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SONOGRAPHIC EVALUATION OF RENAL SIZE, CORTICAL THICKNESS AND RENAL ECHOGENICITY IN PATIENTS WITH PRIMARY HYPERTENSION AND ITS CORRELATION WITH SERUM CREATININE LEVELS

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ABSTRACT Renal related complications are common among patients with hypertension. Sonography can assess kidney size, shape, cortical thickness and echogenicity. The present study was aimed at assessing the renal size, cortical thickness and renal echogenicity in patients with primary hypertension and to correlate it with their serum creatinine levels. Study was conducted at Bharati Hospital, Sangli using an ultrasound machine Affinity 50 and the patient selection was as per reference to Radiology department.

KEYWORDS : Chronic Kidney Disease; Renal Cortical Thickness; Renal Echogenicity; Serum Creatinine

INTRODUCTION

Hypertension is a multisystem chronic disease that affects many organs including kidneys. Primary hypertension is one in which no organic cause can be identified. The fourth District Level Household Survey reported hypertension in 25.3% with greater prevalence in men (27.4%) than women (20.0%). This translates into 207 million persons (men 112 million, women 95 million) with hypertension in India. Renal- related complications are commonly found in patients with hypertension. Over a period of years, these patients can develop chronic kidney disease (CKD). The serum creatinine level is an endogenous serum marker that is commonly used to estimate GFR, and accordingly, the stage of CKD. In addition, observing a small kidney with a thin, echogenic cortex or parenchyma indicates irreversible damage. Sonography is a simple, harmless and inexpensive method not requiring any specific patient preparation or administration of contrast medium. It enables the radiologist to determine kidney position, size, shape as well as visualization of the parenchymal characteristics and cortical thickness and echogenicity. As a result, kidney sonography is usually employed as the first method for visualization of kidneys regardless of the function. The present study was aimed as assessing the renal size, cortical thickness and renal echogenicity in patients with primary hypertension and to correlate it with their serum creatinine levels.

METHODOLOGY

STUDY DESIGN AND SAMPLING

The present study was conducted in the Department of Radiodiagnosis, Bharati Vidyapeeth (deemed to be) University, Sangli, Maharashtra, in which patients aged above 25 years diagnosed with a diagnosis of primary hypertension and referred to our department for sonographic evaluation of the kidneys were included in the study. Over a period of 3 months, 200 patients were included, excluding patients with renal mass, solitary kidney, renal malformation, transplanted kidney and PIH. Purpose of the study was explained to the patients and their written consent was obtained. The study was approved by the Institutional Ethics Committee.

DATA COLLECTION AND DATA ANALYSIS

Diagnosis of hypertension was done based on the '2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults; Report from the Panel Members Appointed to the Eighth Joint National Committee (JNC 8)'. Serum creatinine analysis of such patients were performed. A curvilinear probe with transducer frequency of 2–8 MHz ultrasound machine was used. In each study patient, longitudinal, coronal, and transverse scans of the kidneys were obtained in the supine, supine-oblique, and prone positions. Renal dimensions including length, width, renal cortical thickness and renal parenchymal volume/ echogenicity/ echotexture were assessed. Renal lengths were measured as the greatest pole to pole distance in the sagittal plane. Renal cortical thickness was measured over a medullary pyramid, perpendicular to the capsule as the shortest distance from the base of the medullary pyramid to renal capsule. In each patient, the mean values of the right and left renal longitudinal length, width and cortical thickness were calculated. Cortical echogenicity was compared and graded with the echogenicity of the liver and renal medulla as described in textbooks.

Data analysis was carried out using Statistical package for social sciences (version 22.0 IBM, NY). Data were described as means and standard deviation or frequency distribution. Correlation between serum creatinine and renal sonography parameters was done using Pearson's correlation coefficient.

