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Original Article

Sonographic Comparison between Echogenicity and Renal Length among Patients Suffering with or Without Chronic Kidney Disease

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ABSTRACT

Chronic kidney disease (CKD) is defined as any abnormality and impaired kidney functions for more than three months. The most common causes of CKD are diabetes and hypertension. **Objective:** To determine the association between renal length and echogenicity in patients with or without CKD. **Methods:** A descriptive study was conducted on Ultrasound Machine, Nemio 17 Toshiba in Gilani Ultrasound Centre, Lahore. A total of 70 patients with or without CKD were included. Patients with no previous clinical record of diabetes, high blood pressure, and age below 15 were excluded. **Results:** Data analysis demonstrated that a total of 70 patients, (35 normal and 35 with CKD) were selected for this study. Out of 70, 46(65.7%) were males and 24(34.3%) were females. The results showed that (out of 70 patients) with right kidney echogenicity, 36(51.0%) patients showed normal echogenicity with grade 0, 18(25.7%) with grade I, 10(14.3%) with grade II, 6(8.6%) with grade III and in left kidney echogenicity, 37(52.9%) patients showed normal echogenicity with grade 0, 16(22.9%) with grade I, 10(14.3%) with grade II, 7(10.0%) with grade III respectively. A significant correlation of CKD with right and left kidney were found as in right renal length with CKD mean length was 8.914 ±1.43 cm and without CKD, 10.4 ± 1.2 cm. Similarly, the left renal mean length with CKD was 9.49 ± 1.48 cm and without CKD was 10.28 ±1.14 cm. A significant correlation was found between CKD, right and left renal echogenicity (significant P-value is .000 for right and .000 for left renal length). **Conclusions:** The study concluded that echogenicity and renal length can help us to estimate the severity of CKD. It also states that a significant association was found between renal echogenicity, renal length, and CKD.

INTRODUCTION

Ultrasonography is the non-invasive measuring imaging modality that helps to provide renal measurements as the prognostic factor [1]. CKD is becoming a major health problem and is increasing day by day [2]. Chronic kidney disease (CKD) is described as impaired kidney function and any abnormal conditions of the kidney that lasts for more than three months. The most common causes of CKD are high blood pressure and diabetes [3]. CKD is a group of heterogeneously diverse abnormalities that collectively cause functional and structural changes in the kidney [4]. Echogenicity refers to how bright or dark something appears in the gray-scale image; With regard to the kidney, echogenicity generally refers to how bright or dark the kidney parenchyma appears in comparison to the liver and spleen [5]. According to grades, In Grade 0 renal echogenicity less than liver, Grade 1 renal Echogenicity the same as that of the liver with maintained corticomedullary differentiation, Grade 2 renal Echogenicity greater than that of the liver with maintained corticomedullary differentiation, Grade 3 renal Echogenicity greater than that of the liver with poorly maintained corticomedullary differentiation [6]. The degree of echogenicity is inversely

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proportional to the severity of chronic renal disease [7]. Renal length is the distance measured from pole to pole in a vertical plane or long axis and it varies with the age, sex, height, and the weight of the person. In adults, the average length of the kidney is approximately 10.5 to 11 cm. The lower and upper limits of normal are approximately 9 to 13cm. In established CKD, Sonographically determined length of the kidney is more sensitive than the volume of kidney in predicting kidney function [8]. CKD is a major cause of non-communicable disease, morbidity, and mortality and it should be actively treated in order to reduce non-communicable disease premature mortality by a third by 2030. In 2017, there were 697.5 million cases of CKD worldwide (95 % UI 649, 2 to 752,1), according to the World Health Organization. China (1323 million [95 % UI 1218 to 1437] cases) and India (1151 million [1068 to 1241] cases) accounted for nearly a third of all CKD patients. More than 10 million CKD cases were found in different countries (USA, Brazil, Indonesia, Japan, Mexico, Nigeria, Pakistan, Russia, Bangladesh and Vietnam)[9]. In USA, there was an increase in CKD patient's numbers from 209000 in year 1991 to 472000 in 2004 [10]. More than 19 million individuals in the United States are impacted by CKD, and the number is relied upon twofold in the following decade, so precautions should be taken. The two most common CKD symptoms are clinical depression and chronic pain [11]. CKD was the 27th greatest cause of death in 1990, but by 2010 it had risen to the 18th main cause of death. Around 1 million people died in 2013 as a result of CKD-related causes. The overall prevalence of CKD among Pakistani adults was 21.2 %, with the greatest prevalence of 29.9 % and the lowest incidence of 12.5 % [12]. The prevalence of first-stage CKD is reported to be 100 times higher than kidney failure. In the USA, its affects 11% of adults [13]. The predominance of CKD is assessed to be 8-16% in last phase of CKD[14]. The majority of kidney disease is avoidable, but if it progresses to end-stage kidney disease, dialysis or kidney transplantation may be done for a better prognosis [15]. CKD may lead to kidney failure which can cause sudden [16]. As for the diagnosis of CKD, echogenicity and renal length along with other parameters when measured at an early stage, can lead to the diagnosis of the severity of the chronic kidney disease. We want to compare the echogenicity and renal length of patients suffering from chronic kidney disease to normal and healthy patients' kidneys to help estimate the severity of the effects of CKD on renal parameters..

