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Original Research Article

Sonographic assessment of kidneys and associated abdominal findings in patients with renal parenchymal diseases

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ABSTRACT

Background: The renal parenchymal diseases were common pathological conditions that involved the renal parenchyma. They cause damage to interstitia and glomerula and result in renal failure if left undiagnosed and untreated. The objective of the study was to assess the kidneys in renal parenchymal diseases in Sudanese patients.
Methods: This cross-sectional study involved two hundred and six patients confirmed with renal parenchymal diseases. All the patients were scanned using ultrasonography. The echogenicity, kidney size, surface and thickness of renal cortex were assessed and the related abdominal findings.
Results: A total of 206 patients diagnosed and confirmed renal parenchymal diseases had been selected for the study. The kidneys were normal in size in 47.10% the cases, 30.58% were small and 19.42% were large. The echogenicity of the kidneys was increased in 93.69% and normal echogenicity observed in 5.34% of the cases. The renal cortical thickness was normal in 65.05% and thin in 33.50% of the cases. There were no obstructive changes in the renal pelvicalyceal system in 86.41%, while dilatation observed only in 7.28% of the cases. Abdominal findings were observed in 65.05% of the cases. The most common abdominal findings were 26 cases of ascites, 10 with pleural effusion, 6 with benign prostatic hypertrophy and 4 with liver cirrhosis.
Conclusions: Sonographic evaluation of kidneys in renal parenchymal diseases is very important in diagnosis and management. Pleural effusion, ascites and liver cirrhosis were the most common systematic findings accompanied with renal parenchymal diseases.

Keywords: Abdominal sonographic, Assessment, Findings, Parenchymal, Renal

INTRODUCTION

Renal parenchymal diseases nowadays became serious problems which burden the public health and cause severe morbidity and mortality. Several causes of renal parenchymal diseases among which diabetes and hypertension were considered the most common causes. Differentiation of these diseases is very important and aid in treatment. The study aimed to evaluate the kidneys and to detect the abodominal findings in patients with known parenchymal renal diseases. Ultrasound plays a key role in diagnosis of these renal diseases. It is the first imaging procedure used to investigate the kidneys since it is available, cheap, and accurate and reduces time in hospital.[1]

Ultrasound is able to differentiate the renal parenchymal diseases as it assesses the kidney size, echogenicity and

thickness of the cortex. For evaluation renal parenchymal diseases, kidney size is very important to be estimated. Kidney length is the most useful parameter of kidney size because it reflects how much kidney tissue is lost. On the other hand, it is minimally influenced by interobserver variability.[2]

In most previous studies, the kidney size is determined by the length since it is important in assessment of kidney diseases and helps to differentiate acute from chronic kidney disease (CKD). Thus, small kidneys may confirm the diagnosis of CKD; however, normal or increased kidney length may occur in either acute kidney disease (AKD) or CKD. Large kidneys are always found at AKD which may result from acute parenchymal disorders; this enlargement may due to edema and inflammation [3]. In this study we have categorized the renal size into small, normal and large depending on the renal length. All these sonographic parameters used to classify the parenchymal diseases and helps in follow-up and treatment.

The renal length is a valuable sonographic parameter in urological and nephrologic practice. Some previous studies describe the adult kidney as 12 cm long, 6 cm wide and 3 cm depth.[3] Other literature, the renal size varies with age, gender, body mass index, pregnancy. So, renal size may be considered as a strong indicator of kidney function and disease and it is valuable to assess changes at kidney parenchyma andcortex through comparison with the other uninvolved healthy kidney.[4,5]

In this study, we have evaluated length of the kidney, echogenicity and thickness of renal cortex and kidney surface. These parameters were significantly changed in renal parenchymal diseases and should be evaluated.[6] The abdominal and thoracic were identified. They included pleural effusion, liver cirrhosis, benign prostatic hypertrophy (BPH) and liver cirrhosis. They were associated with renal parenchymal diseases.

METHODS

Study designs and population

The study was a cross-sectional- prospective design. The study was conducted in Khartoum State from the period of 15 June 2014 to May 2016. A total of 206 patients with renal symptoms, different in ages and gender suffering from renal diseases referred to different hospitals in Khartoum city. The exclusion criteria included patients with hepatitis, schistomiasis, autoimmune diseases, renal anomalies and history of renal surgeries and implantation. Renal parenchymal diseases were confirmed with Laboratory investigation for every patient. All patients were scanned by expert radiologists. A designed data collection sheet was used to gather patients' demographic data and clinical history.

Informed consent was obtained from all participant patients. Ethical approval was from the local Ethical committee of the Faculty of Radiological Sciences and Medical Imaging at Alzaiem Alazhari University.

