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COMMON SONOGRAPHIC PATTERNS OF KIDNEY DISEASES IN NNEWI –NORTH, ANAMBRA STATE, NIGERIA

Okpaleke, Michael Sunday[1], Akochi Favour Onyinyechi[1], Ikamaise Valentine[2], Anayo Okwo Christain[3]

[1]Department of Radiography, Nnamdi Azikiwe University,College of Health Sciences and Technology, Nnewi Campus , Anambra State, Nigeria.
[2]Department of Radiography, University of Calabar, Cross River state, Nigeria.
[3]Alex Ekwueme Federal University Teaching Hospital, Ebonyi State, Abakaliki, Nigeria

Corresponding author,
Dr Michael Sunday Okpaleke
Department of Radiography, Faculty of Health Sciences and Technology,
College of Medicine, Nnamdi Azikiwe University, Nnewi Campus, Anambra State

ABSTRACT

Background: Despite the increasing prevalence of kidney diseases in Nigeria, and the value of ultrasonography in the diagnosis of these diseases, there is a paucity of data on the sonographic patterns of kidney diseases peculiar to people in Nnewi North Anambra state, Nigeria.

Objective: The objective of this study was to document the common sonographic patterns of kidney diseases in Nnewi-North, Anambra state, Nigeria and to correlate certain Ultrasound detectable kidney diseases of patients with age and sex.

Methods: This study adopted a cross-sectional retrospective design. Secondary records from files, folders were retrieved from patient's records from the Radiography departments of Waves diagnostic center and Nnamdi Azikiwe University teaching hospital both in Anambra State, Nigeria. A total of 400 patients were reviewed from the health institutions between April 2020 and April 2021. The data were analyzed using descriptive and inferential statistics.

Results: Common kidney diseases were: hydronephrosis [74(17.8%)], nephrolithiasis [69 (17.3%)], renal cyst [39(9.8)], urolithiasis [9(75%)], renal parenchyma disease grade I [27(6.8%)], renal parenchyma disease grade II [12(3.0%)], renal parenchyma disease grade III [12(3.0%)],renal parenchyma disease grade I-II [6(1.5%)], renal parenchyma disease grade II-III [1(0.3)], nephritis [6(1.5%)], ectopic kidney [3(0.8)], polycystic kidney disease[9(2.3%)], pyelonephritis [14(3.5%)], nephrocalcinosis [29(7.2%)]. It was found out that normal patients had the highest occurrence [81 (21.3%)], the most prevalent kidney disease was hydronephrosis [74(17.8%)] and the least prevalent was renal parenchyma disease grade II-III [1(0.3%)]. The prevalence of hydronephrosis was seen more in male patients [42 (59.2%)] than their female counterparts [29 (40.8%)]. The subjects between the ages of 37-52 years were more likely to develop hydronephrosis than other age groups and also there was no significant relationship between kidney diseases and age. It is therefore recommended that Ultrasound should be used as the first line of diagnosis in kidney pathologies and suspected flank pain, because of its availability, cheapness, improved safety profile, and level of diagnostic accuracy.

Conclusion: Common sonographic patterns of kidney diseases were those of hydronephrosis, nephrolithiasis, and renal parenchyma diseases grade I-III predominantly among male subjects. Age and sex had no significant effect on sonographic patterns of kidney diseases.

Introduction

The kidneys are bean-shaped Organs, located on the right and the left hypochondriac region in the retroperitoneal space and in adults it measures about 11 centimeters (4.3 inches) in length [1]. They receive blood from the paired renal arteries and blood exits into the paired renal veins. Each kidney is attached to a ureter. Kidneys filter extra water and wastes out of the body and make urine. Kidney diseases are caused by diabetes type 2, high blood pressure, medications, cancer, cirrhosis, partial blockage in the urinary tract, and vesicourethral reflux. When kidneys are damaged, the kidneys cannot filter blood properly. This may lead to disease conditions such as chronic kidney diseases or renal failure [2].

