ORIGINAL RESEARCH PAPER

Radiodiagnosis

KEY WORDS: CKD, cortical thickness, renal length, cortical echogenicity serum creatinine and eGFR.

ROLE OF ULTRASONOGRAPHICALLY MEASURED RENAL CORTICAL THICKNESS AND BIPOLAR RENAL LENGTH IN PREDICTION OF DEGREE OF RENAL IMPAIRMENT IN PATIENT OF CHRONIC KIDNEY DISEASE

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ABSTRACT

Aim & objectives: To study the relationship between ultrasonographic renal parameters and renal impairment in patients with chronic kidney disease.

Method: Total 106 patients with CKD were undergone ultrasonographic examination for evaluation kidneys. Renal length, cortical thickness and cortical echogenicity were documented on B-mode gray scale using 2-5 MHz probe in Esaote USG machine at beginning, at 3 month and at 6 month.

Results: Mean renal length was 8.88cm, mean cortical thickness was 8.80mm and mean eGFR was 35.99 ml/min/1.73m^2. Serum creatinine showed negative correlation with cortical thickness (r=-0.7498, P<0.001) and renal length (r=-0.5867, P<0.001). eGFR showed positive correlation with cortical thickness (r=0.6931, P<0.001) and renal length (r=0.5668, P<0.001). Cortical echogenicity showed strong positive correlation with serum creatinine (r=0.7782, P<0.001) and strong negative correlation with renal function (eGFR) (r=-0.7698, P<0.001).

Conclusion: Cortical thickness and cortical echogenicity showed significant and strong correlation with serum creatinine and renal function than renal length.

INTRODUCTION

Chronic kidney disease (CKD) causes progressive decline in glomerular filtration. Increasing prevalence of CKD is due to obesity, hypertension diabetes etc. There is progressive decrease in renal size and cortical thickness. On ultrasonography, cortical echogenicity is also increased with progression of disease, and is due to interstitial inflammation, oedema, sclerosis or fibrosis. Previous studies have suggested that progressive decrease in renal length and cortical thickness can predict possibility of renal failure later in course of disease[1]. Therefore, we planned to study the relationship between ultrasonographic renal parameters (renal length, cortical thickness and cortical echogenicity) and renal impairment in patients with chronic kidney disease by correlating these renal parameters with serum creatinine and eGFR.

AIMS AND OBJECTIVES

To correlate renal cortical thickness, renal length, and cortical echogenicity with serum creatinine and eGFR in CKD patient.

MATERIAL AND METHOD

It was hospital based prospective study conducted in department of Radiodiagnosis, MGM Medical College, Indore, form March-18 to August-19, after getting approval from Institutional Scientific Review Board. A total of 106 patients with CKD, age more than 18 years were undergone ultrasonographic examination for kidney evaluation in B-mode grey scale using 2.5 to 5 MHz transducer after taking written consent. Bipolar renal length and cortical thickness were measured. Documentation of cortical echogenicity along with corticomedullary differentiation was done by comparing with liver echogenicity. Echogenicity was further classified into 5 grades as proposed by Siddappa JK et al[2]. A detailed clinical history, serum creatinine and eGFR using Cockroft-Gualt equation were recorded. Each patient was followed up at 3 month and at 6 month. Exclusion criteria: patient with obstructive etiology, congenital renal diseases, acute kidney disease, patients on dialysis, renal malignancy, infections, traumatic injury; and unwilling patients to consent for study were excluded from malignancy. Appropriate statistical tests were applied for renal cortical thickness, renal length, cortical echogenicity and eGFR values. Pearson correlation analysis was done between renal length and renal cortical thickness measurements against serum creatinine and eGFR. P-values of <0.05 was considered to be statistically significant.

RESULTS & DISCUSSION

Out of total 106 CKD patients, 64 were male and 42 were females. In our study, age range was 18-82 year, with mean age 56.09 years. Common age group was 40-55 years (37%).

The mean serum creatinine was 3.15mg/dl. The mean serum creatinine level was increased significantly over the follow-up period of 6 months (P=0.0039). The mean eGFR was 35.99 ml/min/1.73m2. There was significant reduction in eGFR observed over the follow-up period of 6 months (P=0.0018). These results were correlated with the studies done by Siddappa JK et al in 2013[2] and Korkmaz M et al in 2017[3] (Table 1).

The mean bipolar renal length in CKD patients was 8.88cm. Renal length showed reduction over the follow-up period of 6 month. However, reduction in renal length was not significant (P=0.6269). The mean renal cortical thickness in CKD patients was 8.80 mm. No significant reduction in cortical thickness was seen over the follow-up period of 6 month (P-value = 0.3420) (Table 1). It could be due to short duration of follow-up. Longer follow-up may be needed to assess the progressive reduction in cortical thickness. Our results were not in concordance with a study done by Korkmaz M et al in 2017[3], which showed that there was a significant reduction in bipolar renal length and cortical thickness found over follow-up period of 24 months (P<0.01).

96 out of 106 patients with CKD had increased cortical echogenicity. Majority of them had grade 2 cortical echogenicity (42%). 72% patients had maintained corticomedullary differentiation, 17% had poorly maintained CMD and 11% patients had lost CMD on ultrasonography. The results were in concordance with study conducted by Singh A et al in 2016[5].

In our study, serum creatinine was significantly increased with increasing echogenicity (P< 0.001) and mean eGFR was significantly decreased with increasing echogenicity (Table 2). These findings were consistent with the findings of Siddappa JK et al (2013)[2].