Ultrasound technique

The patients were investigated with a standard gray-scale ultrasound using Toshiba ultrasound machine with multi-frequency curvilinear probe (3.5–5 MHz) and Aloka Prosound SSD-3500sx with two probes curvilinear probe 3.5 MHz and linear high frequency 7.5 MHz probe. The machine setting was adjusted and so the image parameters such as overall gain, focusing and depth. The patient was positioned in supine, oblique and even prone to demonstrate the kidneys in their entire size and shape. The kidneys were scanned in variable sections such as coronal, longitudinal and transverse. The renal length was measured from upper margin of upper pole to lower point of lower pole. The thickness of renal cortical layer was measured in the sagittal plane perpendicularly to the capsule. The echogenicity of the right kidney was assessed compared to the liver, and echogenicity left kidney was assed compared to the spleen.

Statistical analysis

The data of the study was analyzed using SPSS software program version 16. Descriptive statistics Percentage were used to describe the data. T-test was used to compare between the variables and p-value was 0.05, values lesser than 0.05 were considered significant.

RESULTS

The study population composed of 206 patients who had been confirmed with renal parenchymal diseases, which had been selected for the study. They underwent renal function test to estimate the urea and creatinine. The gender distribution was shown in Figure 1 and incidence of renal parenchymal diseases was higher in males than females (59.22% versus 40.78%). Diagnosis of the renal parenchymal diseases was confirmed depending on the clinical assessment, sonographic findings of the kidneys and laboratory findings. The distribution of patients' age was shown in Table 1. Most of the patients were in the age group of 20 to 30 years old (22.82%). The size of the kidney was evaluated using sonographic measurement of the kidney length and it was noticed that 47.10% of the diseased kidneys were normal in size, 30.58% were small and 19.42 % were large as shown in Table 2. The renal cortical echogenicity was graded into three categories; hyperechoic, hypoechoic and normal (Table 3). It was found that 93.69% of the diseased kidney was hyperechoic, 5.3% normal and 0.97 hypoechoic.

The thickness of cortex was measured and evaluated as thin or normal. The renal cortex was normal in 65.05% and thin in 33.50% of the impaired kidneys (Table 4). Table 5 and Table 6 showed the surface changes and the effect of parenchymal diseases on the pelvicalyceal system respectively. The surface of the diseased kidneys

remains smooth in 97.57% of the cases and lobulated in 2.43% (Table 5). It was observed that the renal parenchymal disease has no mainly compression effect on pelvicalyceal system. Thus dilatation was observed in 7.28%, dilatation and thick PCS in 3.88% and the majority showed normal pelvicalyceal system (86.41%) as revealed in Table 6.

The abdominal findings were detected in 65.05% of the cases. Ascites was 12.62%, pleural effusion was 4.85% and BPH was 2.91%, as shown in Table 7.

Table 1: The incidence of renal parenchymal diseases among age groups of the study population.

Age groups	Frequency	%
<20	30	14.55 %
20-30	47	22.82%
31-40	42	20.39%
41-50	23	11.17%
51-60	24	11.65%
>60	40	19.42%
Total	**206**	**100%**

Table 2: Evaluation of kidney size using measurement of the renal length.

Size	Frequency	%
Normal	97	47.10
Small	63	30.58
Large	40	19.42
Right normal, left small	3	1.46
Right large obstructive with severe hydronephrosis	1	0.48
Right small left normal	1	0.48
Right normal left absent	1	0.48
Total	**206**	**100**

Table 3: The echogenicity of renal cortex in the study population.

Renal cortical echogenicity	Frequency	%	P-value
Hyperechoic	193	93.69	0.0005
Normal	11	5.34	
Hypoechoic	2	0.97	
Total	**206**	**100**	

Table 4: Sonographic assessment of renal cortical thickness.

Renal cortical thickness	Frequency	%	p-value
Normal	134	65.05	0.00
Thin	69	33.50	
Right thin; Lt normal	2	0.97	
Right normal; Lt thin	1	0.48	
Total	**206**	**100**	

Table 5: Frequency distribution of patients according to kidney surface.

Surface	Frequency	%	p-value
Smooth	201	97.57	0.00
Lobulated	5	2.43	
Total	**206**	**100**	

Table 6: The effect on renal pelvic collecting system.

Effect on pelvicalyceal (PCS) system	Frequency	%	p-value
No compression	178	86.41	0.001
Dilated PCS only	15	7.28	
Dilated and thick PCS	8	3.88	
Thick PCS only	3	1.46	
dilated right kidney with normal Left one	2	0.97	
Total	**206**	**100**	

Table 7: Systematic findings associated with renal parenchymal diseases detected by ultrasound.

