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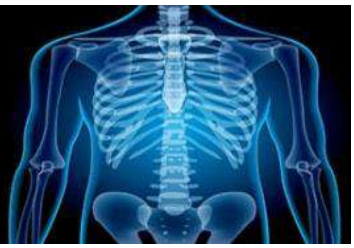

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Role of renal sonography in the diagnosis of chronic kidney disease

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Abstract
Background: CKD will be diagnosed by changes of renal function markers in the urine and blood, Pathological abnormalities and imaging investigations. Best imaging technique is ultrasound, which is non-invasiveness, easy accessibility and visualization of the kidney and provide sufficient anatomical details without exposing radiation and contrast. It is provide information regarding extent of renal damage and the possibility of reversibility and decision to perform renal biopsy.
Methods: Sixty CKD patients are included in this study. In all the participants Serum creatinine are blood urea are estimated. In all the participants, the mean values of both the kidneys renal longitudinal size, parenchymal thickness, and cortical thickness were calculated. Renal cortical echogenicity was compared and graded with the echogenicity of the liver and renal medulla, and graded as Grade 0 to Grade 4.
Results: the renal cortical echogenicity grading based on ultrasound 25 patients had Grade 1, 20 patients had Grade 2, 10 patients had Grade 3 and 5 patients had Grade 4. Mean serum creatinine was significant among echogenicity grades. Mean longitudinal size was significant among echogenicity grades with ANOVA F-Value= 25.5373 ($p< 0.001$). Mean Parenchymal thickness was significant among echogenicity grades with ANOVA F-Value= 4.8535 ($p< 0.001$). Mean Cortical thickness was significant among echogenicity grades ($p< 0.001$).
Conclusion: It was concluded that there is a decreased longitudinal size, parenchymal thickness and cortical thickness along with increased echogenicity grades. Using of ultrasonography is a cost effective, noninvasive, easy and reproducible. Early detection of ultrasonography abnormalities assists in the reducing progression deleterious effects.

Keywords: Ultrasonography, chronic kidney disease, echogenicity grades

Introduction
Chronic Kidney Disease (CKD) is characterized by irreversible sclerosis and loss of nephrons. The renal mass progressively declines over a prolonged period, depending on the underlying etiology [1]. CKD patients are classified five stages. CKD will be diagnosed by changes of renal function markers in the urine and blood, Pathological abnormalities and imaging investigations [2]. Best imaging technique is ultrasound, which is non-invasiveness, easy accessibility and visualization of the kidney and provide sufficient anatomical details without exposing radiation and contrast [3]. All these factors helps us to early diagnosis and prediction of renal function and making necessary therapeutic decision.
Ultrasonography is the best method and most of the CKD patients have only method to assess the kidney disease [4]. Small kidney with a thin echogenic cortex or parenchyma observations indicates irreversible damage of kidney [5]. The ultrasonographic findings like longitudinal length, parenchymal, and cortical thickness represent changes in the kidney echogenicity. Ultrasonography is also a better technique for assessing the progression of the disease [6]. It is provide information regarding extent of renal damage and the possibility of reversibility and decision to perform renal biopsy.
The serum creatinine is a simple method and commonly used for estimation of GFR. But, serum creatinine based GFR has its own drawbacks because tubular secretion of creatinine, and variation of serum creatinine from individual to individual based on muscle mass. Besides this, any significant rise of serum creatinine reflects already a fall of about 50% of GFR [7]. The serum creatinine value changes due to dialysis but ultrasonography echogenicity was not altered and serves as a best marker to assess the degree of kidney damage.

The aim of our study is to use sonographic imaging in grading CKD and assess the serum creatinine, renal longitudinal size, parenchymal thickness, and cortical thickness and compare these parameters based upon ultrasonographic grade. Measuring ultrasonographic echogenicity might throw a warning sign of the future risk. Early intervention could help the CKD patients for early detection and provide a better treatment.

Methodology

Type of study

Cross sectional study.

Study Population

Study population are patients who attend the Department of Radiology and Nephrology.

Sample size

120 in which 60 are normal healthy individuals and 60 are CKD patients.

Selection Criteria

Inclusion Criteria

The patients attending Radiology and Nephrology Department diagnosed with CKD.

