EVALUATION OF SPLIT RENAL FUNCTION ON OBSTRUCTIVE HYDRONEPHROSIS USING DYNAMIC CONTRAST ENHANCED - MAGNETIC RESONANCE RENOGRAPHY

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TARGET AUDIENCE

This study is to evaluate split renal functions by DCE-MRR and is expected to provide information to radiologists as well as nephrologists.

PURPOSE

^{99m}Tc-DTPA renal scintigraphy always fail to accurately assess split renal functions in the context of hydronephrosis; this study is to evaluate the accuracy of calculating split renal functions on patients with urinary obstruction by using Dynamic Contrast Enhanced - Magnetic Resonance Renography (DCE-MRR) on 3.0 T.

METHODS

A group of volunteers without obstructive hydronephrosis (NOH, n = 10) and with obstructive hydronephrosis (OH, n = 7) were enrolled in this study (eight men and 11 women; age range, 25 – 66 years; mean age 50.9 years), excluding any renal space-occupying lesion. DCE-MRR was performed with a clinical 3.0 T MR scanner with a three-dimensional gradient-echo imaging. Glomerular Filtration Rate (GFR) obtained from DCE-MRR (GFR_{MRR}) and renal scintigraphy (GFR_{Gates}) was based on Rutland-Patlak two-compartment model and Gates' method respectively. The Two Plasma Sample method was used to acquire golden standard GFR (GFR_{TPS}). Blood samples collected from all subjects were used to detect serum creatinine (SCr) and cystatin C (CysC), through which the evaluated GFR (eGFR) would be obtained by using the MDRD, Cockcroft-Gault or CKD-EPI equation. Pearson correlation analysis and Bland-Altman plots were applied to assess the correlation and agreement between methods. Interclass correlation coefficient (ICC) was used to test the inter-rater reliability of DCE-MRR and renal scintigraphy.

RESULTS

All GFR data were normalized with respect to body surface area for each volunteer. For NOH, the correlation coefficient (R^2) of GFR_{MRR} versus GFR_{TPS} was 0.483, compared to 0.733 for GFR_{Gates} versus GFR_{TPS}. For the 17 volunteers pooled together, the R^2 of the former rose to 0.627, whereas the latter dropped to 0.227. The R^2 of eGFR versus GFR_{TPS} were 0.237 (MDRD), 0.236 (Cockcroft-Gault) and 0.307 (CKD-EPI) respectively. Comparing the split renal functions of GFR_{MRR} with GFR_{Gates}, the R^2 turned out to be 0.597 and Bland-Altman analysis showed an average difference of -2.00 ml/min (95% confidence interval: -5.01, 1.00). The ICC of DCE-MRR was higher than that of renal scintigraphy in both groups (NOH: 0.834 vs 0.781; OH: 0.954 vs 0.927).

DISCUSSION

Split renal functions are essential for nephrologists to determine the therapeutic regimen for various kidney diseases, such as hydronephrosis, renal neoplasms etc. Since hydronephrosis always lead to supranormal renal function under ^{99m}Tc-DTPA renal scintigraphy,[1] moreover, a certain dose of radiation cannot be neglected for scintigraphy; an alternative non-invasive method will be necessary in clinical application. DCE-MRR has been proved to be a promising method which can not only provide accurate split renal functions comparable to scintigraphy,[2-4] but also look into anatomic alterations in a one-stop exam. The higher correlation and agreement between DCE-MRR and golden standard compared with scintigraphy may have several explanations, such as more accurately in demarcating kidneys on MRR than scintigraphy, and no need to concern about overlapping of kidneys with other abdominal organs on MRR.

CONCLUSION

DCE-MRR can accurately assess split renal functions in the context of obstructive hydronephrosis; it has the potential serving as an alternative non-invasive method for GFR measurement other than renal scintigraphy in the clinical practice.

REFERENCE

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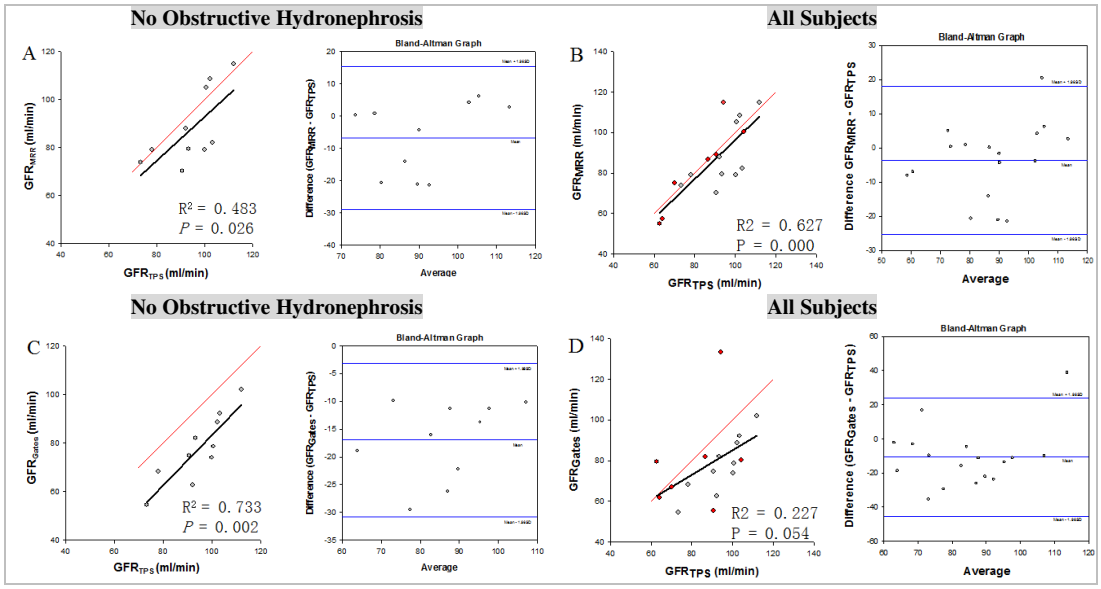

Figure 1. Pearson correlation analysis and Bland-Altman plots of GFR_{TPS} versus GFR_{MRR} (A, B) or GFR_{Gates} versus GFR_{MRR} (C, D), both GFR_{MRR} and GFR_{Gates} correlate well with GFR_{TPS} for volunteers without obstructive hydronephrosis (A, C), when pooling all subjects together, the correlation between GFR_{Gates} and GFR_{TPS} decreases remarkably, red dots represent subjects with obstructive hydronephrosis.

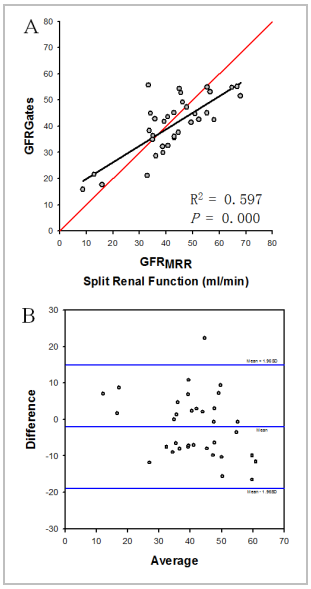

Figure 2. Pearson correlation analysis (A) and Bland-Altman plot (B) of split renal functions between GFR_{MRR} and GFR_{Gates}.