Imaging modalities for diagnosing kidney diseases are: Computed tomography (CT), Magnetic Resonance Imaging (MRI) and Ultrasound machine. CT scan or computed tomography scan (formerly computerized axial tomography or CAT). Computed tomography makes use of computer-processed combinations of many X-ray measurements taken from different angles to produce cross-sectional (tomographic) images (virtual "slice") of a specific area of a scanned object, allowing the user to see inside the object without cutting. The 1979 Nobel Prize in Physiology or Medicine was awarded jointly to Allan M. Cormack and Godfrey N. Hounsfield "for the development of computer-assisted tomography". CT produces data that can be manipulated in order to demonstrate various bodily structures based on their ability to absorb the X-ray beam. Although historically, the images generated were in the axial or transverse plane, perpendicular to the long axis of the body, modern scanners allow this volume of data to be reformatted in various planes or even as volumetric (3D) representations of structures. Although most common in medicine, CT is also used in other fields such as nondestructive materials testing. Uses of CT have increased dramatically over the last two decades in many countries[3].

In recent years, CT has replaced the physical exam and plain X-ray in the evaluation of kidney disease. However, ultrasound has many advantages over CT scanning including shorter length of stay, lower cost, and improved profile[1]. Rosen and colleagues demonstrated a 147 minute reduction in length of stay when performing ultrasound in the place of CT for evaluation of renal colic. Furthermore, recent literature has increased physician awareness of the ill effects associated with ionizing radiation exposure from CT scans [2]. For these reasons, there is growing interest in the use of Ultrasound instead of CT for the evaluation of flank pain and nephrolithiasis [5].

Magnetic Resonance Imaging uses radio waves and magnets to make detailed pictures of the body's organs and soft tissues. These images can be seen in 3-D (3 dimensions). Magnetic Resonance Imaging does not use ionizing radiation (unlike X-rays or CT scans), it shows differences between normal and diseased tissues the images are clearer than with Computed Tomography, it does not typically need dye like with CT, certain settings will show different types of tissues, spot masses, and cystic structures. It can clearly show blood vessels. Limitations of routine Magnetic Resonance Imaging is that it does not work very well in the urinary tract, is expensive and its signals will not show calcifications in soft tissue and bladder abnormalities[3] except on susceptibility-weighted (S -W) MRI[4] which is not common in our locality. Also, in addition to being expensive, MRI and CT imaging are not readily available in most local settings in Nigeria. [4]

Ultrasound machine uses high frequency sound waves to look at organs and structures. It is a high-spatial-resolution modality that provides greater, high-level detail of a structure, especially when it is not too deep from the skin's surface. Ultrasound is like a flashlight that allows us to see high detail over a small area of tissue. It has many advantages as an imaging modality. Ultrasound does not use ionizing radiation; they are widely accessible and less expensive than other modalities [5] in our locality. Renal ultrasound is a non-invasive diagnostic examination that produces images, which are used to assess blood flow to the kidney. Ultrasound uses a transducer that sends out an ultrasound wave at a frequency too high to be heard. The ultrasound transducer is placed on the skin and the ultrasound waves move through the body to organs or tissues being examined. A kidney ultrasound may be used to assess the location, size, and shape of the kidneys and the related structure, such as the ureters and urinary bladder. Ultrasound can detect cysts, tumors, abscesses, obstructions, fluid collection, and infection within or around the kidneys. Calculi of the kidneys and ureters may be detected by ultrasound. A kidney ultrasound may be performed to assist in the placement of needles used to drain fluid from cyst or abscess or to place a drainage tube. This procedure may also be used to determine blood flow to the kidneys through the

renal arteries and veins. Kidney ultrasound may be used after a kidney transplant to evaluate the transplanted kidney[6].

