Section: Radio-Diagnosis

Research

CORRELATION OF SONOGRAPHIC GRADING OF RENAL CORTICAL ECHOGENICITY WITH SERUM CREATININE IN PATIENTS WITH CHRONIC KIDNEY DISEASE

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Corresponding Author:
Dr. Archana R,
Email: adiiti1234@yahoo.com
ORCID: 0000-0002-4385-5207

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K. Swathi[1], Kakumanu Mounika Reddy[1], Archana R[2]

[1]Assistant Professor, Department of Radio-diagnosis, Government Medical College, Suryapet, Telangana, India
[2]Professor and HOD, Department of Radio-diagnosis, Government Medical College, Suryapet, Telangana, India

Abstract

Background: Low inter-observer variability renal ultrasound is a straightforward, affordable method that may be used at the patient's bedside to give the clinician crucial information about the kidneys' anatomical details. The GFR and subsequently the stage of CKD is frequently estimated using the endogenous serum marker known as serum creatinine. The purpose of the current study was to examine the relationship between renal cortical echogenicity as measured by sonography in individuals with chronic kidney disease and blood creatinine levels. **Materials and Methods:** The current investigation comprised adults older than 18 who had a clinical diagnosis of chronic renal disease. It was a hospital-based prospective observational study. **Result:** In presents study, 94 patients of CKD were studied. Majority were from 51-60 years age group (44.68 %) & 41-50 years age group (24.47 %), were male (56.38 %). Majority were due to diabetes (36.17 %), hypertension (19.15 %), combined diabetes and hypertension (5.32 %). Among 37 cases (39.36 %) cause of CKD not established. In present study, as per cortical echogenicity, majority had Grade 1 Renal cortical echogenicity (mild form) (63.83 %), followed by Grade 2 (moderate) (22.34 %), Grade 3 (severe form) (9.57 %) and Grade 4 (end-stage renal disease) (4.26 %). The difference between increased renal cortical echogenicity and rising serum creatine levels was statistically significant (p 0.001). The mean longitudinal length, mean parenchymal thickness, and mean cortical thickness did not significantly correlate with blood creatinine (p>0,05). **Conclusion:** Renal echogenicity correlates better with serum creatinine than kidney length in adult CKD patients.

INTRODUCTION

Chronic kidney disease frequently results in renal failure (CKD). It indicates that, whether or not there is a fall in glomerular filtration rate, kidney structure and function gradually deteriorate over a period of months (GFR).[1] Imaging methods, clinical CKD indicators, changes in kidney function markers in the blood or urine, or any one of these factors by itself can all be used to make the diagnosis.[2] Renal ultrasound can be performed quickly, affordably, and at the patient's bedside to give the clinician access to crucial kidney anatomical information with little inter-observer variability.[3]
The size, position, and architecture of the kidneys can be determined by renal ultrasonography, and obstruction can be ruled out.[4,5] Although kidney sizes in CKD fluctuate depending on the aetiology, echogenic kidneys indicate the presence of renal parenchymal disease. A better imaging method for tracking the progression of the illness is ultrasound since it detects enduring abnormalities that may be identified by characteristics including echogenicity, longitudinal length, parenchymal thickness, and cortical thickness.[6]
An endogenous serum measure called serum creatinine is frequently used to determine GFR and, consequently, the stage of CKD.[2] The goal of the current investigation was to determine if blood creatinine levels in people with chronic kidney disease correlate with the renal cortical echogenicity score on sonography.

MATERIALS AND METHODS

Present study was Hospital based, prospective, observational study, conducted in Department of Radio-diagnosis, Government Medical college, Suryapet, India. Study duration was of 2 years (January 2020 to December 2021). Study approval was obtained from institutional ethical committee.

Inclusion Criteria

Patients willing to take part in the current study who have been clinically diagnosed with chronic renal disease (GFR 60/mL/min, determined using the Cockcroft-Gault equation, for three months or more).

Exclusion Criteria

- Dialysis patients, peritoneal dialysis patients, recipients of kidney transplants,
- Individuals with kidney tumours and those with ultrasonographically detected renal illnesses (Both Primary and Secondaries).

Study was explained to patients in local language & written consent was taken for participation & study.

The whole medical background of the patient, including age, duration of any diabetes or hypertension, other potential causes of chronic renal failure, and previous therapies. The most recent serum creatinine measurements were shown.

