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Orignal Article

Correlation of Increased Renal Parenchymal Echogenicity with Renal Function Tests and Urine Routine Examination in Patients From all over Lahore with Low Socio-economic Status

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ABSTRACT

Evaluation of kidney function is vital in the treatment of patients with renal diseases with altered kidney function. **Objective:** To evaluate the Correlation of Increased Renal Parenchymal Echogenicity with Renal Function Tests and Urine Routine Examination in patients coming to Life Hospital, Lahore, Pakistan. **Methods:** A descriptive study was conducted at Life Hospital, Lahore over a period of fourteen months. A total of 115 patients both male and female, aged 12 to 83 years with the diagnosis of increased renal parenchymal echogenicity (RPE) were included in the study and patients with normal renal cortical echogenicity were excluded from this study. The study includes different grades of RPE, both males and females of different age groups and correlation with lab findings (Renal Function Tests and Urine R/E). Statistical analysis was conducted in SPSS version 22.0 and Microsoft Excel. **Results:** RPE was raised in 55% of males and 44% of females. The most common cause for increased RPE was concluded to be Urinary Tract Infection (UTI)%; (with WBCs seen in 28% of patients, Blood seen in 25% of patients, Leukocytes seen in 23% of patients, RBCs seen in 22% of patients and pus cells seen in 3% of patients). Only 8% of patients were seen with deranged RFTs. Mean age of patients with increased RPE was 32.4 years. Most patients presented with lumbar region pain, burning micturition and dehydration. **Conclusions:** UTI seems to be the main cause of increased RPE in the patients we studied as majority of the patients did not have a normal urine report. Males were more likely seen with increased RPE. As majority of our patients belonged to poor socio-economic status, so it was concluded that the main cause of UTI could be dehydration due to lack of availability of clean water and poor hygiene conditions.

INTRODUCTION

The kidney has two main parts: cortex and medulla. Each kidney comprises of 2 million nephrons which are the functional unit of kidney. The kidneys carry out many vital roles in acid- base balance, removal of waste namely urea, creatinine and ammonia and electrolyte regulation [1]. Kidney is primarily divided into four main parts; glomerulus, tubules, interstitium and the vessels. Biopsy could easily determine the progression of disease and the affected part if done initially in renal diseases. But as it is invasive, it is necessarily done only to meet any indication, mostly to determine the nature of renal tumors [2]. Creatinine is the commonly utilized endogenic marker for the evaluation of glomerular function. Serum urea is seen to be raised in the situations involving decreased renal waste removal such as in acute or chronic kidney failure. Serum creatinine is a much more precise analysis of kidney function in comparison to the urea; but urea is raised initially in renal pathology. Urine examination entails the evaluation of urine elements to help in the diagnosis of disease. It comprises of microscopic study, chemical and physical inspection [3]. Kidney diseases are usually diagnosed with urine analysis and lab findings. If there is no known cause of renal disease then biopsy is performed to properly diagnose the origin of kidney disease [4]. Ultrasonography

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is an inexpensive and non-intrusive tool for the examination of renal diseases without the patient being under the risk of radiations [5]. Grayscale along with Color Doppler Ultrasound is the fundamental modality for the imaging of the renal diseases and for the direction of the interventional operations. Normally on Gray scale US, the cortex of the kidneys is seen to be of reduced echotexture when compared to the hepatic parenchyma, splenic parenchyma and the renal sinus, while the renal pyramids when compared to the renal cortex are hypoechoic in comparison [6]. Increased renal echogenicity can be caused by multiple underlying causes like diabetes, genetic conditions, medications etc. and the most common cause of secondary hypertension is renal parenchymal disease [7]. Raised renal parenchymal echotexture is a prognosticator of decreased kidney function [2]. Renal parenchymal echotexture is commonly seen to be increased in the patients with parenchymal disorders of the kidneys. Renal echotexture is believed to be enhanced if the echogenicity of the right kidney is increased in comparison to the liver and the echogenicity of the left kidney is increased in comparison to the spleen. The underlying histologic diagnosis can then be determined by conducting a renal biopsy on normal or inflamed kidneys. A chronic disease with end-stage changes is usually indicated by small kidneys [8].

