## Original Article

# Grading Of Renal Parenchymal Disease Using Gray Scale Ultrasound

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## ARTICLE INFO

## ABSTRACT

The shape of the normal adult kidney is like a bean, retroperitoneally present between twelve thoracic and third lumbar vertebra. Ultrasound can identify increased cortical echogenicity and reduced cortical parenchymal thickness, as well as reduced renal size in CKD. **Objective:** To diagnose renal parenchymal disease and its grading using gray scale sonography. **Methods:** It was cross-sectional research undertaken at Tertiary Hospital in Lahore, Pakistan radiology department. This research took place over five months, from January 2022 to May 2022. A convenient sampling approach using previously published articles was used to obtain a sample size of 78 patients. After informed consent, patients who were assessed for renal ultrasonography at the study region, during the study period, were included. Data was entered and analyzed on SPSS version 22.0. **Results:** The mean age was 46.47±12.0. The frequency for males was 47(60.3%), and for females was 31(39.7%). Blood urea (mg/dl) had a mean value of 92.16±46.88, and Serum creatinine (mg/dl) in male patients had a mean value of 6.86±6.18 while in female patients had 5.50±5.36. The blood urea nitrogen of patients had a mean value of 50.16±33.70 and a glomerular filtration rate with a mean value of 81.34±23.12. The frequencies of sonographic grading of renal cortical echogenicity show patients of Grade 1 had 32(41.0%), Grade 2 28(35.9%), Grade 3 12(15.4%), and Grade 4 6(7.7%). **Conclusion:** Renal parenchymal disease is the most prevalent disease in elder males. Grade 1 of renal parenchymal disease is most common in patients, followed by Grade 2, Grade 3, and Grade 4.

## INTRODUCTION

The kidneys are intricate organs that contribute significantly to normal physiological functions [1]. The urinary system is comprised of paired kidneys, paired ureters, urinary bladder, and urethra. The shape of the normal adult kidney is like a bean and sits retroperitoneally present between the twelve thoracic and third lumbar vertebra [2]. The renal medulla and renal cortex are the functioning portions of the kidneys. The kidney has several functional units in each lobe. The typical lobe is made up of a calyx, a medulla, a cortex, and blood vessels [3]. Kidney disease is a broad phrase that encompasses a wide range of diseases that disrupt the anatomy and physiology of the kidneys [4]. Acute refers to a time of three months or less, whereas chronic refers to a term of more than three months [5]. A variety of illnesses have detrimental effects on renal parenchyma and can lead to kidney failure [6]. It is

considered to have higher echogenicity when the liver or spleen is less echogenic than the right or left kidney respectively [7]. Chronic kidney disease (CKD) has a detrimental effect on long-term health outcomes because it increases the risk of cardiovascular disease and accelerates the onset of renal failure [8]. Patients with kidney illness frequently experience cognitive impairment. The level of serum creatinine is a well-established indication of renal parenchymal disease severity [9,10]. Ultrasonography is a low-cost, non-invasive examination technique that provides enough anatomical information to diagnose kidney abnormalities without patient exposure to radiations, and it has so effectively supplanted traditional radiography in the United States and internationally [11]. These details help determine the severity of renal parenchymal damage, its reversibility, and whether or not a

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renal biopsy is necessary. Cortical echogenicity is used to grade kidney disease, with Grade 1 indicating mild disease, Grade 2 indicating moderate disease, Grade 3 indicating severe disease, and Grade 4 indicating end-stage renal disease [12]. Grade 0:renal parenchyma is less echogenic than the liver [13]. Grade 1:renal parenchyma has the same echogenicity as the liver.Grade 2:renal parenchyma has echogenicity more than that of the liver [10]. Grade 3:renal parenchyma has echogenicity more than that of the liver, and poor corticomedullary distinction [13,14]. Grade 4: renal parenchyma has echogenicity more than that of the liver, and corticomedullary distinction is lost [15]. To evaluate regardless of whether the renal disease is worsening or is normal, serial sonographic tests are conducted. USG can identify increased cortical echogenicity and reduced cortical parenchymal thickness, as well as reduced renal size [16]. Early detection can aid in the adoption of early treatment [17]. Sonographic measurements such as length of kidney, corticomedullary distinction, and echogenicity of renal cortex do not allow for differentiating various types of renal health illnesses in individuals with renal parenchymal disease [18,19]. Increased cortical echogenicity, on the other hand, is a non-specific sign of renal parenchymal illness. Sonographic parameters for assessing renal parenchymal disease include the size of the kidney, contour, cortico-medullary distinctions, thickness of the cortex, and prominence of the medullary pyramids [20,21]. In a healthy kidney, the renal cortex generates lower-intensity back-scattered echoes than that of the liver, spleen, or renal sinus. In contrast, the renal medulla is somewhat hypoechoic [22]. Renal length and parenchymal thickness diminish as CKD progresses, whereas parenchymal echogenicity rises [23]. Permanent damage is indicated by a renal length of less than 10cm and increased echogenicity [24]. Diabetes and hypertension are two of the most prominent chronic non-communicable diseases, both of which are common triggers for end-stage renal failure [25,26]. Ultrasound is the initial imaging modality utilized to explore the kidneys, it is critical in the diagnosis of renal illness. The radiologist will be able to understand the clear criteria and detrimental findings that are symptomatic of pathology, allowing them to recognize it early and design a treatment strategy to avoid complications.