In our study, bipolar renal length and cortical thickness were decreased significantly with increasing grades of cortical echogenicity in CKD patients (P<0.001) (Table 2). Our results were in accordance with study by Siddappa JK et al (2013)[2] and Ahmed S et al (2019)[6].

In our study, serum creatinine showed statistically significant negative correlation with cortical thickness (r=-0.7498, P<0.001) and with renal length (r=-0.5867, P<0.001). The renal function (eGFR) showed statistically significant positive correlation with cortical thickness (r=0.6931, P<0.001) and renal length (r=0.5668, P<0.001). Thus, in our study, cortical thickness was more strongly related to serum creatinine and eGFR then renal length (Table 3). These findings were in concordance with results of Yamashita SR et al (2015)[4] and Beland MD et al (2010)[1] in theirs separate studies.

The cortical echogenicity had shown strong positive correlation with serum creatinine (r=0.7782, P<0.001) and strong negative correlation with renal function (eGFR) (r=-0.7698, P<0.001) (Table 3). This correlation between serum creatinine and eGFR with cortical echogenicity can be explained by the finding in a study done by Rosenfield and Siegel (1981)[7]. They stated that echogenicity of kidneys was due to interstitial disease on biopsy such as glomerular sclerosis, tubular atrophy interstitial fibrosis and inflammation. These findings, on biopsy, were clinically associated with decreased renal function thereby decreasing eGFR and higher serum creatinine level. These findings were further supported by Moghazi S et al (2005)[8] and Gareeballah et al (2015)[9]. Increase in renal cortical echogenicity is irreversible as comparison to serum creatinine levels and it becomes apparent in CKD patient even before change in cortical thickness and renal length. Therefore, echogenicity may have an important role in assessing current status of renal function, progression of disease as well as in follow-up care of CKD patients.

Table 1: Comparison of serum creatinine, eGFR, cortical thickness and renal length at beginning, at 3 month and at 6 month of study:

	At beginning	AT 3 month	AT 6 month	P-value
Serum creatinine (mg/dl) (Mean±SD)	2.74±1.69	3.11±1.94	3.61±2.04	0.0039
eGFR (ml/min/1.73m2) (Mean±SD)	40.57±23.67	37.43±24.41	29.96±17.57	0.0018
Cortical thickness (mm) (Mean±SD)	9.08±2.43	8.74±2.61	8.59±2.54	0.3424
Renal length (cm) (Mean±SD)	8.97±1.35	8.85±1.28	8.80±1.27	0.6263

Table 2: Comparison of various parameters according to grades of cortical echogenicity:

	Serum Creatinine (mg/dl)	eGFR (ml/min/1.73m^2)	Renal length (cm)	Cortical thickness (mm)
Echogenicity	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Grade 0	1.28±0.25	73.68±11.71	10.51±0.53	12.12±0.40
Grade 1	1.85±0.59	53.78±18.50	9.86±0.55	10.78±0.84
Grade 2	2.94±0.93	29.68±11.71	8.86±0.58	8.99±0.72
Grade 3	3.99±1.07	22.91±7.48	8.06±0.42	7.16±0.73
Grade 4	6.64±2.21	14.74±5.31	6.13±0.30	4.14±0.43
f-value	49.95	50.47	94.61	254.37
P-value	<0.001	<0.001	<0.001	<0.001

Table 3: Statistical correlation of serum creatinine and eGFR with renal parameters:

Renal Parameters	Serum creatinine		eGFR	
	Correlation (r)	P-value	Correlation (r)	P-value
Mean RCT	-0.7498	<0.001	0.6931	<0.001
Mean RL	-0.5867	<0.001	0.5668	<0.001
Echogenicity	0.7782	<0.001	-0.7698	<0.001

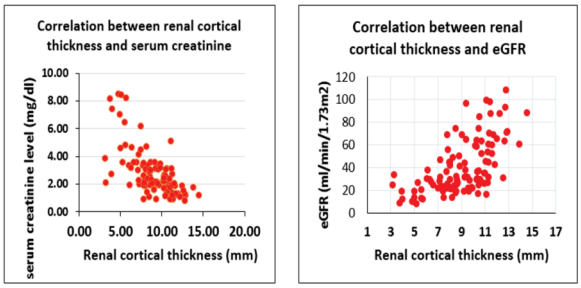

Figure 1: Statistical correlation between cortical thickness and serum creatinine and eGFR:

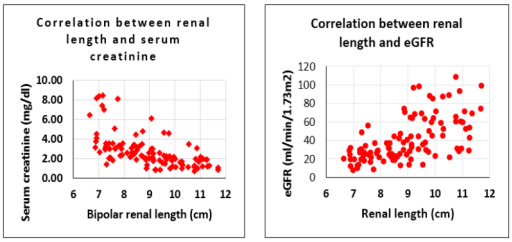

Figure 2: Statistical correlation between renal length and serum creatinine and eGFR:

CONCLUSION

From the data in our study, we conclude that, renal parameters such as renal cortical thickness, renal length and cortical echogenicity measured by ultrasonography were well correlated with serum creatinine and renal function (eGFR) in CKD patients. Cortical thickness and cortical echogenicity had shown statistically significant and strong correlation with serum creatinine and renal function as compared to renal length. These parameters can be used to assess the status of renal function and for follow-up to predict the progression of

disease over the time in patients with CKD.

Our study had some limitations such as follow-up period was short which was not sufficient to observed the progression of thinning of renal cortex and change in the renal length in CKD. Also, ultrasonographic assessment of renal parameters especially echogenicity is operator dependent which causes inter-observer variations.

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