Magnetization transfer MR imaging of the kidney: Quantitative evaluation at 3.0T in association with renal function

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Target audience: Medical doctor

Purpose: To evaluate the feasibility of magnetization transfer (MT) MR imaging of the kidney at 3.0T MR system in association with renal function.

Materials and Methods: Forty-four patients who underwent abdominal MR imaging at 3.0T system including gradient-echo (GRE) sequences with and without MT pulse were included (29 men, 15 woman; age range, 29-92 years; mean age, 67.1 year). In each patient, MT ratio (MTR; 100 x (SI off - SI on)/SI off) of the renal cortex and medulla was measured by using regions of interest (ROIs) placed on the MTR map image. The relationship between eGFR and MTR of the renal cortex and medulla was determined by linear regression analysis.

Results: Regression analysis showed good correlation between eGFR and MTR of the renal cortex ($r=-0.645$, $p<0.0001$). Among 44 patients, 22 patients were categorized as the normal renal function group while 22 patients were classified into the decreased eGFR group. The mean MTR of the renal cortex in patients with decreased eGFR (mean MTR; 30.7 +/- 3.2%) was significantly higher ($p<0.0001$) than that in patients with normal renal function (mean MTR; 25.3 +/- 2.2%), although the mean MTR of the renal medulla between the two groups was not significantly different.

Discussion: This study using 3.0T MR system showed that there was a good correlation between eGFR and MTR of the renal cortex, and MTR of the renal cortex increased in patients with decreased eGFR, indicating that MT imaging has a potential to assess the degree of renal function non-invasively in patients with renal impairment. In patients with impairment of renal function, the affected kidney is characterized by reduced blood perfusion, loss of nephron, interstitial fibrosis, tubular atrophy, and/or scarring of glomeruli [19]. These pathological changes cause an increase of collagen content in the tubulointerstitial space. This may explain why MTR values of the renal cortex increased in patients with decreased eGFR.

Conclusion: There was a good correlation between eGFR and MTR of the renal cortex derived from MT MR imaging at 3.0T. This technique has a potential to evaluate the degree of renal function non-invasively in patients with renal impairment.

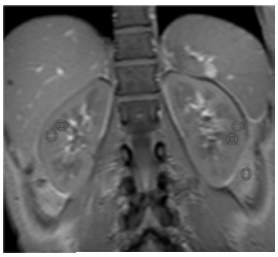

Figure 1a

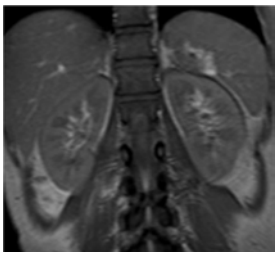

Figure 1b

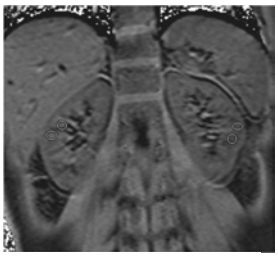

Figure 1c

Figure 1. a) GRE image with MT pulse off . b) GRE image with MT pulse on. c) MTR map image. White circles in the renal cortex and the medulla of both kidney and retroperitoneal fat represent ROIs placed for SI measurement and MTR measurement.

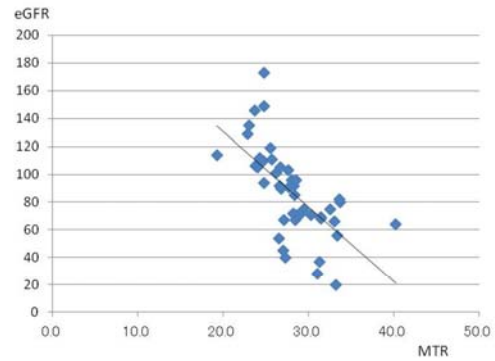

Figure 2

Figure 2. The relationship between eGFR values and MTR of the renal cortex. Regression analysis showed good correlation between eGFR and MTR of the renal cortex ($r=-0.645$, $p<0.0001$).

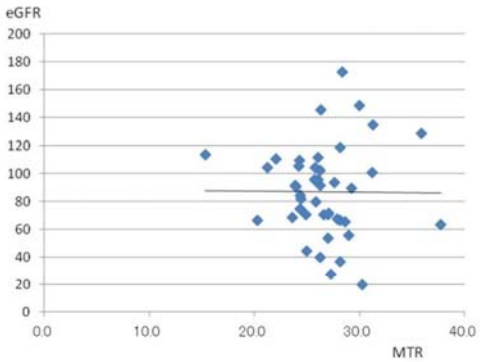

Figure 3

Figure 3. The relationship between eGFR values and MTR of the renal medulla. Regression analysis showed no significant relationship between eGFR and MTR of the renal medulla ($r=0.008$, $p=0.96$).