## METHODS

It was cross-sectional research undertaken at Tertiary Hospital in Lahore, Pakistan radiology department. This research took place over five months, from January 2022 to May 2022. A convenient sampling strategy using previously published articles was used to obtain a sample size of 78 patients [6,10,19,21,27]. After informed consent, patients who were assessed for renal ultrasonography, increased Urea, Serum creatinine, Blood urea Nitrogen, and Glomerular Filtration Rate at the study region during the study period were included. Known subjects with a history of acute kidney injury, kidney transplant patients, and obstructive uropathy were excluded. The patient demographic data was collected on a specially designed data collection sheet. Data were entered and analyzed on SPSS version 22.0.

## RESULTS

The mean age was 46.47±12.03, with a minimum age of 28.00 and a maximum age of 83.00. Gender distribution shows the frequency of males 47(60.3%), and females 31(39.7%). According to signs and symptoms of patients with renal parenchymal disease shows that 32(9.2%) patients came with nausea, 16(4.6%) patients came with vomiting, 21(6.0%) patients came with the loss of appetite, 61(17.5%) patients came with fatigue and weakness, 21(6.0%) patients came with sleep problems, 45(12.9%) patients came with urinating more or less, 57(16.3%) patients came with muscle cramps, some of them like 19(5.4%) came with shortness of breath, 32(9.2%) came with dry itchy skin, 39(11.2%) patients came with swelling of feet and ankles and 6(1.7%) patients came with others, Table 1.

| Signs and Symptoms of patients | Frequency | Percent |
|---|---|---|
| Nausea | 32 | 9.2 |
| Vomiting | 16 | 4.6 |
| Loss of appetite | 21 | 6.0 |
| Fatigue and weakness | 61 | 17.5 |
| Sleep problems | 21 | 6.0 |
| Urinating more or less | 45 | 12.9 |
| Muscle cramps | 57 | 16.3 |
| Shortness of breath | 19 | 5.4 |
| Dry itchy skin | 32 | 9.2 |
| Swelling of feet and ankles | 39 | 11.2 |
| Others | 63 | 1.7 |
| Total | 49 | 100.0 |

**Table 1:** Classification of a subject according to signs and symptoms

Classification by clinical etiology of the renal parenchymal disease shows that 34(43.6%) patients came with diabetes mellitus, 21(26.9%) patients came with hypertension, 17(21.8%) came with diabetes and hypertension combined and 6(7.7%) patients came with unknown etiology, Table 2.

| Clinical history of patients | Frequency | Percent |
|---|---|---|
| Diabetes Mellitus | 34 | 43.6 |
| Hypertension | 21 | 26.9 |
| Diabetes and hypertension | 17 | 21.8 |
| Unknown etiology | 6 | 7.7 |
| Total | 78 | 100.0 |

**Table 2:** Classification by clinical etiology

Table 3 demonstrates the descriptive statistics of Blood urea (mg/dl) with the least value of 41.00, a higher value of 239.00, and a mean value of 92.17±46.9. Serum creatinine in male patients (mg/dl) was with the least value of 1.40, a higher value of 18.90, and a mean value of 6.87±6.2. Serum creatinine in female patients (mg/dl) was with the least value of 1.40, a higher value of 17.40, and a mean value of 5.50 ± 5.4. Blood urea nitrogen of patients was with the least value of 26.00, a higher value of 248.00, and a mean value of 50.17±33.7. Glomerular filtration rate was with minimum value 35.00, maximum value 220.00, and mean value 81.34±23.12.