Ultrasound (US) can be utilized in the evaluation of patients with suspected kidney pathology to diagnose causes of renal colic, renal failure, hematuria, and decreased urine output. Renal Ultrasound is becoming more commonly used and is considered a safe initial test in the evaluation of suspected kidney diseases. In practice, Ultrasound is commonly applied when the clinical suspicion for a kidney stone is high, and the concern for another etiology of flank pain, such as an abdominal aortic aneurysm (AAA), although stones in the kidney are easily visualized on ultrasound, when they pass into the ureter and cause pain they are often obscured by bowel gas and not readily seen. For this reason, the diagnosis of nephrolithiasis and renal colic on Ultrasound is often made by secondary findings such as hydronephrosis [7]. Ultrasound is often the first line of investigation for kidney diseases and the decision to proceed to secondary investigative procedures such as further radiological or histological examinations are frequently determined by the findings of the initial ultrasound scan. Increasingly, Ultrasound is also a reliable tool for more focused, complex examinations[7]. To this end, Mahmoud *et al,* (2011)[8] studied the incidence of kidney stones with topiramate treatment in pediatric patients to assess the incidence of nephrolithiasis in a group of children on topiramate (TPM) therapy for at least one year were recorded. They studied 96 children on topiramate with a mean age of 6.9 (±3.8) years were reviewed; 52 (54.2%) of the children were male. The follow–up Ultrasound showed that 5 children (5.2%) had developed kidney stones. The occurrence of kidney stones was found in five female patients (80%) vs. one male (20%). However, the findings of another related study opined that male subjects have a higher potential for some kidney conditions [9], The researchers studied the prevalence of renal cysts in both male and female adult subjects and concluded that renal cysts were more prevalent in men with reported male-to-female in the ratio of 4:1. Whereas these studies did not evaluate the accuracy of ultrasonography in the assessment of kidney diseases, the accuracy of ultrasound in the diagnosis of renal disease conditions has been found to be satisfactory [10]. This has been collaborated by Ganesan *et al,* (2017) [11] in a study to determine the accuracy of Ultrasonography for renal stone detention and size determination, They retrospectively identified all patients with a diagnosis of nephrolithiasis who underwent ultrasound followed by non-contrast computed tomography (CT) within 60 days. Data on patient characteristics, stone size (maximum axial diameter), and stone location were collected. A total of 552 US and CT examinations met the inclusion criteria. Overall, the sensitivity and specificity of Ultrasound were 54% and 91%, respectively. There was a significant association between the sensitivity of Ultrasound and stone size (P<.001).

However, despite the value of ultrasonography in the diagnosis of kidney diseases, there is a paucity of data on the sonographic pattern of kidney diseases peculiar to people in Nnewi North Anambra state,Nigeria. This study aims to identify the common sonographic patterns of kidney diseases in Nnewi town in order to provide baseline data for the diagnosis and management of kidney diseases in the locality.

Methods

This study adopted a cross-sectional retrospective design. Ethical approval for this study was obtained from the research and ethic committee of the Nnamdi Azikiwe University (approval no – NAU/FHST/2021/RAD105. The sample size of 384 was determined using the Cochrane formula (1963)[12]but this was increased to 400 to increase the statistical power[13]. The folders, files of these 400 patients were retrieved from the records of the Nnamdi Azikiwe University teaching hospital (NAUTH) and Waves diagnostic centers both in Anambra state, Nigeria for which the patients had provided informed consent as part of a prior research study. The study was conducted between April 2020 and April 2021. The age, sex, and sonographic reports of these patients were identified, grouped, and recorded. The data was analyzed using descriptive and inferential statistics.

Results

Four hundred subjects were recruited for the study aged 5 – 86 years and above. The majority of the subjects were between the age 37 - 52 years of age (table 1).

Table 1 Age distribution of the respondent

Age	Percentage (%)	Frequency
5-20 years	38	9.5
21-36 years	98	24.5
37- 52years	103	25.8
53-68 years	95	23.8
69-84years	54	13.5
86 years and above	12	3.0
Total	400	100.0

Male respondents constitute 53% while the female respondents constitute 47% in the population (table 2).

Table 2 Gender of the respondents

GENDER	FREQUENCY (%)
Male	212(53.0)
Female	188(47.0)
TOTAL	400(100)

The sonographic patterns of hydronephrosis were the most common pattern of kidney diseases constituting 17.8% while the sonographic patterns of renal parenchymal diseases grade ii-iii (0.3%) were the least (table 3).

