IVIM-DWI and Non-contrast MRI of Allograft Kidneys in 48 hours after Transplantation

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[Purpose] Kidney transplantation is the best therapy for patients with dialysis-dependent renal insufficiency. MRI assessment of graft kidney function is currently important and potentially promising in clinical practice. Delayed graft function is a form of acute renal failure that results in post-transplantation oliguria. The reported frequency of delayed graft function varies from 2% to 50%. This failure might partly be explained by arterial stenosis, venous thrombosis, long ischemia time or shock. Recently, the pathophysiology of renal ischemia and reperfusion injury has been recognized as the consequence to the development of delayed graft function, but there was a lack of imaging biomarkers to demonstrate or interpolate the delayed graft function. The goal of the present study is to perform IVIM MRI and non-contrast MRI and MRA in patients after renal transplantation to evaluate the micro- and macrocirculation status of graft kidneys.

[Materials and Methods] Twelve cases with kidney allografts and twelve healthy young volunteers were included with in this study. This study was performed on a 1.5T (Aera, Siemens, Erlangen, Germany) with fast spin echo T1WI and T2WI, 3D-TrueFISP non-contrast MRA, 2D TOF and gated phase-contrast MRA, IVIM sequence for 10 patients in 48 hours after renal transplantation. IVIM sequence was acquired in the longitudinal planes by using free breathing spin echo-echo planar imaging (EPI).The imaging parameters were TR/TE=2000/61ms, FOV=300*300 mm, matrix size=109*128, scan time, 240s, Twelve b values were used: 0, 10, 20, 30, 50, 100, 300, 500 and 1000s/mm2. Additionally, 12 healthy volunteers were also recruited for acquisition of IVIM-DWI of kidneys with the same free-breathing EPI-DWI sequence. Three IVIM parameters were calculated by using the built-in bi-exponential analysis software in Siemens system, including the diffusion coefficient of slow or non-perfusion-based molecular diffusion (D;um^2/ms), which represents pure molecular diffusion; the diffusion coefficient of fast or perfusion-based molecular diffusion (D*;um^2/ms), which represents intravoxel microcirculation or perfusion; and perfusion fraction (f; %). ROI positioning was performed by a single reader placing in every image slice free-hand regions of interest (ROI) as large as possible in the cortex area of the whole kidney (Figure 1). The mean size of the transplanted kidney ROI-1 is 40 mm^2.

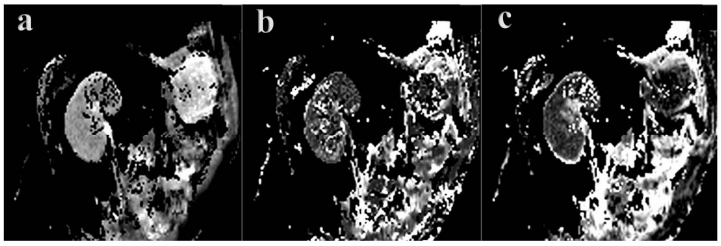


Fig.1. There is motion artifacts on the image while free breathing. It image quality is bad .

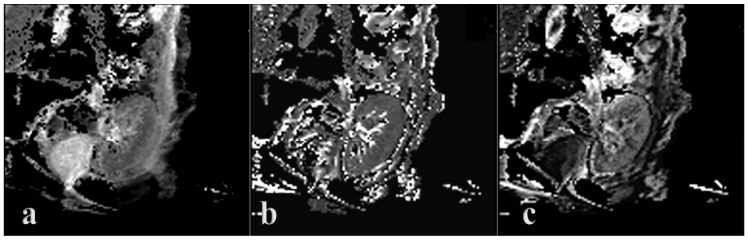
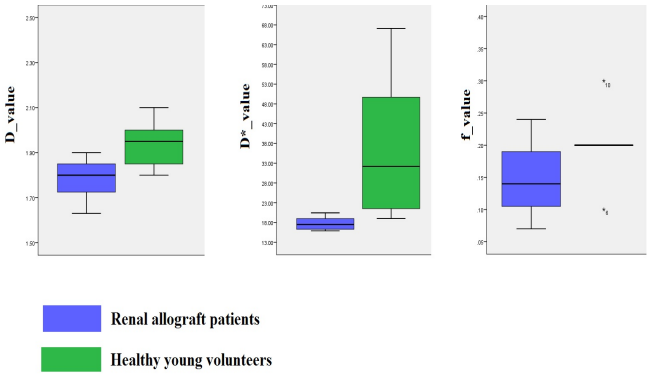


Fig.2. Kidney transplant patients is acquired better image quality .



[Results]

In this study, the results showed that MRI can acquire good image quality of morphological, MRA and also IVIM_DWI images. Those images were apparently presented less motion artifact than those in healthy volunteer because the location of graft kidneys in the iliac fossa suffered less from breathing motion artifact, as shown in figure 1 and 2. For the diffusion parameters, Diffusion parameters of D: 1.79±0.11 um^2/ms, D*: 17.06±1.6 um^2/ms and f: 0.15±0.06 were significantly lower than in the helthy volunteers, D: 1.96±0.12 um^{22}/ms, D*: 47.84±5.49 um^2/ms and f: 0.17±0.02. The higher discrepancy of D* in both groups would highlight the effect of fast/perfusion-based molecular motion in reperfusion function.

[Conclusion]

The study illustrated the clinical benefit of the non-contrast MRI in evaluation of functional changes in renal allografts from morphological and circulation points of views. Particularly, IVIM-DWI providing the functional change in micro-structural and micro-circulation would be very useful in clinical application.

[References]

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