DETECTING THE ACUTE RENAL ALLOGRAFT REJECTION IN EARLY STAGE: A COMPARISON OF DIFFERENT MR SEQUENCES

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Target audience: Those interested in kidney transplant and radiologists, neurologists, scientists and MRI researchers.

Introduction: Acute rejection is one of the key influencing factors associated with the survival period of renal allograft. Early detection of the rejection is essential for patients who underwent transplant surgery, because a delay of treatment may lead to irreversible nephron loss or graft failure. Functional renal imaging methods such as diffusion-weighted imaging (DWI), Diffusion kurtosis imaging (DKI) and arterial spin-labeling (ASL) could non-invasively provide diffusion and perfusion information in a microstructural level. The aim of this study is to find useful indications for diagnosing acute renal allograft rejection in the early stage.

Materials and method: Twenty patients participated in this committee–approved study (10 acute rejection (AC) and 10 transplanted kidneys in normal controls (NC)). Due to the renal disease is a high risk contraindication of Gd-contrast, all patient data was acquired without the use of exogenous Gd-containing contrast by using a MAGNETOM Skyra 3T MR scanner (Siemens Healthcare, Erlangen, Germany). For DKI, EPI sequences were acquired in the coronal plane with the following parameters: three b-values: 0, 1000, 2000 s/mm^2, 30 directions, TR/TE=5100/110ms, FOV=340x340mm^2, slice thickness=2.0mm, number of slices=25. A 2D-pASL prototype sequence was employed to measure the perfusion, the parameters were: TR/TE=3300/27 ms, FOV=300x300 mm^2, thickness=5.0mm, number of slices=14, number of measurement=101. The DKI data were post-processed using a Diffusion Kurtosis Estimator pipeline. The post-processing of ASL data included non-linear motion correction and rCBF calculation based on the formula published in a previous study [1]. Region-of-interest (ROI) measurements were performed using Mricron to determine mean dispersed (dmean), mean kurtosis (kmean) and apparent diffusion coefficient (ADC), fractional anisotropy (FA) and relative cerebral blood flow (rCBF) of the cortex and the medulla of the kidneys. The ROI areas were manually selected on 2D-T2WI and copied to the results of different modalities. The group-level differences between AC and NC were tested with two-sample t-test algorithm in SPSS17.

Results: As shown in Fig.1, the CBF values of AC patients were smaller than of NC subjects. The statistic results in Fig.2 demonstrated that dmean, FA, ADC, rCBF in the AC group were significantly lower ($P<0.05$) than those in the NC group in the cortex area. However, the kmean of the cortex had no significant differences between the two groups. The results of the values in renal medulla showed significant decrease of dmean and FA in the AC group, while the other parameters of the medulla didn't show significant differences.

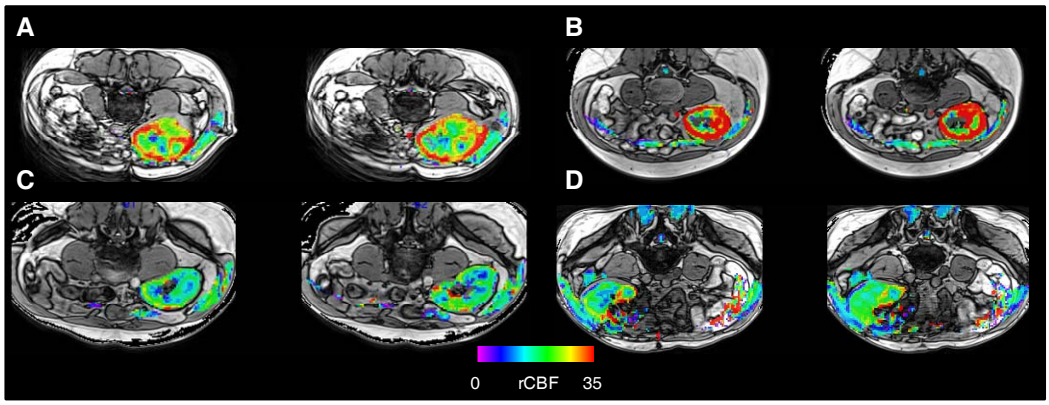

Figure 1. The rCBF map of two NC subjects (A)(B) and two AC subjects (C)(D).

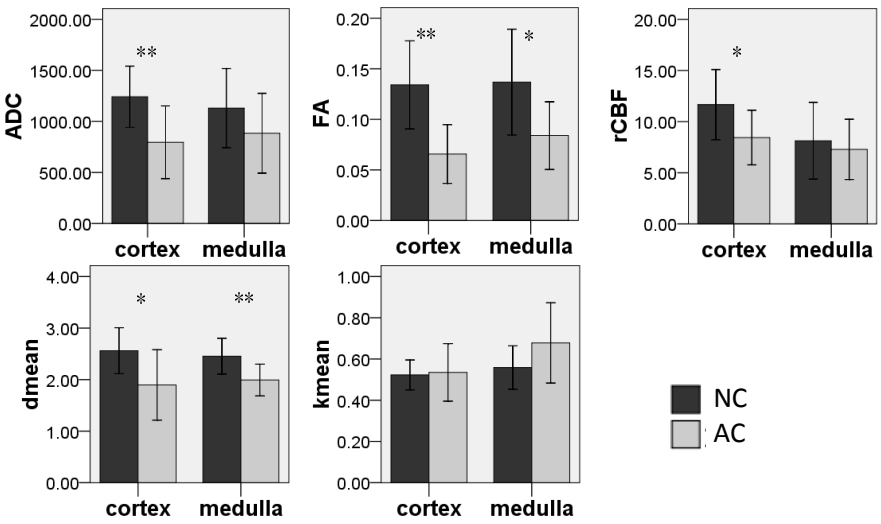

Figure 2. The statistic results of different parameters in group level.

Conclusions: DKI and ASL were both able to detect the early functional changes by measuring diffusion and perfusion properties of transplanted kidneys, showing a reduction of cortical and medullary values, especially in the cortex. Compared with the ADC values calculated with the classical model, the dmean corrected by DKI model shows better performances in detecting acute rejection at an early stage. A combination of these parameters may potentially be a clinically viable index for monitoring the acute renal allograft rejection in early stage.

References: 1. JJ-Wang et al. JMRI 18:404-413(2003).