On a Toshiba ultrasound machine model-SSA 510A employing a curvilinear probe between 3.5 and 5 MHz or a linear high frequency probe between 7 and 12 MHz, all patients had an abdominal USG examination primarily to check renal parameters. Oblique, transverse, and longitudinal images were captured.

The maximum pole-to-pole distance in the sagittal plane could be used to measure the renal lengths. The thickness of the renal parenchyma was assessed from the renal hilum to the most convex region of the lateral renal border. Measuring the renal cortical thickness over a medullary pyramid perpendicular to the renal capsule was necessary to determine the shortest route between the base of the medullary pyramid and the renal capsule. For each patient, the average parenchymal thickness and cortical thickness were determined in addition to longitudinal measurements of the right and left kidneys. assessment of renal cortical echogenicity and cortico-medullary differentiation.

Comparing and rating the echogenicity of the renal cortex,

1. **Grade 0:** The cortico-medullary distinction is still there, but it is less echogenic than the liver.
2. **Grade 1:** The cortico-medullary distinction is maintained with liver-like echogenicity.
3. **Grade 2:** Keeping cortico-medullary differentiation and having stronger echogenicity than the liver
4. **Grade 3:** Greater hepatic echogenicity and less well-maintained cortico-medullary distinction.
5. **Grade 4:** Greater loss of echogenicity and cortico-medullary differentiation than liver

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. A statistically significant value was defined as one with a P value less than 0.5.

RESULTS

In presents study, 94 patients of CKD were studied. Majority were from 51-60 years age group (44.68 %) & 41-50 years age group (24.47 %), were male (56.38 %). Majority were due to diabetes (36.17 %), hypertension (19.15 %), combined diabetes and hypertension (5.32 %). Among 37 cases (39.36 %) cause of CKD not established.

Table 1: General characteristics

Characteristics	No. of Cases	Percentage
Age (in years)		
20-30	3	3.19%
31-40	10	10.64%
41-50	23	24.47%
51-60	42	44.68%
Above 60	16	17.02%
Gender		
Male	53	56.38%
Female	41	43.62%
Cause of CKD		
Cause of CKD not established	37	39.36%
Diabetes	34	36.17%
Hypertension	18	19.15%
Diabetes and Hypertension Combined	5	5.32%

In present study, as per cortical echogenicity, majority had Grade 1 Renal cortical echogenicity (mild form) (63.83 %), followed by Grade 2 (moderate) (22.34 %), Grade 3 (severe form) (9.57 %) and Grade 4 (end-stage

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renal disease) (4.26 %). Increasing levels of serum creatine were observed with rising renal cortical echogenicity & difference was statistically significant (p<0.001).

Table 2: Comparison of serum creatinine with renal cortical echogenicity

Renal Cortical Echogenicity	No. of Patients	Frequency (%)	Serum Creatinine (mg/dL)		
			Mean ± S.D	F- value	p- value
Grade 1	60	63.83%	2.87 ± 1.45	3.985	<0.001
Grade 2	21	22.34%	3.9 ± 2.12		
Grade 3	9	9.57%	4.2 ± 2.67		
Grade 4	4	4.26%	6.19 ± 3.53		

The mean longitudinal length, mean parenchymal thickness, and mean cortical thickness did not have any statistically significant correlations with serum creatinine (p>0,05).

Table 3: Relationships between serum creatinine and average longitudinal length, average parenchymal thickness, and average cortical thickness

Renal Parameters	Serum Creatinine (mg/dL)	
	Pearson's Correlation Coefficient	p- value
Mean longitudinal length (cm)	-0.387	0.23
Mean parenchymal thickness (cm)	-0.312	0.43
Mean cortical thickness (mm)	-0.148	0.69

DISCUSSION

The prevalence of chronic kidney disease (CKD) and associated medical expenses are making it a global public health concern.[1] Even though the sonographic signs of renal disorders are nonspecific, they are incredibly helpful in diagnosing nephrological diseases.[7] Even with normal range of serum creatinine, person can have significantly reduced renal function and by the time the serum creatinine is increased above normal range, there could be reduction in up to 50% of renal function.

