NONINVASIVE ASSESSMENT OF ACUTE KIDNEY INJURY WITH DIFFUSION WEIGHTED MR IMAGING: A PROSPECTIVE STUDY

Jian Dong[1], Li Yang[2], Tao Su[2], Xiaoying Wang[1], and Xuexiang Jiang[1]
[1]*Radiology, Peking University First Hospital, Beijing, Beijing, China,* [2]*Nephrology, Peking University First Hospital, Beijing, Beijing, China*

Target audience: Uro-Radiologists, Nephrologists, MR technologists

Introduction Acute kidney injury (AKI) is a frequent event, with the incidence of more than 5000 for non-dialysis therapy and 295 for dialysis treatment per million people per year.[1] Early accurate diagnosis with noninvasive tools and proper intervention of therapeutic strategies is of utmost importance to preserve or restore renal function. Diffusion-weighted (DW) MR is a functional imaging technique providing quantitative parameters of diffusion and microcirculation in tissues based on the apparent diffusion coefficient (ADC). Recent studies have confirmed DW MR imaging is feasible and reproducible in detection of changes in renal function.[2-4] The purpose of this study is to investigate the feasibility of DW MR imaging in the diagnosis and therapeutic effect of AKI.

Methods Eight patients (7M/3F, 31-62 years) with pathologically confirmed AKI and 12 healthy volunteers (7M/5F, 26-64 years) were performed examinations on a clinical 3.0T GE scanner. All the subjects were trained to hold breath during examination (20-30s). DWI was performed using a spin-echo type sequence with an echo-planar imaging readout (SE-EPI). The imaging parameters were: TR/TE = 2300ms/70ms, flip angle = 90° , b value = 800s/mm^2, FOV = 36cm, nex = 2, matrix was 128×128, slice thickness = 5mm, and axial slices including global kidney were scanned. Multiple regions of interest (ROI) were placed with an area of 50-100 mm^2 to calculate ADC values on GE ADW 4.2 workstation using the formula: $ADC= -\ln(S/S_0)/(b-b_0)$, where S and S_0 are signal intensities of ROI in cortex and medulla. Follow-up DW MRI was performed in one patient in the first and fifth month after therapy. Cortical and medullary ADC values were analyzed between two groups.

Results Patients with AKI demonstrate significantly lower ADC values in both cortex ($2.41\times10^{-3}\pm1.76\times10^{-4}$ vs. $1.89\times10^{-3}\pm2.69\times10^{-4}$, $P<0.01$) and medulla ($2.08\times10^{-3}\pm1.21\times10^{-4}$ vs. $1.67\times10^{-3}\pm2.24\times10^{-4}$, $P<0.01$) than healthy volunteers (Fig 1). Follow-up ADC values in the patient gradually recovered (Fig 3)

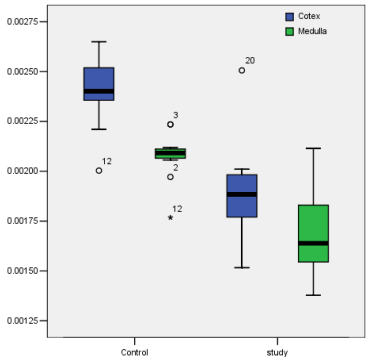

Fig 1. Comparisons of ADC values in cortex and medulla between patients with AKI and healthy volunteers.

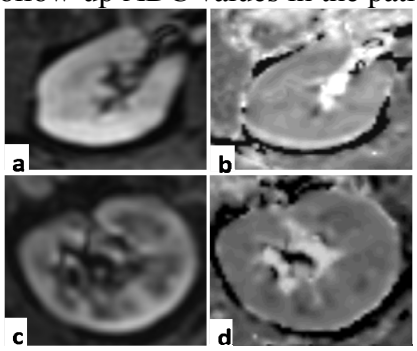

Fig 2. Comparisons of DWI images in patients (a) and (b), and healthy volunteers (c) and (d).

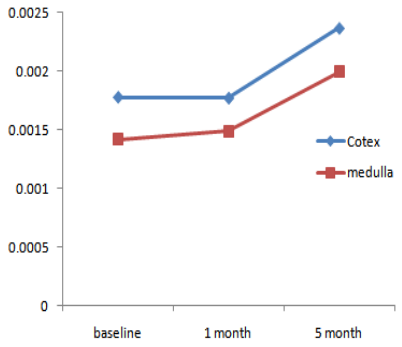

Fig 3. ADC values gradually recover in Patients with AKI before, after 1month and 5month therapy

Discussion and conclusions The results of our study show DW MR imaging can help detect the differences in the AKI kidney compared with the healthy volunteers. To our knowledge, ADC values in patients with AKI have not been reported previously. The corticomedullary differences were smaller in AKI than control group, which is in accordance with the former study in renal parenchymal diseases.[4] The recovery of cortical and medullary ADC values to normal level in follow-up is consistent with the patient's restored renal function. In conclusion, DW MR imaging is a feasible imaging tool to depict early alterations in AKI, with a potential capability to reflect prognosis.

References:

[1].Hsu CY, et al. Kidney International. 2007 72: 208-212. [2].Thoeny HC, et al. Radiology. 2009 252: 721-728. [3].Thoeny HC, et al. Radiology. 2005 235: 911-917. [4].Thoeny HC, et al. Radiology. 2006 241: 812-821.