METHODS

It was a cross-sectional study performed to find out the association between renal length and echogenicity in patients with or without chronic kidney disease. It included 70 patients (35 normal, and 35 with CKD) including both males and females along with a convenient sampling technique. The duration of data collection was 4 months and data were collected from the university Ultrasound clinic, Gilani center Lahore on an Ultrasound machine, Nemio 17 Toshiba. Patients of both gender were included with clinical suspicion of CKD. The exclusion criteria were patients with no history of hypertension, diabetes, normal RFTs, and with an age less than 15 years. Data was analyzed and crosstabs were made using SPSS version 21.0.

RESULTS

Table 1 shows variables and their frequencies along with their percentage. This table also shows total 70 patient in which we had 24 females and 46 males. Out of 70, 35 were CKD and 35 normal. Right kidney echogenicity: 36 (51.4%). No. of patients shows normal echogenicity with grade 0, 18 (25.7%) had with grade I, 10(14.3%) had grade II and 6 (8.6%) had with grade III. Left kidney echogenicity: 37(52.9%) no of patient shows normal echogenicity with grade 0, 16(22.9%) had with grade I, 10(14.3%) had grade II and 7(10.0%) had with grade III.

Variables	Categories	Frequency (%)
Gender	Female Male	24(34.3) 46(65.7)
Chronic kidney disease(CKD)	NO YES	35(50.0) 35(50.0)
Echogenicity right kidney	Grade 0 Grade I Grade II Grade III	36(51.4) 18(25.7) 10(14.3) 6(8.6)
Echogenicity left kidney	Grade 0 Grade I Grade II Grade III	37(52.9) 16(22.9) 10(14.3) 7(10.0)

Table 1: Variables and their frequencies

Table 2 shows that with CKD: No. Of patients who had GRADE 0 was 1(2.9%), Grade I was 18(51.4%), Grade II was 10 (28.6%), Grade III was 6 (17.1%), and without CKD, Grage 0 was 36(51.4%), Grade I was 18(25.7%), Grade II was 10 (14.3%), Grade III was 6(8.6%). Chi-Square Test: Table 3 shows a significant correlation between CKD and right kidney echogenicity.

CKD		Echogenicity Right Kidney				Total
		Grade 0	Grade I	Grade II	Grade III	
NO	Count	35	0	0	0	35
	% within CKD	100.0%	0.0%	0.0%	0.0%	100.0%
Yes	Count	1	18	10	6	35
	% within CKD	2.9%	51.4%	28.6%	17.1%	100.0%
Total	Count	36	18	10	6	70
	% within CKD	51.4%	25.7%	14.3%	8.6%	100.0%

Table 2: Cross-tabulation of CKD-Right Renal Echogenicity

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	Value	df	Asymp. Sig. (2 - sided)
Pearson Chi - Square	66.111 [a]	3	.000
Likelihood Ratio	87.902	3	.000
N of Valid Cases	70		

Table 3: Chi-square Testing

Table 4 shows that with CKD, No. of Patients who had grade 0 was 2(5.7%), Grade I was 16(45.7%), Grade II was 10(28.6%), Grade III was 7(20.0%) and without CKD, GRADE 0 was 37(52.9%), Grade I was 16(22.9%), Grade II was 10(14.3%), Grade III was 7(10.0%). Chi-Square Test: Table 5 shows a significant correlation between CKD and left kidney echogenicity.

CKD		Echogenicity Left Kidney				Total
		Grade 0	Grade I	Grade II	Grade III	
NO	Count	35	0	0	0	35
	% within CKD	100.0%	0.0%	0.0%	0.0%	100.0%
Yes	Count	2	16	10	7	35
	% within CKD	5.7%	45.7%	28.6%	20.0%	100.0%
Total	Count	37	16	10	7	70
	% within CKD	52.9%	22.9%	14.3%	10.0%	100.0%

Table 4: Cross-tabulation of CKD-Left Renal Echogenicity

Variables	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	62.432	3	.000
Likelihood Ratio	81.480	3	.000
N of Valid Cases	70		

Table 5: Chi-Square Test

There is also a significant correlation was found between CKD, right and left renal echogenicity (significant P-value was .000 for right and .000 for left renal length). The relation of CKD with left and right renal lengths is shown in Table 6.

Renal Length, N=35	CKD	Mean	SD	SE Mean
Left Renal length	Yes	9.4629	1.48405	.25085
	No	10.2800	1.14707	.19389
Right Renal length	Yes	8.9143	1.43673	.24285
	No	10.4514	1.20156	.20310

Table 6: Group statistics

Left renal length: CKD (YES), mean: 9.46 ±1.48, CKD (NO), mean: 10.28 ±1.14

Right renal length: CKD (YES), mean: 8.914 ±1.43, CKD (NO), mean: 10.4 ±1.2

Results showed that there is a significant correlation between renal length and chronic kidney disease. The significant value for Right Renal length is(.000), and for Left Renal length is (.012) (Table 7). There is also a significant correlation was found between CKD, right and left renal echogenicity (significant P-value was .000 for right and .000 for left renal length).