| Descriptive Statistics | N | Minimum | Maximum | Mean+SD |
|---|---|---|---|---|
| Blood urea of patients (mg/dl) | 78 | 41.00 | 239.00 | 92.17+46.9 |
| Serum creatinine of male patients (mg/dl) | 47 | 1.40 | 18.90 | 6.87+6.2 |
| Serum creatinine of female patients (mg/dl) | 31 | 1.40 | 17.40 | 5.50+5.4 |
| BUN (Blood Urea Nitrogen) | 78 | 26.00 | 248.00 | 50.17+33.7 |
| GFR (Glomerular Filtration Rate) | 78 | 35.00 | 220.00 | 81.35+23.1 |

**Table 3:** Descriptive statistics of Blood chemistry

Table 4 demonstrates the frequencies of sonographic grading of renal cortical echogenicity with Grade 1 had 32(41.0%), Grade 2 28(35.9%), Grade 3 12(15.4%), and Grade 4 6(7.7%).

| Sonographic grading of renal cortical echogenicity | Frequency | Percent |
|---|---|---|
| Grade 1 | 32 | 41.0 |
| Grade 2 | 28 | 35.9 |
| Grade 3 | 12 | 15.4 |
| Grade 4 | 6 | 7.7 |
| Total | 78 | 100.0 |

**Table 4:** Sonographic grading of renal cortical echogenicity

# DISCUSSION

In the present study, out of 78 patients, the minimum age was 28.00 years, the maximum age was 83.00 years, and the mean age was 46.47±12.03 as mentioned by the study by Raju et al, with a mean age of 49.27±10.09 [21]. Another previously published study by Singh et al, also shows the mean age of 54.32±12.25. All of the above-mentioned previously published studies and the present study concluded that renal parenchymal disease is most prevalent in the elder age. In this study, the renal parenchymal disease is observed to be more common in males 47(60.3%), and less in females 31(39.7%) as stated by the study by Raju et al, that renal parenchymal disease is more common in male 63%, and less in female 37% [21]. Another previously published study by Singh et al, also shows that renal parenchymal disease is more common in males 58(58%), and less in females 42(42%) [10]. All of the above-mentioned previously published studies and the present study concluded that renal parenchymal disease is most prevalent in males. In the current study, the grading of renal parenchymal disease is made based on the sonographic appearance. In the current study, the frequencies of sonographic grading of renal cortical echogenicity with Grade 1 had 32(41.0%), Grade 2 28(35.9%), Grade 3 12(15.4%), and Grade 4 6(7.7%). Raju et al, designed a cross-sectional study "Role of renal sonography in the diagnosis of chronic kidney disease" published in 2018 with a sample size of 60 patients and had similar findings with 25 patients who had Grade 1 CKD, followed by 20 patients with grade 2 of CKD, 10 participants with grade 3 of CKD and only 5 patients had grade 4 of CKD [21]. Another study conducted by Singh et al, published in 2016 also presents similar findings as 35 patients who had Grade 1 of CKD, followed by 42 participants with grade 2 of CKD, 16 participants with grade 3 of CKD and only 7 participants had grade 4 of CKD [10]. These previously published studies and current study shows that Grade 1 of chronic kidney disease is most common in patients, followed by Grade 2, Grade 3, and Grade 4 is observed in the least number of patients. The present study shows that blood urea (mg/dl) with a mean value of 92.16±46.88, serum creatinine of male patients (mg/dl) with a mean value of 6.86±6.18, Serum creatinine of female patients (mg/dl) with mean value 5.50±5.36, and glomerular filtration rate with mean value 81.34±23.12. Similar findings were also observed in previously published studies by Raju et al, as the mean of serum creatinine is 3.36±2.12 and the mean of blood urea is 58.22±22.90 and Vinayaka et.al. mean of serum creatinine is 2.1±0.93 and glomerular filtration rate with mean value as 46.8±30.4 [21].

# CONCLUSION

Ultrasound can identify increased echogenicity and reduced cortical parenchymal thickness, as well as reduced renal size. The renal parenchymal disease is most prevalent in elder males. Grade 1 of chronic kidney disease is most common in patients, followed by Grade 2, Grade 3, and Grade 4 is observed in the least number of patients.

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