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LETTER TO THE EDITOR

Correlation of ultrasonographically determined renal cortical thickness and renal length with estimated glomerular filtration rate in chronic kidney disease patients

Chronic kidney disease (CKD) is a worldwide public health problem. The incidence and prevalence of kidney failure are rising, the outcomes are poor, and the costs of management are high[1]. Chronic kidney disease is defined as either kidney damage or glomerular filtration rate (GFR) <60 mL/min/1.73m^2 for ≥3 months. Kidney damage is defined as pathologic abnormalities in blood or urine tests or imaging studies[1].

In patients with CKD, the renal cortical echogenicity increases at ultrasound. In addition, the renal cortex often becomes thinned. Often this finding occurs with a normal bipolar renal length and an increase in the relative amount of central sinus fat[2]. As the change in renal cortical thickness is an important sign of renal disease, ultrasonographic measurement of renal cortical thickness has been suggested as an index for studying the health status of the kidney[3,4].

The purpose of this study was to determine the correlation of ultrasonographically measured renal cortical thickness and renal length with estimated glomerular filtration rate (eGFR) in patients with CKD using two widely accepted computational methods of estimating GFR.

This cross sectional study was carried out in the Department of Radiology & Imaging, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), from 1st June, 2010 to 31st May, 2011. A total of 52 patients having the clinical diagnosis of CKD who were not on dialysis and who had at least three serum creatinine reports and weight recorded within 90 days of the ultrasound were selected for ultrasound scanning. A total of 10 subjects were excluded due to sonographic findings of hydronephrosis and 42 patients (22 males and 20 females, age range 42-85 years) were finally enrolled in this study.

The research protocol was approved by the institutional ethical review committee and informed written consent was taken from each subject. The lowest creatinine performed within 90 days of the ultrasound was used for eGFR calculations. The Cockcroft-Gault (CG) and the Modification of Diet in Renal Disease Study (MDRD) equations were used for eGFR calculation[1].

Using standard gray-scale B-mode imaging with a 3.5-MHz curvilinear transducer, renal length was measured as the greatest pole-to-pole distance in the sagittal plane[3]. Renal cortical thickness was measured in the sagittal plane in four points- upper pole, lower pole, and two points of the lateral cortex- for each kidney. The mean of these four measurements for each kidney was reported as renal cortical thickness[4]. The measurement was taken over a medullary pyramid, perpendicular to the capsule as the shortest distance from the base of the medullary pyramid to the renal capsule[3].

All the collected data were entered, cleaned and analyzed using statistical package for the social sciences (SPSS) version 16.0. The correlation of ultrasonographically measured renal cortical thickness and renal length with eGFR were evaluated using Pearson's correlation coefficient test. Significance was considered at a 'p' value < 0.05.

In this current study it was observed that the mean CG eGFR was 34.3±14.0 mL/min (range, 9.0 - 65.1 mL/min) and mean MDRD eGFR was 36.3±14.6 mL/min/1.73m^2 (range, 11.0 - 60.9 mL/min/1.73m^2. The mean renal length was 9.9±0.9 cm (range, 8.15 - 11.9 cm). The mean renal cortical thickness was 0.62±0.20 cm (range, 0.28 - 0.98 cm). A significant strong positive correlation ($r = 0.810$, $p<0.001$) was found between mean renal cortical thickness and CG eGFR, as shown in Figure 1. Similarly, a significant strong positive correlation ($r = 0.852$, $p<0.001$) was found between mean renal cortical thickness and MDRD eGFR (Figure 2). On the other hand, a significant weak positive correlation ($r=0.340$, $p<0.05$) was found between mean renal length and CG eGFR (Figure 3). Similarly, a significant weak positive correlation ($r=0.317$, $p<0.05$) was found between mean renal length and MDRD eGFR (Figure 4). This present study showed that renal cortical thickness had strong positive correlation with eGFR and renal length had weak positive correlation with eGFR. So, ultrasonographically measured renal cortical thickness correlates better with eGFR than renal length in patients with CKD who are not on dialysis.