Table 3: Common sonographic patterns of kidney diseases.

Kidney Diseases	Frequency
Normal	85(21.3)
Hydronephrosis	74(17.8)
Nephrolithiasis	69(17.3)
Hydronephrosis and Nephrolithiasis	13(6.7)
Renal cyst	39(9.8)
Nephro-calcinosis	29(7.2)
Nephritis	6(1.5)
Polycystic kidney disease	9(2.3)
Renal parenchyma disease grade i	30(6.8)
Renal parenchyma disease grade ii	7(1.0)
Renal parenchyma disease grade iii	18(3.0)
Renal parenchyma disease grade i-ii	6(1.5)
Renal parenchyma disease grade ii-iii	1(0.3)
Pyelonephritis	14(3.5)
Total	400(100)

Table 4 showed that the total number of hydronephrosis was the highest common sonographic pattern of kidney diseases while renal Parenchyma Disease grade II-III is the least.

Table 4 Gender distribution of the common sonographic patterns of kidney diseases.

Kidney diseases	**Male**	**%**	**Female**	**%**	**Total (%)**
Normal	43	(50.6)	42	(49.4)	85(100)
Hydronephrosis	42	(59.2)	32	(40.8)	74(100)
Nephrolithiasis	31	(44.9)	38	(55.1)	69(100)
Renal cyst	21	(38.5)	9	(61.5)	30(100)
Urolithiasis	9	(74.4)	3	(25.6)	12(100)
Nephro-calcinosis	10	(75.0)	19	(65.5)	29(100)
Nephritis	4	(33.3)	7	(66.7)	11(100)
Pyelo-nephritis	7	(50.0)	7	(50.0)	14(100)
Polycystic Kidney disease	4	(44.4)	5	(55.6)	9(100)
Renal parenchyma Disease grade I	17	(63.0)	10	(37.0)	27(100)
Renal Parenchyma Disease grade II	7	(100)	0	(0)	7(100)
Renal Parenchyma Disease grade III	3	(16.7)	1	(83.3)	11(100)
Renal Parenchyma Disease grade I-II	5	(50.0)	11	(50.0)	16(100)
Renal Parenchyma Disease grades II-III	6	(100)	0	(0)	6(100)
Total	209(53.2%)		184(46.8%)		393(100%)

Age correlated weakly with the common sonographic patterns of kidney diseases. Age had no significant correlation with the common sonographic pattern of kidney diseases (table 5).

Table 5: Relationship between age and kidney diseases

	Kidney diseases	p-value	N
Age	r=0.02	0.690	400

*r= spearman's correlation coefficient, *N= sample size

Sonographic patterns of	Age range in years						Total n(%)
Kidney conditions	5-20	21-36	37-52	52-67	68-83	>86	
Normal	10(11.8%	26(30.6%)	12(14.1%)	24(28.2%)	6(7.1%)	7(8.2%)	85(100%)
Hydronephrosis	4(5.6%)	18(25.4%)	23(32.4%)	11(15.5%)	14(19.7%)	1(1.4%)	74(100%)
Nephrolithiasis	7(10.1%)	20(29%)	18(26.1%)	19(27.5%)	4(5.8%)	1(1.4%)	69(100%)
Hydroneposis & Nephroliiasis	0(0%)	5(38.5%)	8(61.5%)	0(0%)	0(0%)	0(0%)	13(100%)
Renal cyst	5(12.8%)	2(5.1%)	8(20.5%)	13(33.3%)	11(28.2%)	0(0%)	39(100%)
Urolithiasis	0(0%)	4(33.3%)	4(33.3%)	2(16.7%)	2(16.7%)	0(0%)	12(100%)
Nephrocalcinosis	1(3.4%)	8(27.6%)	8(27.6)	6(20.7%)	5(17.2%)	1(3.4%)	29(100%)
Nephritis	0(0%)	1(16.7%)	4(66.7%)	1(16.7%)	0(0%)	0(0%)	6(100%)
Polycystic kidney	1(11.1%)	1(11.1%)	5(55.6%)	1(11.1%)	1(11.1%)	0(0%)	9(100%)
RPD Grade1	3(11.1%)	7(25.9%)	6(22.2%)	5(18.5%)	6(22.2%)	0(0%)	27(100%)
RPD Grade 11	0(0%)	1(25%)	0(0%)	2(50%)	1(25%)	0(0%)	4(100%)
RPD Grade111	3(25%)	3(25%)	0(0%)	3(25%)	1(8.3%)	2(16.7%)	12(100%)
RPD grade 1-11	1(16.7%)	0(0%)	2(33.3%)	3(50%)	0(0%)	0(0%)	6(100)
RPD Grade11-111	1(100%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1(100%)
Pyelonephritis	2(14.3%)	2(14.3%)	5(35.7%)	4(28.6%)	1(7.1%)	0(0%)	14(100%)