Exclusion Criteria

Known Subjects with history of acute kidney injury, kidney transplant patients, and patients on hemodialysis, patients on peritoneal dialysis, patients with fatty liver and chronic liver disease were excluded from the study. Patients with any debilitating illness also excluded from this study. CKD patients who did not provide inform constant were excluded

Study design

The study consists of 60 CKD patients Informed consent will be taken from the patients and controls. Demographic data will be collected followed by history regarding current health status, history of medication, alcoholism and Active smoking. A questionnaire was given to all patients and detailed clinical examination was performed.

Ultrasound of kidneys

Both the Kidneys and Liver ultrasound scans recorded for each participant with sector curved array transducer of 3.5-5 MHz by two radiologists. The echogenicity of both the kidney and liver assessed by applying low tissue harmonic and speckle reduction imaging to decrease the inter observe bias. The longitudinal length was estimated in a section visually measured to represent the largest longitudinal section from pole to pole. The width and thickness were estimated in a section perpendicular to the longitudinal axis of the kidney. Parenchymal thickness was measured from the renal hilum to convex border of the lateral renal margin. Cortical thickness was measured in the sagittal plane of medullary pyramid, perpendicular to the capsule. In all the participants, the mean values of both the kidneys renal longitudinal size, parenchymal thickness, and cortical thickness were calculated. Renal cortical echogenicity was compared and graded with the echogenicity of the liver and renal medulla, and graded as

Grade 0: Normal echogenicity less than that of the liver, with maintained corticomedullary distinction. Grade 1: The Echogenicity same as that of the liver, with maintained corticomedullary distinction. Grade 2: Echogenicity greater than that of the liver, with maintained corticomedullary distinction. Grade 3: Echogenicity greater than that of the liver, with poorly maintained corticomedullary distinction. Grade 4: Echogenicity greater than that of the liver, with a loss of corticomedullary distinction [8].

Sample Analysis

In all the participants' venous blood was collected for biochemical analysis. Serum creatinine was estimated by alkaline picrate method [9], blood urea was estimated by Urease method [10].

Statistical analysis

Data will be expressed in Mean and Standard deviation (mean ±SD). Statistical analysis was calculated by using one way analysis of variance (ANOVA). The statistical significance was determined at 5% ($p< 0.05$) level. The Pearson correlation coefficient was calculated for bivariate associations.

Results

In the present study was a total of 60 CKD subjects were included.

Table 1: Profile of chronic kidney disease

	CKD
Number	60
Age (mean ± SD) years	49.27±10.09
Sex	
(Males %)	63
(Females %)	37
Blood urea (mg/dl)	58.22±22.90
Serum Creatinine (mg/dl)	3.36±2.12

Table1 shows the mean age of the CKD was 49.27 years±10.09. As regards the sex distribution, the majority of subjects were male in CKD 63%. The diagnostic criteria for CKD like blood urea and serum creatinine were higher in CKD than the normal range.

Table 2: Comparison of mean serum creatinine with renal cortical echogenicity (Based on ultra sound)

Based on Ultrasound Grading of Renal Cortical echogenicity	No. of Patients	Serum Creatinine (mg/dL)		F Value	p Value
		Mean	SD		
Grade 1	25	1.98	1.24	7.6659	<0.001
Grade 2	20	2.53	1.84		
Grade 3	10	3.81	1.45		
Grade 4	5	5.12	1.87		

Table2 shows the renal cortical echogenicity grading based on ultrasound 25 patients had Grade 1, 20 patients had Grade 2, 10 patients had Grade 3 and 5 patients had Grade 4.The mean serum creatinine was 1.98mg/dL±1.24 for Grade 1, 2.53mg/dL±1.84 for Grade 2, 3.81mg/dL±1.45 for Grade 3, and 5.12mg/dL±0.528 for Grade 4.Mean serum creatinine was significant among echogenicity grades with ANOVA F-Value= 7.6659 ($p< 0.001$).