METHODS

This descriptive study was concluded in the Radiology department of Life Hospital, Lahore for a period of fourteen months from 31st January 2020 to 2nd February 2021. Adults and children of both genders, aged 12 to 83 years with the diagnosis of increased RPE were included in the study. All the patients who were not diagnosed with increased RPE were excluded from this study. Cortical echogenicity was compared to that of liver and spleen. Increased RPE were divided into three types: RPE equal to liver parenchyma (Grade-I). RPE greater than that of liver parenchyma (Grade-II). RPE equal to that of renal cortex (Grade-III). All the data was collected with a 3 to 5 MHz convex transducer of Toshiba Xario by one radiologist and the gains were changed according to the patient to obtain best possible images. Data collection was started after taking informed consent from the patients. All patients meeting inclusion criteria were selected for the study. Study information included different grades of RPE, sex, and age in different age groups correlated with lab findings (RFTs and Urine R/E). The diagnosis of increased RPE was made in accordance to the operational definitions. Data were managed and analyzed in SPSS software version 22 and Microsoft Excel. For the qualitative data like increased RPE, frequencies, gender and percentages were measured. The quantitative variables like age groups were presented as mean.

RESULTS

115 patients with increased RPE were included in this study and out of these there were 64 males (55%) and 51 females (44%). Out of 115 patients 100 (86.9%) were adults and 15 were children (13%). RPE was seen bilaterally in 96 (83%) patients and was seen unilaterally in about 19 (16%) patients, out of these 19 patients, 12 (10%) had right sided increased RPE and 7 (6%) had left sided increased RPE. Increased RPE of Grade-I was seen in 102 (88.7%) patients, Grade- I-II was seen in 7 patients (6%), Grade-II was seen in 4 patients (3.5%) (Table 1). Table 2 shows bilateral and unilateral parenchymal ecogenecity. RFTs were found to be normal in 107 (93%) patients and deranged in only 8 (7%) patients (Figure 1). Urine routine examination of most patients diagnosed with increased RPE showed the signs of UTI (53%); with WBCs seen in 28% of patients, Blood seen in 25% of patients, Leukocytes seen in 23% of patients, RBCs seen in 22%, Pus cells seen in 3% of patients and glucose, proteins and bacteria was seen in some patients that were diagnosed with CKD. 46.9% of patients had normal urine routine examination (Figure 2). Figure 3 shows bilateral increased RPE and figure 4 shows Unilateral increased RPE

Grades of Renal Parenchymal Echogenecity	Frequency	Percentage
Grade-I	102	88.7
Grade-I-II	7	6.0
Grade-II	4	3.5
Lt. Grade-I, Rt. Grade-I-II	1	0.9
Lt. Grade-I, Rt. Grade-II	1	0.9

Table 1: Descriptive statistics of percentages of Grades of Renal Parenchymal Echogenicity

Renal Parenchymal Echogenicity	Frequency	Percentage
Bilateral	96	83%
Unilateral	19	16%
Unilateral	**Frequency**	**Percentage**
Rt. sided	12	10%
Lt. sided	7	6%

Table 2: Descriptive statistics of bilateral/unilateral Renal Parenchymal Echogenicity

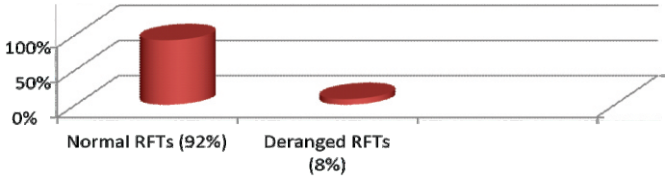

Figure 1: Graphical representation of the effect of Renal parenchymal echogenicity on RFTs

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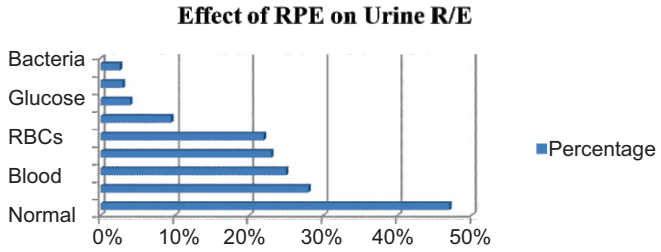

