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Title of Abstract: **Blood oxygen level-dependent liver MRI: can it predict microvascular invasion in HCC?**

Abstract:

Institution: UHN

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Modality: MR

Organ System: GI

Intro: LIVER RESECTION AND transplantation are the only curative treatment options currently available for hepatocellular carcinoma (HCC). However, longterm survival is still poor as a result of a high rate of recurrence among other drawbacks, such as lack of reliable prognostic factors, phenotypic diversity of the disease, and the lack of effective systemic treatment. Among many outcome prediction parameters such as tumor grade, differentiation, size, multiplicity, and vascular invasion (macro and microscopic), microvascular invasion (MVI) has been correlated to be one of the most significant independent risk factors affecting recurrence-free survival following curative resection and or liver transplantation. Preoperative prediction of microvascular invasion could allow appropriate patient selection for liver transplantation and predicting prognosis. Although the combined use of imaging modalities, including MRI, computed tomography (CT), and ultrasonography, can detect tumor invasion of the major branches of the portal and hepatic veins in 81–95% of cases at the time of diagnosis, imaging studies currently do not have the ability to detect microvascular invasion. The diagnosis of MVI cannot be reliably achieved by a biopsy due to sampling errors. Blood oxygen level dependent (BOLD) MRI is a noninvasive diagnostic method capable of assessing tumor oxygenation and indirectly hypoxia, by detecting signal changes secondary to changes in blood flow and oxygenation. Hypoxia enhances proliferation, angiogenesis, metastasis, and chemo- and radioresistance of HCC resulting in increased tumor invasiveness (MVI), which is essentially the primary step for future development of macrovascular invasion and or metastases in HCC.

Purpose: To assess Blood Oxygen Level-Dependent (BOLD) Magnetic Resonance Imaging (MRI) for noninvasive preoperative prediction of Microvascular Invasion (MVI) in Hepatocellular Carcinoma (HCC).

Methods Used: In this prospective, institutional review board approved study, 26 patients (21 men and 5 women age range, 34–77 years with mean age of 61 years) with HCC were evaluated preoperatively with liver MRI including baseline and post oxygen (O₂) breathing BOLD MRI. Post processing of MRI data was performed to obtain R^{2*} values (1/s) and correlated with histopathological assessment of MVI. Statistical analysis was performed to assess correlation of baseline R^{2*}, post O₂ R^{2*} and R^{2*} ratios to presence of MVI in HCC by binary logistic regression analysis.

Results of Abstract: MVI was present in 15/26 (58%) of HCC on histopathology. The mean R^{2*} values 6 SD at baseline and post O₂ with and without MVI were 35.6 ± 12, 36.6 ± 12, 38.6 ± 10, 42.6 ± 17. The R^{2*} values between the groups with and without MVI were not significantly different statistically.

Discussion: Based on our preliminary results, BOLD MRI is unable to accurately predict MVI in HCC. The noninvasive preoperative detection of MVI in HCC remains an elusive challenge.

Scientific and/or Clinical Significance? Tumor invasion into microscopic branches of the portal and/or hepatic veins (MVI) is associated with increased risk of early tumor recurrences following surgical treatment of HCC and shorter survival. Accurate prediction of MVI would impact treatment decisions based on anticipated tumor biology, therapeutic response and clinical outcomes, but because current imaging techniques as well as preoperative biopsy are unable to accurately predict MVI in HCC, this important prognostic marker remains unconsidered while making treatment decisions for HCC. Hypoxia enhances proliferation, angiogenesis, metastasis, and chemo- and radioresistance of HCC resulting in increased tumor invasiveness (MVI), which is essentially the primary step for future development of macrovascular

invasion and or metastases in HCC. Thus, the level of intratumoral oxygenation, precisely hypoxia, could be a contributing factor to development of MVI. A noninvasive technique that could estimate tumor oxygenation would find broad applications in prediction of MVI in HCC. Blood oxygen level dependent (BOLD) MRI is a noninvasive diagnostic method capable of assessing tumor oxygenation and indirectly hypoxia, by detecting signal changes secondary to changes in blood flow and oxygenation. The ability of BOLD MRI to preoperatively predict MVI would have significant impact on the treatment and prognostication of HCC.

Relationship to existing work This is the first study reporting attempt of BOLD MRI to predict MVI preoperatively in HCC.