

# Ultrasonographic Characteristics of Chronic Kidney Disease: Analysis of 100 Cases at the University Hospital of Conakry

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## Abstract

Ultrasonography is the reference imaging modality for evaluating renal failure, whether acute or chronic, due to its simplicity, safety, and low cost. Chronic kidney disease (CKD), often silent and diagnosed at a late stage, leads to a progressive and irreversible reduction in renal size and function, with a prevalence that increases with age. In Guinea, no data are currently available. This study was therefore conducted to assess renal morphology and biometry in patients with chronic kidney disease. **MATERIALS AND METHODS:** This was a retrospective descriptive and analytical study conducted over a one-year period, from January 1, 2022, to December 31, 2022, in the radiology department of Donka National Hospital. The study included records of patients whose ultrasound findings were consistent with CKD during the study period. Files of patients whose ultrasound findings did not support a diagnosis of CKD were excluded. **RESULTS:** A total of 100 cases were collected, representing a frequency of 75%. The mean age was  $49.64 \pm 16.28$  years (range: 13–80 years). Males predominated with 59% of cases, yielding a sex ratio of 1.43. Nephrologists were the main prescribers (59%). The main indications were renal dysfunction (67%) and edema syndrome (37%). Most patients presented with a hyperechoic cortex (88%) and atrophic kidneys (71%). The mean values of right renal parameters were lower than those of the left kidney. Echographic stages II and III were the most common (35% and 58%, respectively). A statistically significant correlation was found between cortical hyperechogenicity and echographic stages ( $p = 0.0000$ ).

## Keywords

Chronic Kidney Disease, Renal Ultrasound, Renal Atrophy, Cortical

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## Echogenicity

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### 1. Introduction

From a diagnostic standpoint, chronic kidney disease (CKD) is primarily defined based on biological criteria, particularly a persistent decrease in the glomerular filtration rate (GFR) below 60 mL/min/1.73 m<sup>2</sup> for at least three months and/or the presence of urinary or histological abnormalities indicating structural renal damage [1]. Although ultrasound alone cannot establish the diagnosis of CKD, it plays a fundamental role in assessing morphological changes, determining the stage of disease progression, and guiding etiological evaluation. It therefore represents an essential complement to clinical and biological data in the overall management of CKD.

Ultrasound is the imaging modality of choice for evaluating renal insufficiency, whether acute or chronic. Its safety, availability, low cost, and ease of use make it an essential tool in nephrology. In most cases, ultrasound is the first, and often the only, imaging examination required in the assessment of chronic kidney disease. CKD is a chronic, progressive disease that is frequently asymptomatic in its early stages and is therefore often diagnosed late [2]-[4].

Its prevalence continues to rise, leading to significant human, medical, and socioeconomic consequences [5]. CKD is usually associated with a progressive and irreversible reduction in renal size and function. Its prevalence increases with age [6], and diabetic nephropathy and hypertensive/vascular nephropathy together account for more than 50% of cases of end-stage renal disease worldwide [7].

In France, Braley-Berthoumieux *et al.* (2014) reported renal ultrasound abnormalities in 10.6% of patients, including 7.7% hydronephrosis and 2.9% renal atrophy [8]. In Togo, Sabi *et al.* (2011) found renal atrophy in 56% of patients undergoing abdominal ultrasound, with 29.9% at stage II and 42.8% at stage III of CKD [9]. In Côte d'Ivoire, Zabsonré *et al.* (2001) reported that 81.1% of small kidneys corresponded to pre-terminal or terminal ultrasound stages (stages II or III) [10].

To our knowledge, no similar study has previously been conducted in Guinea. The absence of local data and the need to evaluate the diagnostic value of ultrasound in CKD motivated the present study.

### 2. Materials and Methods

This was a retrospective, descriptive, and analytical study conducted over a 12-month period, from January 1 to December 31, 2022. It included all renal ultrasound reports of patients with suspected or confirmed renal impairment recorded in the departmental database during the study period, regardless of age or sex.

Patients who underwent abdominal ultrasound examinations with conclusions

not suggestive of CKD, as well as incomplete patient files, were excluded.

Data were collected using a standardized data collection sheet including patient demographic characteristics, clinical indications, ultrasound technique, and sonographic findings.