Figure 2: Graphical representation of Urine R/E findings

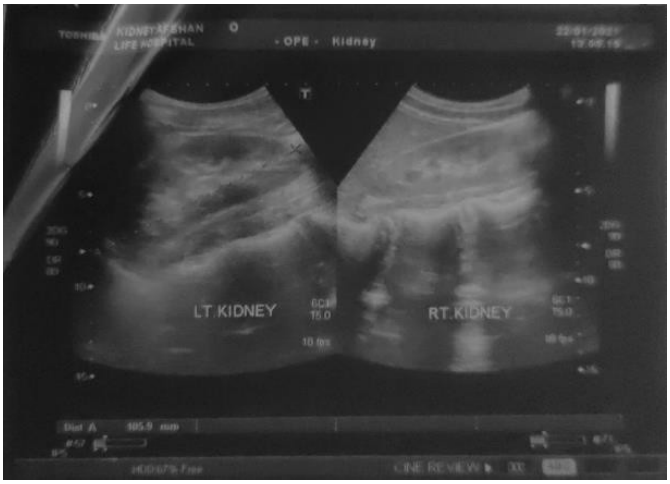

Figure 3: Bilateral increased renal parenchymal echogenicity

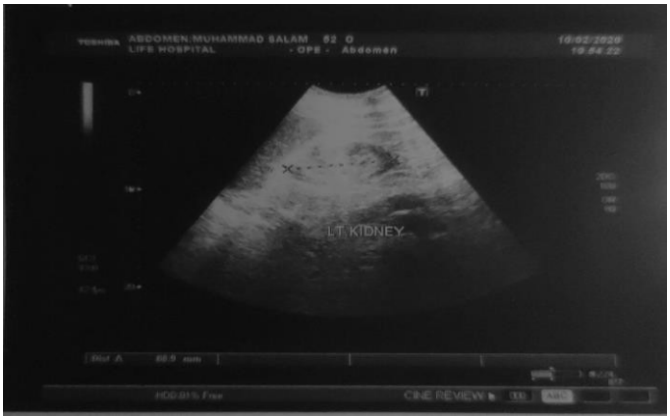

Figure 4: Unilateral increased renal parenchymal echogenicity

DISCUSSION

Ultrasound is considered to be the most common, low cost, radiation free and easily available imaging tool in the diagnosis of renal diseases [9]. Similar is the reason for us to use this modality in our study as well. In a comparative study done at University of Michigan Hospitals by JF Platt et al., in August 1988, they observed that echogenicity of the kidney was often equal to the liver especially in the patients with no evidence of any renal disease [10]. This was the same observation in our study as well, which conflicts with the general concept that echogenicity of normal kidneys is always less than that of the liver. A study done in Atlanta, USA by JA Manley et al., showed that currently echogenicity is measured qualitatively by just comparing the difference in brightness of the cortex with liver and spleen. A quantitative method for renal cortical echogenicity with liver was developed, echogenicity was expressed as the ratio of cortical brightness to that of liver. This study concluded that renal cortical echogenicity in healthy individuals is less than that of liver and is influenced by the state of hydration [11]. The current study also showed that dehydration does affect renal cortical echogenicity in the presence of no kidney disease and echogenicity reverts back to normal in most of the cases after maintaining good hydration. A study done in children by Mooneera Peerboccus *et al.*, showed that hydration influences the renal length, volume and echogenicity in children, cortical echogenicity progressed from hypo to iso-echogenicity [12]. The same was noted by Chih-Chiang Chien *et al.*, in March 2012. They reported two cases of abdominal infection which caused dehydration; their ultrasound showed increased RPE. But after the treatment and intravenous hydration; the repeated ultrasound done after a few days showed normal echogenicity of the kidneys [13]. We also noted that the patients before and after having a good hydration status had a difference in their echogenicity. Jack Wolfsdorf on 24th March, 2021 described that the causes of increased RPE included diabetes, renal stones, hypertension, viral and bacterial infections, medications, auto-immune diseases (nephritis and lupus) and genetic conditions [14]. In our study bacterial infection was the main cause of increased RPE in the patients with no underlying chronic disease. A study done by Sarah Faubel *et al.*, on February 2014 described that increased RPE was seen in both acute and chronic phases of kidney disease and it is difficult to differentiate between the two. However, it was observed that in chronic kidney disease increased echogenicity was associated with small echogenic kidneys. It was concluded in the study that ultrasound is the best imaging modality to differentiate between acute and chronic renal diseases [15]. The same was seen in our study that small echogenic kidneys were seen only in the patients already diagnosed with CKD and according to the studies done by Jagdeesh K. Siddappa *et al.*, Liborio A.B *et al.*, and Arvinder Singh *et al.*, that renal echogenicity and its grading correspond with RFTs [16-18]. and those with acute insult were shown to have reversed echogenic findings. Other studies by F. Wiersma et al., in January 2008 and Yong Seung Lee et al., concluded that increased RPE seen in the children with acute illness was not indicative of renal disease and rather was a transient feature [19,20]. and in our study increased RPE in pediatric age group was a common finding with no evidence of any kidney disease.

CONCLUSIONS

Increased RPE is a common sonographic finding in patients

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presenting to our health care setting. RPE similar to that of the liver was a common finding, which was concluded to have normal RFTs suggesting that increased RPE of Grade-I is not a good criterion for the initial diagnosis of renal disease. As most of the patients belonged to lower socio-economic status with a history of low water in-take and having signs of UTI on urine examination, suggesting that dehydration leading to UTI could be the real cause of increased RPE in these patients without any real underlying kidney disease. However, patients diagnosed with CKD had a higher grade of RPE with deranged RFTs.

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