In a study by Khadka H et al,[8] the mean serum creatinine levels for Grades 1 through 4 were 1.7 mg/dl, 2.38 mg/dl, 4.18 mg/dl, and 5.65 mg/dl, respectively (range: 1.1-4.7 mg/dl, STD 0.44), 2.38 mg/dl, 2.18 mg/dl, 4.18 mg/dl, 2.6-6.0 mg/dl, STD 0.88), 2.38.

Renal echogenicity and its grading shown a stronger correlation with serum creatinine in CKD as compared to other sonographic parameters. The cortical echogenicity grade of renal disease was determined by Singh A. et al's study,[9] with Grade 1 denoting mild disease, Grade 2 denoting moderate disease, Grade 3 denoting severe disease, and Grade 4 denoting end-stage renal disease. The average serum creatinine levels in Grades 1, 2, 3, and 4 were 2.87 mg/dL, 3.27 mg/dL, 4.3 mg/dL, and 5.8 mg/dL, respectively. Serum creatinine levels were not correlated with renal length, parenchymal thickness, or cortical thickness. In contrast to other sonographic data, the ultrasonography grading of renal echogenicity in CKD showed the highest correlation with serum creatinine (P 0.001).

81 (72.32%) of the 112 participants evaluated by Shetty M. C. et al,[10] who had an average age (SD) of 54.37 (17.29) years, were men. The bulk of the study's patients (n=51,45.54%) were 60 years of age or older. Eight participants (7.14%, 95% CI: 3.66, 13.46) had considerable discrepancy in renal size, while sixty-eight subjects (60.71%, 95% CI: 51.45, 69.43) had optimally sized kidneys. Most of the study participants (n=43, 38.74%, 95%CI: 29.73, 47.64) had Grade 1 renal echogenicity. With increasing grades of renal echogenicity, serum creatinine values increased considerably (F=9.58, p0.001, one-way ANOVA test). On a pairwise correlation test, the degree of echogenicity and serum creatinine levels displayed a statistically significant correlation (p0.001). Renal echogenicity and the average longitudinal renal length were substantially correlated (F=14.07, p0.001).

Megally HI et al,[11] reported that the average renal length was 97.6 mm, the average cortical thickness was 9.38 mm, the average serum creatinine level was 2.46 mmg/dl, and the average estimated glomerular filtration rate was 60.95 mmg/min using the Cockcroft and Gault equation. Although there was a strong statistically significant link between cortical thickness and creatinine clearance (r = 0.67, P 0.001) and between renal length and creatinine clearance (r = 0.42, P = 0.002), the largest correlation was for mean cortical thickness.

Sonological In a study by Mahender G R, Grade 1 CKD was discovered in 12 out of 80 patients, Grade 2 CKD in 29, Grade 3 CKD in 9, and Grade 4 CKD in 4. The trial had 80 patients in total. The mean serum creatinine in grades 1 through 4 was 2.7 mg/dl, 3.7 mg/dl, 3.9 mg/dl, and 7.8 mg/dl, respectively. Correlations between serum creatinine and cortical echogenicity scores were favourable and statistically significant. There were statistically significant and positive relationships between renal echogenicity, cortical thickness, and parenchymal thickness.[12]

USG is the first investigative modality used in patients with renal disorders because it is readily available, does not emit ionising radiation, is portable, and has the option of repeatability.[13] Parenchymal renal disease is indicated by echogenic kidneys, which can be either normal size or

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enlarged. Advanced chronic renal disease may be indicated by small kidneys.[14]

Renal cortical echogenicity rises with worsening renal insufficiency. This could be a sign of deteriorating renal function. The kidney seems fully echogenic as the parenchyma gradually acquires echogenicity and merges with that of the renal sinus.[5]

Ultrasound is a valuable investigation in the evaluation of both acute and chronic renal failure. The ease of visualisation of the kidneys coupled with safety as no ionising radiation is involved, simplicity, low cost and easy availability makes it the modality of choice in routine initial method of evaluation. It provides an edge over the traditional renal biopsy and intravenous urography being non-invasive and without the risk factors of intravenous contrast administration.

CONCLUSION

Renal echogenicity correlates better with serum creatinine than kidney length in adult CKD patients. The implication of this is that radiologists should routinely report grade of renal echogenicity, as this correlates more with renal injury and will serve as a useful guide for nephrologists. Due to the long-term changes in kidney morphology and function, these renal measures are also crucial in the evaluation and follow-up of patients.

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