#### Limitations

This study has certain limitations. Renal function was not assessed using estimated GFR or creatinine clearance. The evaluation focused exclusively on renal morphological features on ultrasound, which does not allow assessment of the functional severity of CKD. A more comprehensive assessment would require the integration of clinical, biological, and sonographic parameters.

#### Ethical Considerations

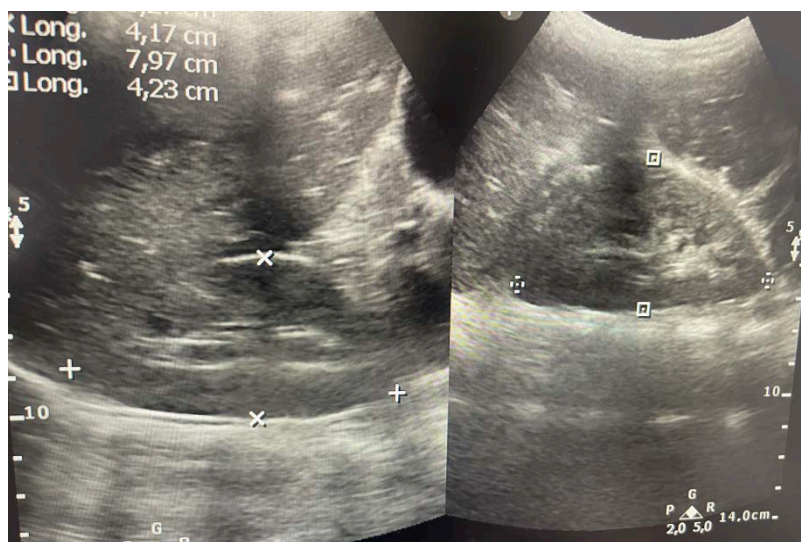
Although individual informed consent was not required due to the retrospective design, data were collected and analyzed with strict respect for confidentiality and anonymity. Authorization for this study was obtained from the department head and the medical imaging center administration.

#### Operational Definitions

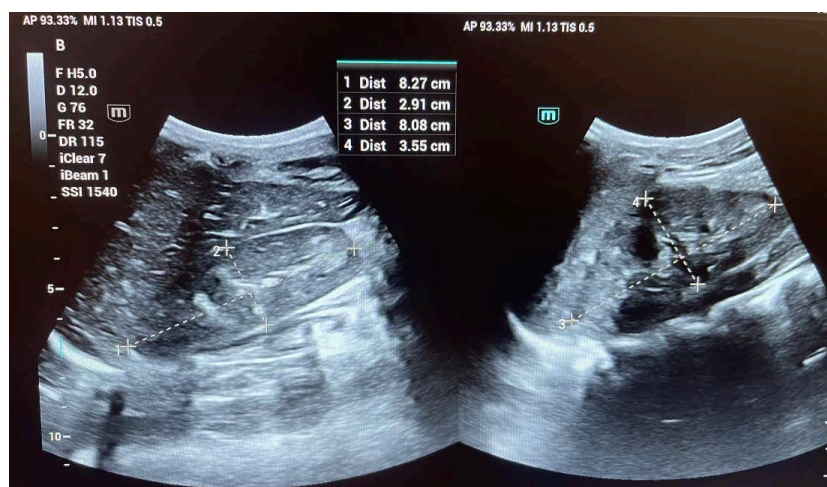
- **Renal atrophy:** longitudinal length < 85 mm, transverse diameter < 35 mm, or parenchymal thickness < 25 mm.
- **Cortical echogenicity:** hypoechoic, isoechoic, or hyperechoic relative to the liver.
- **Corticomedullary differentiation:** preserved or lost.