Renal Length		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	SE Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Left Renal length	Equal variances assumed	1.032	.313	-2.577	68	.012	-.81714	.31705	-1.44980	-.18448
	Equal variances not assumed			-2.577	63.939	.012	-.81714	.31705	-1.45053	-.18376
Right Renal length	Equal variances assumed	.203	.654	-4.855	68	.000	-1.53714	.31659	-2.16888	-.90540
	Equal variances not assumed			-4.855	65.937	.000	-1.53714	.31659	-2.16924	-.90505

Table 7: Correlation between renal length and chronic kidney disease

DISCUSSION

Ultrasonography has an important role in diagnosing kidney disorders. Our study was designed to see sonographic comparison between echogenicity and renal length among patients suffering with or without CKD. Preeti Gupta MD(2021), conducted a study. In this study, 150 patients (50 with CKD and 100 without CKD) were taken. Renal length, renal parenchymal thickness, renal cortical thickness, cortical echogenicity of kidney and Corticomedullary differentiation were assessed. In this study, renal cortical echogenicity, cortical thickness, and length of kidney showed strong association for independently diagnosing and monitoring progression of CKD [17]. In our study we took 70 patients 35 with CKD 35 without CKD and conclusion is that grading of renal length on ultrasound is the strongest parameter to assess the severity and progression of CKD. Arvinder Singh (2013 - 2015) conducted a study on 100 patients, their Cortical echogenicity, renal length, cortical and parenchymal thickness were all measured using ultrasound. Cortical echogenicity was used to assess renal disease, with Grades 1-4 indicating mild-moderate, severe, and End-stage of renal disease. The grading of renal echogenicity on sonography is linked better than any other sonographic parameter in CKD [6]. In our study, we end up with the same results that grading of renal echogenicity on sonography is the strongest parameter to assess CKD. Muhammad Waqas Naeem (2019), conducted a study in which he took 138 patients with suspected chronic renal failure. Changes in kidney size renal parenchyma and cortical thickness of the kidney were measured sonographically. In this study, they concluded that there is no ultrasonographic correlation between cortical thickness and echogenicity among

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patients suffering from chronic renal failure [18]. We took 70 patients (35 normal and 35 CKD) with the same exclusion criteria. Our Study concluded that echogenicity and renal length can help us to estimate the severity of CKD and there is a significant association between renal length, echogenicity, and CKD. Mustafa Yaprak (2016) in his study, 120 patients were taken with stage 1-5 CKD. Kidney length, parenchymal thickness, and echogenicity were measured by ultrasound. All three standards were scored for both kidneys, separately. Parenchymal thickness, mean kidney length, median parenchymal echogenicity, and ultrasonographic CKD score were observed as 10.97 ± 2.59 mm, 96.2 ± 12.3, and 1.0 (0–3.5), 6.28 ± 2.52 respectively. According to this study, a sonographic score of CKD can be advantageous for the discrimination of CKD stages 1-2 from stages 3 and 5 [19]. In our study, 50-75 age group of males seen with CKD also shows that renal length is compromised in severe CKD. Our Study concluded that echogenicity and renal length can help us to estimate the severity of CKD and there is a significant association found between renal length, echogenicity, and CKD. A study in 2021 included 50 patients. Ultrasonographically, renal length, mean parenchymal thickness, and echogenicity of kidney were evaluated for both kidneys. Each kidney was assessed on all three criteria, and the total of the average scores was used to determine the ultrasonographic CKD score. The ultrasonographic CKD score, which is determined by the US, such as renal length, parenchymal thickness, and parenchymal echogenicity, is helpful for distinguishing between CKD stages 3-5 and 1-2 [20]. In our study, we used renal echogenicity grades are used with renal length and ended up with results that grading of renal echogenicity on sonography is the strongest parameter to assess the early progression of CKD. At the end of the discussion, in our study, we correlate the echogenicity of both kidneys of 70 patients. In the right kidney, 36 patients were with normal echogenicity grade 0, 18 with grade I, 10 with grade II, and 6 with grade III respectively. In the left kidney, 37 patients with normal echogenicity grade 0.16 with grade I, 10 with grade II, and 7 with grade III respectively. There is also a significant correlation of CKD with right and left renal were found as, in right renal length with CKD mean length was 8.914 ±1.43 and without CKD, 10.4 ± 1.2 similarly in left renal length with CKD mean length was 9.49 ± 1.48 and without CKD, 10.28 ±1.14. (Significant P-value is .000 for right and .000 for left renal length).

CONCLUSION

This study concluded that echogenicity and renal length can help us to estimate the severity of CKD and there is a significant association found between renal length, echogenicity, and CKD.

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