Table 3: Comparison of mean longitudinal size with renal cortical echogenicity (Based on ultra sound)

Based on Ultrasound Grading of Renal Cortical echogenicity	No. of Patients	mean longitudinal size (Cm)		F Value	p Value
		Mean	SD		
Grade 1	25	10.21	1.01	25.5373	<0.001
Grade 2	20	9.11	0.85		
Grade 3	10	8.06	0.88		
Grade 4	5	6.92	0.72		

Table 3 shows the mean longitudinal size was 10.21Cm±1.01 for Grade 1, 9.11Cm±0.85 for Grade 2, 8.06Cm±0.88 for Grade 3, and 6.92Cm±0.72 for Grade 4. Mean longitudinal size was significant among echogenicity grades with ANOVA F-Value= 25.5373 (p< 0.001).

Table 4: Comparison of mean Parenchymal thickness with renal cortical echogenicity (Based on ultra sound)

Based on Ultrasound Grading of Renal Cortical echogenicity	No. of Patients	Mean Parenchymal thickness (Cm)		F Value	p Value
		Mean	SD		
Grade 1	25	4.81	0.98	4.8535	<0.001
Grade 2	20	4.24	0.72		
Grade 3	10	3.92	0.70		
Grade 4	5	3.63	0.48		

Table 4 shows the mean Parenchymal thickness was 4.81Cm±0.98 for Grade 1, 4.24Cm±0.72 for Grade 2, 3.92Cm±0.70 for Grade 3, and 3.63Cm±0.48 for Grade 4. Mean Parenchymal thickness was significant among echogenicity grades with ANOVA F-Value= 4.8535 (p< 0.001).

Table 5: Comparison of mean cortical thickness with renal cortical echogenicity (Based on ultra sound)

Based on Ultrasound Grading of Renal Cortical echogenicity	No. of Patients	Mean Cortical thickness (Cm)		F Value	p Value
		Mean	SD		
Grade 1	25	1.25	0.08	182.6066	<0.001
Grade 2	20	0.91	0.11		
Grade 3	10	0.53	0.14		
Grade 4	Not measured due to loss of corticomedullary distinction.				

Table 5 shows the mean Cortical thickness was 1.25Cm±0.08 for Grade 1, 0.91Cm±0.11 for Grade 2, 0.53Cm±0.14 for Grade 3, and Grade 4 was not measured due to loss of corticomedullary distinction. Mean Cortical thickness was significant among echogenicity grades with ANOVA F-Value= 182.6066 (p< 0.001).

Discussion

In CKD there is increased blood urea and serum creatinine due to decreased glomerular filtration rate. Chronic kidney disease defined as progressive damage of kidney and causes structural and functional abnormalities. The Kidney damage gets worse, kidney function impairs and manifested by pathological abnormalities and abnormalities in the imaging test [11].

Morphology of kidney can be measured length of kidney, volume and renal cortical thickness. Kidney function can be assess through length and cortical thickness and gives important clinical decision and also provide progression of kidney disease [12]. The renal parenchymal and cortical thicknesses are accurate measurements in chronic kidney disease. Whereas longitudinal length is sufficient in normal patients [13]. Chronic kidney disease can alter the Ultrasonographic findings like longitudinal length, parenchymal and cortical thickness [14]. In glomerulosclerosis and interstitial fibrosis due to presence of collagen the echogenicity is increased and but it is never been recognized. Increased interstitial inflammation also increases echogenicity [15]. The echogenicity also assessed by human eye but it is unreliable. In the previous study echogenicity was quantified and established a normal range. It was also found that there is a significant correlation between cortical echogenicity with glomerular sclerosis [16].

In the present study serum creatinine was increased along with increased echogenicity grades previous studies also reported similar significant changes [17]. In the present study longitudinal size was significantly decreased along with increased echogenicity grades. Previous studies also reported similar results [18]. There is decreased mean parenchymal thickness along with increased echogenicity grades similar results are reported by Siddappa *et al.* [17] It is also reported that decreased cortical thickness along with increased echogenicity grades. Singh A *et al*., reported also found similar results [19]. This study determines the functional capacity of the kidney in chronic kidney disease. Sonography is the best imaging technique due to easily available and provides real time data on the renal measurement and echogenicity [20].

From the findings of present study, it was concluded that there is a decreased longitudinal size, parenchymal thickness and cortical thickness along with increased echogenicity grades. Using of ultrasonography is a cost effective, noninvasive, easy and reproducible. Early detection of ultrsaonography abnormalities assists in the reducing progression deleterious effects.

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Declarations

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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