Other findings	Frequency	%
No systematic findings	139	65.05
Ascites	26	12.62
Pleural effusion	10	4.85
Others	7	3.40
BPH	6	2.91
Liver cirrhosis	4	1.94
Multiple small cortical cyst due to dialysis	3	1.46
Ca-bladder	3	1.46
Thick GB wall	2	0.97
Hepatosplenomegaly	2	0.97
Absent Right kidney; small Left kidney	2	0.97
Ascites and pleural effusion	2	0.97
Multiple small cyst bilateral (MCDK)	1	0.48
Doppler prominent blood vessel high vascularity	1	0.48
Edematous thick bowel wall	1	0.48
Splenomegaly	1	0.48
Hepatitis	1	0.48
Total	**206**	**100**

DISCUSSION

The objective of the study was to evaluate the kidneys and the associated abdominal findings in renal parenchymal diseases. This helps in the treatment and management of renal complications which may progress

to renal failure. It was observed that most of the renal parenchymal diseases involved the age group of 20-30 years old. This is an important finding. This causes severe health problems and complications. This result was consistent with Gareeballah A et al, who studied the sonographic findings of renal parenchymal diseases in Sudanese.[7] They reported that the incidence of renal parenchymal diseases was common in the age group 20-30 years old.

The present study found that the kidneys in renal parenchymal diseases were normal in size in 47.10% of the study population while small and large kidneys were 30.58% and 19.42% respectively. This indicates that kidney length is a useful parameter that could distinguish acute kidney disease (AKD) from CKD. This finding is consistent with Sarah et al who reported that renal length is a useful parameter in evaluating patients with acute kidney disease (ACD) and may help to differentiate AKD from CKD.[8] Consequently, small hyperechoich kidney suggests the diagnosis of CKD; however, normal or increased kidney length may occur in either acute or chronic kidney disease.[9] In the current study, we observed enlarged kidneys in19.42% of the study population and this may result from edema and inflammation.

The study revealed that echogenicity of the renal cortex was increased in 93.69% of the cases. This increased echogenicity was mainly attributed to inflammatory infiltrates, fibrosis and proteinaceouscasts.[10,11] This finding agrees with Jagdeesh et al who reported that echogenicity is a useful sonographic parameter to assess renal parenchymal diseases.[12]

In the current study, it was observed the renal cortex was normal in 65.05% of the cases while it was thin in 33.5%. This agreed with previous a study that shown the renal cortex is a common sonographic finding in renal parenchymal diseases specifically in CKD.[13] Thinning of the renal cortex indicates decrease number of nephrons due to longstanding of pathological process.

The present study revealed that the majority of the renal parenchymal diseases (97.57%) revealed smooth surface while lobulation occurs in 5 cases only (2.43%). This finding indicates that lobulation of kidney surface is not a common finding in renal parenchymal diseases while smooth surface would not reflect health of the kidneys.

In this study, it was observed that the renal parenchymal diseases had no common effect on the pevicalyceal system of the kidneys since they were not obstructive diseases. The renal pelvis and calyces remained unchanged in 86.41% of the cases because there were less significant causes of renal obstruction among the study population.

Through the abdominal scanning for other systematic findings, it was observed that 65.05% of the cases revealed no accompanied systematic findings. Among the remaining cases, ascites is the most common finding associated with renal parenchymal diseases. This is attributed to imbalance of body fluids that caused by the impaired kidneys. This result agreed with Glück and Nolph who studied association of ascites in end-stage renal disease, and they reported that ascites was associated with end-stage renal disease.[14] Contributing mechanisms may include fluid overload, peritoneal membrane, hypoproteinemia, and lymphatic drainage disturbances.The other systematic findings which associated with renal parenchymal diseases were pleural effusion, BPH, liver cirrhosis and carcinoma of the urinary bladder (UB) respectively. In previous studies, renal parenchymal diseases were associated with BPH and carcinoma of the UB. Rule et al reported there was association between UB outlet obstructions.[15] This finding agrees with our result.

CONCLUSION

Ultrasound is an essential imaging method to assess kidneys and complications in renal parenchymal diseases. Small hyperechoic kidneys with thin cortices were the most common findings in renal parenchymal diseases while irregularity of renal surface is less frequent. Pleural effusion, ascites and liver cirrhosis were the most common systematic findings complicated of renal parenchymal diseases. Sonographic assessment of kidneys in parenchymal diseases might be helpful in treatment and prevention of renal failure and other severe complications.

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