#### Ultrasound staging of CKD:

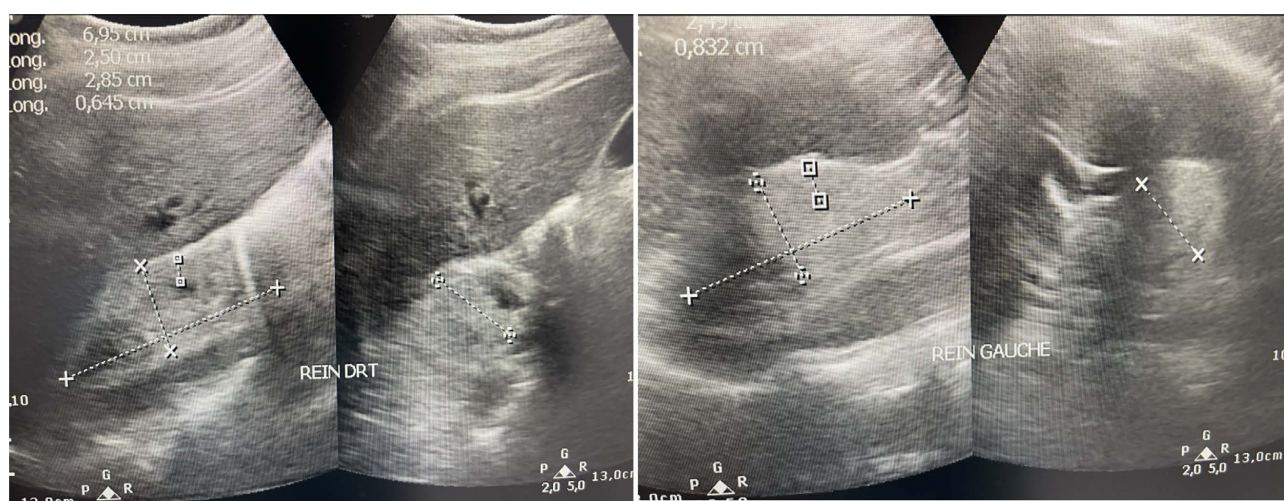
- **Stage 0:** Normal kidney; cortex hypoechoic relative to the liver.
- **Stage I:** Cortex isoechoic relative to the liver (**Figure 1**).
- **Stage II:** Cortex hyperechoic relative to the liver but still hypoechoic relative to the renal sinus, with preserved corticomedullary differentiation (**Figure 2**).
- **Stage III:** Cortex hyperechoic relative to the liver and isoechoic to the renal sinus, with loss of corticomedullary differentiation (**Figure 3**).



**Figure 1.** Cortex isoechoic relative to the liver.



**Figure 2.** Cortex hyperechoic relative to the liver but still hypoechoic relative to the renal sinus, with preserved corticomedullary differentiation.



**Figure 3.** Cortex hyperechoic relative to the liver and isoechoic to the renal sinus, with loss of corticomedullary differentiation.

### Statistical Analysis

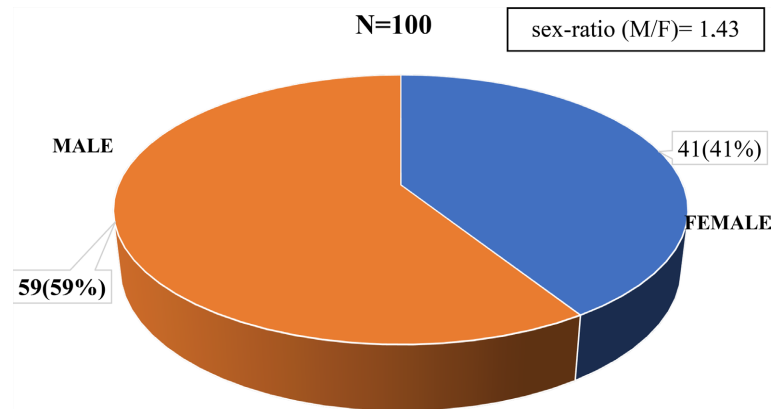
Data were entered and analyzed using Epi Info. Qualitative variables were compared using Fisher's exact test or Chi-square test. A p-value < 0.05 was considered statistically significant.

### 3. Results

During the study period, 132 patients underwent renal ultrasound examinations in the department. Among them, 100 patients were diagnosed with CKD, representing a proportion of 75%. Males accounted for 59% of cases and females 41%, corresponding to a sex ratio of 1.43 in favor of males (**Figure 4**). The mean age was  $49.64 \pm 16.28$  years, with extremes ranging from 13 to 80 years (**Table 1**).

The most affected age group was 58 - 72 years (28%, n = 28). Patients aged 13 - 27 years represented 11% (n = 11), while only 1% were older than 80 years. The unemployed and self-employed accounted for 38% (n = 38) and 44% (n = 44),

respectively. The most frequent cardiovascular risk factors were hypertension (24%, n = 24), diabetes (9%, n = 7), smoking (11%, n = 11), and advanced age ( $\geq 65$  years) (13%, n = 13). The main clinical manifestations included impaired renal function in 67% (n = 67) and lower limb edema in 35% (n = 35) (**Table 2**).



