**Preoperatively Evaluating the Correlation between Pathological Grades and Blood Oxygenation Level-Dependent MRI in Clear Cell Renal Cell Carcinomas**

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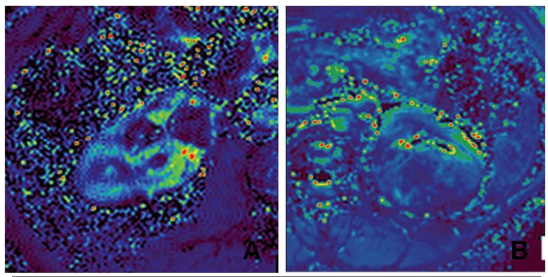
***Purpose:*** Blood oxygen level-dependent magnetic resonance imaging (BOLD-MRI) is a noninvasive tool that assesses regional tissue oxygenation. R2* values from BOLD-MRI have been correlated with the amount of local deoxyhemoglobin as well as the extent of hypoxia. [1,2] Although BOLD-MRI technique has been used to measure changes related to tumor oxygenation in various organs, [3,4] the correlation between R2* values and clear cell renal cell carcinomas (CRCC) grade has not been reported. This study aims to investigate the value of R2* values in grading CRCC.

***Methods:*** 26 patients with pathologically-proven CRCCs underwent BOLD-MRI. According to the Fuhrman criteria, all tumors were classified as a grade on the scale of Ⅰ - Ⅳ. On the basis of the Fuhrman nuclear grade, each tumor was then identified as a low-grade (Grade Ⅰ + Ⅱ) or high-grade group (Grade Ⅲ + Ⅳ). All studies were performed on a 3T imaging system using a standard 12-channel phase array body-matrix coil. BOLD-MRI was acquired with transversal multiple gradient-recalled-echo sequence (TR/TE, 336/6-39.84; field of view, 270mm × 360mm; matrix size, 163×256; slice thickness, 5mm; gap 1.0mm; flip angle, 30). In order to obtain R2* as accurately as possible, T1WI, T2WI, enhanced T1WI and raw T2*-weighted imaging (T2*WI) were used to avoid necrosis and hemorrhage in the tumors. Mean T2* values of CRCCs were measured on T2* maps.

***Results:*** There were 17 low-grade and 9 high-grade cases,. The mean R2* value of CRCCs was 27.72±12.68 $s^{-1}$. Mean R2* values of low-grade and high-grade CRCCs were 21.22±6.96 $s^{-1}$ and 39.98±12.11 $s^{-1}$, respectively. R2* values of low-grade tumors were lower than that of high-grade tumors and there was a positive relationship between R2* value and CRCC grade (r=0.66, $P$<0.005). In a more detailed analysis, there was a significant difference in R2* values between Fuhrmann grades Ⅰ and Ⅲ ($P$< 0.005), as well as between grades II and Ⅲ ($P$< 0.01), but not between grades I and II. There were not enough patients with grade IV CRCC (n=1) to perform statistical analysis.




T2* maps of low- and high-grade CRCC. Low-grade CRCC (A) appears higher T2* values than that of high-grade CRCC (B).

***Discussion:*** Many treatment options exist nowadays in the management of RCC, including surgery, radiofrequency ablation (RA), as well as active surveillance. Preoperative evaluation of CRCC grades is important for deciding on the best therapeutic option for the patient. Our study demonstrated that there were significant differences in R2* values between pathologically approved low-grade and high-grade CRCCs. High-grade CRCCs had higher R2* values than low-grade CRCCs. The difference in R2* values between low-grade and high-grade CRCCs might be caused by differences in tumor oxygenation levels. Moreover, T2*-weighted images can detect intratumoral hemorrhage more sensitively than conventional T1- and T2-weighted MRI, thus offering improved accuracy by reducing the potential influence of hemorrhage on R2* values of tumor parenchyma.

***Conclusion:*** In conclusion, BOLD-MRI can be used to help in the grading of CRCC preoperatively.

***References:***

1. Sadowski EA, Fain SB, Alford SK, et al. Assessment of acute renal transplant rejection with blood oxygen level-dependent MR imaging: initial experience. Radiology. 2005; 236(3):911-9.

2. Prasad P, Li LP, Halter S, et al. Evaluation of renal hypoxia in diabetic mice by BOLD MRI. Invest Radiol. 2010; 45(12):819-22.

3. Christen T, Lemasson B, Pannetier N, et al. Is T2* enough to assess oxygenation? Quantitative blood oxygen level-dependent analysis in brain tumor. Radiology. 2012; 262(2):495-502.

4. Rakow-Penner R, Daniel B, Glover GH. Detecting blood oxygen level-dependent (BOLD) contrast in the breast. J Magn Reson Imaging. 2010; 32(1):120-9.