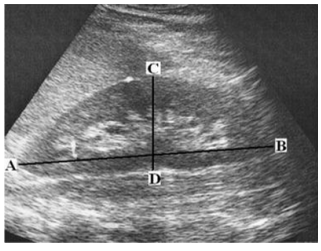


Fig 1: ASSESMENT OF RENAL LENGTH AND WIDTH. Renal length is measured as the greatest pole to pole distance in the sagittal plane

Fig 2 : ASSESSMENT OF RENAL CORTICAL THICKNESS. THE RENAL CORTEX IS MEASURED FROM THE OUTER MARGIN OF THE MEDULLARY PYRAMID TO RENAL CAPSULE.

Fig 3 : Grade 0, Normal renal cortical echogenicity less than that of liver

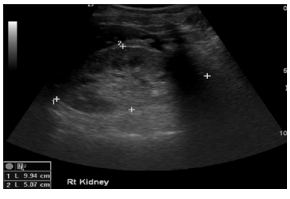


Fig 4 : Grade 1, Renal cortical echogenicity equal to that of the liver

Fig 5 : Grade 2, Renal cortical echogenicity greater than that of liver but less than that of renal sinus echogenicity

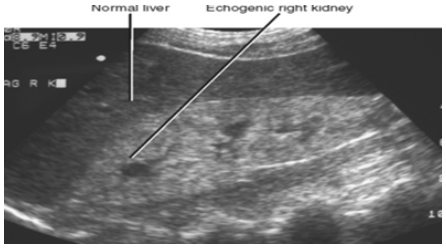


Fig 6 : Grade 3, Renal cortical echogenicity equal to the renal sinus echogenicity

RESULTS

Mean age of the patients included in the study was 61.67 years (ranging from 25 to 87 years). Patients aged more than 60 years comprised 61% of the study population (Table 1). Males comprised 58% of the total study population. Mean systolic and diastolic blood pressure was 146.19 and 94.1 mm Hg respectively. Serum creatinine in our study population ranged from 0.9 to 8.0 mg/dl, with a mean of 1.78 ± 0.57 mg/dl. Serum creatinine less than 1.2 mg/dl was observed in 34% of the patients, between 1.2 to 2.1 mg/dl in 38% and more than 2.1 mg/dl was observed in 29% of the patients. Renal sonography revealed 26% of the patients to be in echogenicity grade 0, 35% in grade 1, 27% in grade 2 and rest of the 13% in grade 3 (Table 2). Mean right and left kidney length was 89.22 ± 19.34 mm and 95.85 ± 15.25 mm Hg respectively. Mean right and left kidney width was 44.57 ± 7.35 mm and 47.59 ± 7.24 mm Hg respectively and mean right and left kidney cortical thickness was found to be 13.45 ± 3.07 mm and 14.26 ± 2.71 mm. The renal sonography parameters were analysed to find their correlation with serum creatinine levels (Table 3). It was found that the serum creatinine correlated positively and significantly with echogenicity grade (r = 0.75. p value <0.01) and inversely and signifi cantly with mean cortical thickness (r= =0.21, p value <0.01). Mean kidney length and width were not found to correlate significantly with serum creatinine levels in our study population (Figure 1).

Table 1. Baseline characteristics of the patients included in the study

Age group (in years)	**Number of patients**	**%**	
Up to 40	33	17%	
41 to 60	45	23%	
More than 60	122	61%	
Gender			
Females	85	43%	
Males	115	58%	
Serum creatinine (in mg/dl)			
Less than 1.2	67	34%	
> 1.2 to 2.1	76	38%	
More than 2.1	57	29%	
	Range	**Mean**	**Std. Deviation**
Age (in years)	25 to 87	61.67	16.82
Systolic blood pressure (in mm Hg)	141 to 155	146.19	4.51
Diastolic blood pressure (in mm Hg)	90 to 98	94.1	2.2
Serum creatinine (in mg/dl)	0.9 to 8.0	1.78	0.57