Beland et al.[3] also showed a statistically significant positive relationship between eGFR and mean cortical thickness using both the CG and the MDRD equations (CG, $p<0.0001$; MDRD,

p=0.005). There was a statistically significant relationship between CG eGFR and mean renal length (p=0.0029) but not MDRD eGFR (p=0.0756). The strongest relationship, as evidenced by the highest r^2 value, was for mean cortical thickness and CG eGFR (r^2 = 66.0%), in patients with CKD[3]. In another study, Muto et al.[5] mentioned that renal cortical volume, measured at CT had a strong positive relationship with the renal function.

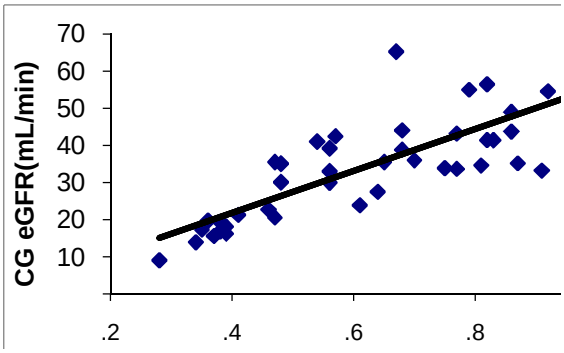

Fig. 1: Scatter diagram showing the significant strong positive correlation (r =0.810, p<0.001) between mean renal cortical thickness and CG eGFR.

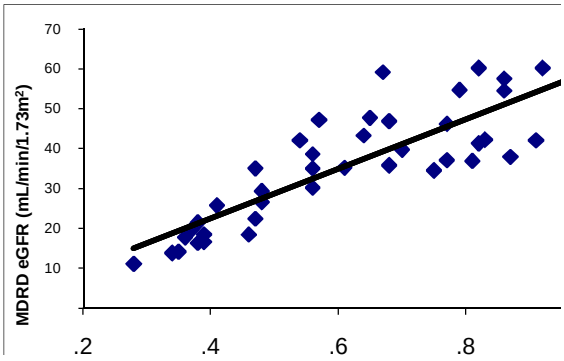

Fig. 2: Scatter diagram showing the significant strong positive correlation (r =0.852, p<0.001) between mean renal cortical thickness and MDRD eGFR.

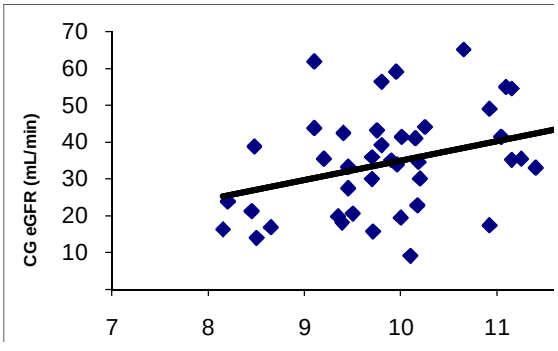

Fig. 3: Scatter diagram showing the significant weak positive correlation (r =0.340, p<0.05) between mean renal length and CG eGFR.

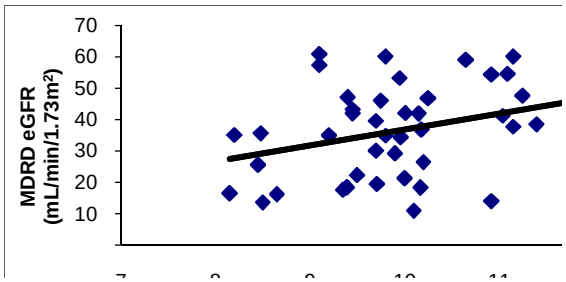

Fig.4: Scatter diagram showing the significant weak positive correlation (r=0.317,p<0.05) between mean renal length and MDRD eGFR.

Future areas of investigation using larger patient samples may include development of a predictive range of renal function given a particular cortical thickness. Alternatively, a determination of a threshold cortical thickness above which renal function is preserved may be identified.

Conclusion: Renal cortical thickness had strong positive correlation with eGFR compared to renal length. Renal cortical thickness measured at ultrasound appears to relate to the degree of renal impairment in patients with CKD, who are not on dialysis, and routine measurement reporting of renal cortical thickness could be considered in such patients.

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