**Figure 4.** Representation of patients with CKD on ultrasound by sex.

**Table 1.** Distribution of patients with CKD on ultrasound according to age group.

Age group (years)	Frequency	Percentage(%)
13 - 27	11	11.00
28 - 42	26	26.00
43 - 57	27	27.00
58 - 72	28	28.00
73 - 79	7	7.00
$\leq 80$	1	1.00
<b>TOTAL</b>	<b>100</b>	<b>100.00</b>

**Table 2.** Distribution of CKD patients by ultrasound indications.

Ultrasound indications	Frequency (N = 100)	Percentage(%)
Impaired renal function	67	67.00
Edema/ascites	35	35.00
Exploratory workup	33	33.00
Oligo-anuria	31	31.00
Hypertension	24	24.00
Lower urinary tract symptoms	16	16.00
Diabetes	9	9.00
Lumbar mass	5	5.00
Other indications (abdominal pain, hepatomegaly)	5	5.00

Nephrologists were the primary prescribers of renal ultrasound (59%), followed by other specialists (25%) (**Table 3**). Renal atrophy was observed in 71 patients. Cortical hyperechogenicity was present in 88% of cases, inversion of the cortico-medullary echogenicity gradient in 4 patients, and equalization in 8 patients. Loss of corticomedullary differentiation was noted in all patients (100%) (**Table 4**). The mean longitudinal renal length was 83.7 mm (range: 45 - 145 mm) for the right kidney and 86.7 mm for the left kidney (range: 17 - 86 mm) (**Table 5**).

**Table 3.** Distribution of patients by prescribers.

Prescribers	Frequency	Percentage(%)
Nephrologist	59	59.00
Other specialties	25	25.00
General practitioner	16	16.00
<b>TOTAL</b>	<b>100</b>	<b>100.00</b>

**Table 4.** Renal cortex echogenicity.

Cortical echogenicity	Frequency	Percentage (%)
Hyperechoic	88	88
Echogenicity inversion	4	4
Echogenicity equalization	8	8
<b>TOTAL</b>	<b>100</b>	<b>100</b>

**Table 5.** Average renal parameters (mm).

Parameters (mm)	Right kidney		Left kidney	
	mean	Standard deviation	mean	Standard deviation
Height	83.74	17.82	86.72	17.75
Width	42.78	9.99	43.50	11.79
Thickness	36	10.72	37.61	11.40
Volume	62.30	21.86	65.55	33.42

CKD was classified as ultrasound stage III in 58% of cases, stage II in 35%, and stage I in 7% (**Figure 5**). Ascites was found in 36 patients, and hepatic or splenic abnormalities in 34 patients.

When both kidneys were present, the size reduction was generally bilateral, with preserved asymmetry. Only four patients had marked renal asymmetry. Among the five patients with increased renal size, three had bilateral hydronephrosis and one had bilateral polycystic kidney disease (**Table 6**).

Of the 67 patients with small kidneys, 30.99% were classified as stage II and 63.38% as stage III. Conversely, patients with normal-sized kidneys (8.33%) were

predominantly stage I. More than half of the patients with enlarged kidneys were classified as stage III (Table 7).

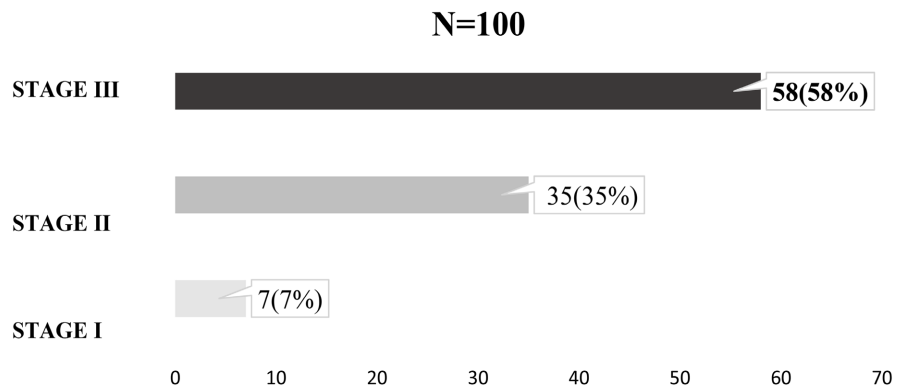


Figure 5. Representation of patients according to the ultrasound stages of CKD.

