Evaluation of a non-enhanced MRI protocol compared to gadolinium-enhanced MRI for hepatocellular carcinoma

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Introduction: Although gadolinium-enhanced MRI is accurate for identifying hepatocellular carcinoma (HCC) (1), patients with severe renal dysfunction are contraindicated for gadolinium due to the risk of Nephrogenic Systemic Fibrosis (NSF) (2). Therefore, there is a necessity to develop non-contrast MRI techniques which can be used to image these patients. Diffusion-weighted MR imaging (DWI) is a non gadolinium-enhanced technique which has been shown to be able to distinguish benign from malignant liver lesions (3). HCC can also be identified using a multi-echo T2* GRE sequence without gadolinium by exploiting the differences in iron deposition between liver parenchyma and tumor (4). In this study, we evaluate the performance of an MRI protocol using a combination of non gadolinium-enhanced imaging techniques compared with gadolinium-enhanced imaging as the reference standard.

Methods: 56 patients with cirrhosis were evaluated in this HIPPA compliant retrospective study (31 male, mean age 55.6 y). All patients had undergone 1.5T liver MRI (Avanto, Siemens Medical Solutions, Berlin, Germany) using an axial imaging protocol including triple B value DWI (B 0, 50, 500) (TR 9000, TE 90, flip angle 90, FOV 350x320, slice thickness 7mm, respiratory gated (PACE), time of acquisition approximately 200 seconds), multi-echo T2*W GRE (TR 171, TE 4.8-28.7 (6 echoes), FOV 400x 400, slice thickness 10mm, breath-hold in 3 concatinations, time of acquisition 60 seconds), and multiphase fat saturated T1W GRE (VIBE) (TR 4.15, TE 1.5, flip angle 12, FOV 350x320, slice thickness 3mm, breath-hold 11 seconds) following administration of gadolinium chelate (Magnevist, Bayer Pharmaceuticals). A single reader evaluated all non-contrast images for liver lesions. 1 month later, in random order, the same reader evaluated the gadolinium enhanced images, which served as the reference standard. Sensitivity and specificity, per liver lesion, were assessed using generalized estimating equations (GEE) based on a binary logistic regression model.

Results: On the reference standard, there were 46 liver lesions identified (average size 2.48 cm) including 26 lesions classified as HCC (average size 2.81 cm). On the interpretation of the non-contrast sequence, the detection rate of all liver lesions was 97.8%. The per-lesion performance of the non-contrast dataset for HCC (sensitivity, specificity, PPV, NPV, accuracy) was 69.2%, 100%, 100%, 77.1%, 84.9%. On subset analysis, 6 of the 26 HCC were seen on the DWI sequence but not on T2*W GRE and 4 HCC were seen on T2*W GRE but not DWI. 12 HCC were identified on both DWI and T2*W GRE while only 4 HCC were not seen on either non-contrast sequence.

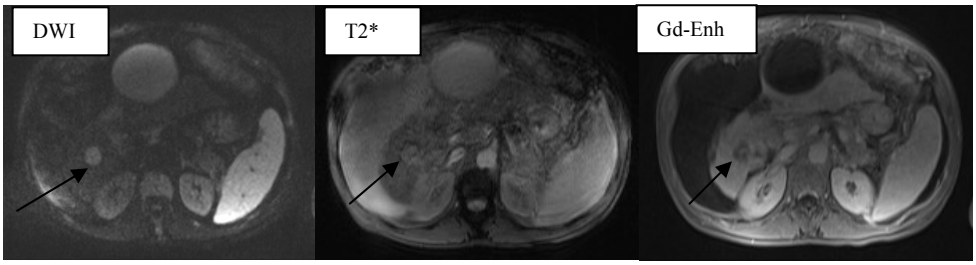

Figure 1: 2 cm HCC (arrow) in the right hepatic lobe in a cirrhotic patient with ascites. A benign cyst is in the left lobe of the liver

Discussion: Despite a reduced sensitivity for HCC, the combined non-enhanced imaging protocol used in this study was highly specific for diagnosing HCC. In patients who are unable to have gadolinium chelates administered due to impaired renal function, a non-enhanced MR protocol is likely the best alternative. This study demonstrates the benefits of a non-enhanced protocol using both DWI and T2*W GRE sequences, as some lesions were identified on only one of the two techniques. Most importantly, this study demonstrates that a lesion identified on these sequences as being suspicious for HCC has a very high likelihood of indeed representing HCC.

Conclusion: Given the clinical need for imaging of cirrhotic patients contraindicated for gadolinium, we propose that a non-enhanced MRI protocol can be a reasonable alternative. Using a combination of multi-echo T2* GRE and DWI is better than either alone and can diagnose HCC with a reasonable confidence.

Reference:
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3. Parikh T et.al. Radiology. 2008 ; 246:812-22.
4. Hardie AD et al. ISMRM 2009