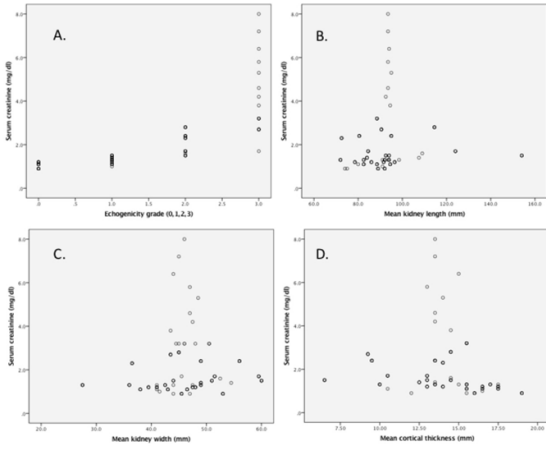
Table 2. Renal sonography findings of the patients included in the study

Renal sonography parameters				
Echogenicity grade	**Number of patients**	**%**		
0	51	26%		
1	69	35%		
2	54	27%		
3	26	13%		
	Minimum	**Maximum**	**Mean**	**Std. Deviation**
Right kidney length (mm)	60	159	89.22	19.34
Right kidney width (mm)	25	61	44.57	7.35
Right kidney cortical thickness (mm)	6	20	13.45	3.07
Left kidney length (mm)	74	149	95.85	15.25
Left kidney width (mm)	30	62	47.59	7.24
Left kidney cortical thickness (mm)	7	18	14.26	2.71
Mean kidney length (mm)	72	154	92.53	15.89
Mean kidney width (mm)	27.5	60	46.08	6.98
Mean cortical thickness (mm)	6.5	19	13.86	2.85

Table 3. Correlation of serum creatinine with renal sonography parameters

Renal sonography parameters		**Serum creatinine**
Echogenicity grade	Pearson Correlation	.755**
	Sig. (2-tailed)	<0.01
Mean kidney length	Pearson Correlation	0.062
	Sig. (2-tailed)	0.382
Mean kidney width	Pearson Correlation	0.082
	Sig. (2-tailed)	0.25
Mean cortical thickness	Pearson Correlation	-.215**
	Sig. (2-tailed)	<0.01
** Correlation is significant at the 0.01 level (2-tailed).		

Figure 7. Scatter plot of serum creatinine with various renal sonography parameters



DISCUSSION

The present study was conducted to assess the correlation of serum creatinine level with renal sonography parameters. It was found that the serum creatinine level correlated positively and significantly with echogenicity grade (r = 0.75. p value <0.01). Similar results were demonstrated by Siddappa et al (8) in patients with chronic kidney disease. Renal cortical thickness decreases as first sonographic findings in patients of CKD secondary to primary hypertension. It inversely correlates with renal cortical thickness (r =0.21, p value <0.01). These findings are similar to those observed by Beland et al (12). They reported that cortical thickness has statistically significant correlation with renal function impairment. There was no statistically significant correlation between mean renal length and width, so also with serum creatinine levels. Similar results were also found by Singh

et al (14) that there is no statistically significant correlation between serum creatinine and mean longitudinal length of kidney.

There are a few limitations. First, we used serum creatinine as a marker for renal function. Estimates of glomerular filtration rate measured by MDRD equations have been shown to be the best overall index of the level of kidney function. Second, since the accuracy of sonography is operator dependent, the results of our study might not be generalizable to other health facilities.

CONCLUSION

In patients with essential hypertension, serum creatinine level significantly correlates with renal echogenicity and inversely correlates with renal cortical thickness. Increase in echogenicity of kidneys is irreversible even when serum creatinine levels were corrected with due treatment. Serum creatinine levels do not correlate with morphology of kidneys i.e, renal length and width. Therefore, renal morphology like length and width and renal sonographic findings like renal echogenicity and cortical thickness helps clinician in deciding line of management and thus, should be considered as investigation of choice.

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