Table 6. Renal morphology.

Kidney morphology	Frequency	Percentage(%)
<b>Taille des reins</b>		
Kidney size increased	5	5.00
Kidney size decreased	71	71.00
Kidney size normal	24	24.00
<b>Contours</b>		
Irregular contours	2	2.17
Regular Contours	90	97.83
<b>Pyelocaliceal dilation</b>		
Pyelocaliceal dilatation absent	84	84.00
Pyelocaliceal dilatation present	16	16.00
<b>Corticomedullary differentiation lost</b>		
Yes	100	100.00
No	0	0.00

Table 7. Ultrasound CKD stages by age group. According to age, the proportion of subjects under 45 years of age significantly ( $p < 0.001$ ) increased from stage 0 to stage III.

Age	Stage I	Stage II	Stage III	Total
<65 yrs	5 (6.4)	25 (32)	48 (61.5)	78
>65 yrs	2 (9)	10 (45.4)	10 (45.4)	22
<b>Total</b>	<b>7</b>	<b>35</b>	<b>58</b>	<b>100</b>

#### 4. Discussion

Although ultrasound alone cannot establish the diagnosis of CKD, it plays a fun-

damental role in assessing renal morphological changes, determining the stage of disease progression, and guiding etiological investigation. It therefore constitutes an essential complement to clinical and biological assessment in the management of CKD.

The mean dimensions of the right kidney were smaller than those of the left. This finding is consistent with the results reported by Seyed A. [11] and Coulibaly J. [12]. Anatomically, this difference may be explained by the larger volume of the liver compared to the spleen, which exerts greater compression on the right kidney. Furthermore, the left renal artery is shorter and more direct than the right, which may lead to greater perfusion of the left kidney [13], predisposing the right kidney to greater atrophic changes in chronic renal disease.

The renal dimensions observed in our study are comparable to those reported by Coulibaly J. [12], but lower than those observed by Agboton BL *et al.* [13] in hemodialysis patients, which may be explained by the inclusion of end-stage renal disease cases in their study population.

We found a statistically significant association between cortical echogenicity and ultrasound staging. Most patients with hyperechoic cortex (88%) were classified as stage II (38%) or stage III (50%) ( $p < 0.05$ ). Similar findings were reported by Agoda-Koussema LK *et al.* [14], who found that 88.19% of patients were at advanced stages, and by N'Gbesso *et al.* [15], who reported that 93.60% of patients were classified as stage II or III. These observations support the role of cortical echogenicity as a key sonographic indicator of CKD severity.

Although no statistically significant association was found between renal size and ultrasound stage (Table 8), most patients with renal atrophy were classified as stage II or III. Likewise, no significant correlation was noted between cortical echogenicity and renal size; however, most patients with a hyperechoic cortex also had renal atrophy.

**Table 8.** Correlation between cortex echogenicity and ultrasound stages of CKD.

	Stage I	Stage II	Stage III
	0	30	58
<b>Hyperechoic</b>	0.00%	34.09%	65.91%
	0.00%	85.71%	100.00%
	4	0	0
<b>Echogenicity inversion</b>	100.00%	0.00%	0.00%
	57.14%	0.00%	0.00%
	3	5	0
<b>Echogenicity equalization</b>	37.50%	62.50%	0.00%
	42.86%	14.29%	0.00%

$\chi^2 = 77.27$ ; ( $p < 0.05$ ).

## 5. Conclusions

Renal ultrasound remains a key imaging modality for the evaluation and monitoring of chronic kidney disease. It is non-invasive, widely accessible, cost-effective, and provides valuable information on renal morphology and parenchymal alterations.

In our study, the majority of patients presented with reduced renal size, cortical hyperechogenicity, and loss of corticomedullary differentiation—findings characteristic of advanced CKD. These results highlight the crucial role of ultrasound not only in identifying structural damage but also in staging and monitoring disease progression, particularly in resource-limited settings.

Early referral for renal ultrasound may contribute to earlier diagnosis and improved management of chronic kidney disease in our population.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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