV was identified as follows: RHA in 5 (1-V, 2-V/VIII, 2-IVA/VIII), anterior RHA in 5 (VII/VIII-1, VIII-2, IV/VIII-2), posterior RHA in 5 (VI-2, VI/VII-2, VII-1) and LHA in 4 cases (II-1, II/III-1, III-2); Roman numerals here indicate liver segment. In 11/14 lesions with catheter angiogram, the main donor to segmental vessel embolized was concordant (79%, 95%CI: 0.5-0.9); three lesions were hypovascular on angiography (Fig.3). In 3/14 lesions with catheter angiogram findings were discordant, neither TFV nor DV identified on MRI; two lesions were hypovascular on angiography (Fig.3). In 14/14 lesions with catheter angiogram a concordant finding of absent extracapsular feeding branches (100% specificity,) and presence/absence of variant arterial anatomy was noted (100% sensitivity) (95%CI: 0.73-1).

Conclusion: High spatial and temporal resolution multiphasic contrast enhanced liver MRI via view sharing yields multiple angiographic and arterial phases within single breath-hold and enables depiction of vascular anatomy with acceptable quality and concordant findings with catheter angiogram. Identification of variant vascular anatomy, absence of an extra-capsular feeding branch and main donor to segmental vessel to be embolized may aid pre-treatment planning in HCC.

References: [1] Heilmaier et al. Radiology 2007; 245(3):872-80. [2] Kim et al. Radiographics 2005; S25-39. [3] Saranathan et al JMRI 2012; 35(6):1484-92

Figure 1: Percentage of cases with acceptable and unacceptable scores for visibility of hepatic arteries.

Figure 2: One pre-contrast (a), 7 post-contrast phases (b-h) and MIP image in arterial phase (i). White arrows show progressive enhancement of arterial TFV (b-c), portal vein (e-g) and non-enhanced (f) and enhanced hepatic vein (g). DV to TFV is LHA (i). Blue arrows point to HCC (b-f).

Figure 3: Number of cases with concordant and discordant findings with angiogram on main DV to SV embolized (hyper & hypovascular lesions per angiogram) and cases with no catheter angiogram (TFV/DV seen and not seen on MRI).

Figure 4: TFV from RHA for HCC in segment VII.