The sonographic patterns of hydronephrosis was predominant between 37-52 years (table 6)
Table 6: Age and sonographic patterns of kidney diseases

Discussion

We recruited 188 and 212 female and male volunteer subjects aged 5 - >86 years in the ratio of 1:1. There were 85 apparently healthy subjects and 315 volunteers with various kidney diseases/conditions (table 1). We observed that hydronephrosis 74(14.8%) was more prevalent in the population followed by nephrolithiasis 69(17.3%), renal cyst 39 (9.8), and renal parenchymal disease grade 1 respectively (Table 3). This can be attributed to the lifestyle of the people.

Hydronephrosis was more prevalent in male subjects than female subjects which is contrary to the findings of another study which opined that certain kidney diseases is more common in the female population than in the male population (Huda et al.,2012)[14]. In men, obstructive hydronephrosis especially among subjects between 37 years to 83years was predominant in the present study. One major cause of obstructive hydronephrosis in these age groups in south-eastern Nigeria is the changing patterns of prostate cancer [15]. According to the researchers [15], prostatic cancer is responsible for 56% of cases of urinary

retention and hydronephrosis among 145 men examined over a ten-year period in a study to ascertain the incidence and clinical patterns of prostate cancer in the South- Eastern states of Nigeria. As a result, obstructive hydronephrosis secondary to prostatic cancer may explain the high incidence of hydronephrosis in the male population in the present study. Another possible cause of the high incidence of hydronephrosis in males in this study can be attributed to excessive abuse of local gins and alcoholic drinks. This finding has been collaborated by Bundy J.D et al, 2018[16], wherein they found out that tobacco, alcohol, and illicit drug use causes chronic kidney disease. This was contrary to the finding of Yuan, Q et al,2011[17], where the researchers found out that preconditioning levels of ethanol protect the kidney against ischemia/reperfusion injury by modulating oxidative stress. The occurance of hydronephrosis in women in this study may be attributed to pregnancy and or fibroid. Fibroid is a predominant public gynecological disorder among women in Nnewi and other southeastern states of Nigeria like Enugu[18, 19] and is often associated with backpressure renal changes including hydroneprosis[20] similar to the findings of the present study. Similarly, hydronephrosis is usually seen in pregnancy often affecting the right maternal side and associated with the gradual increase in Pelvi-calyceal diameter throughout the period of pregnancy (Oyinloye 2010) [21].

We also found out that kidney diseases were more prevalent in male subjects than in female subjects in this study (Table 4). This may be attributed to gene expression in male subjects which makes them susceptible to kidney diseases than female subjects. This has collaborated in a related study on gender and the prevalence and progression of kidney diseases. The researchers found out that the Male gender is at a higher risk for the prevalence of diabetic nephropathy. They further stated that Sex hormones as a matter of fact affect several cellular processes directly or indirectly by regulating the production of cytokines, growth factors, and vasoactive agents. They concluded that estrogen has specific effects on extracellular matrix metabolism and transforms growth which may contribute to alterations in kidney hemodynamics and affect kidney disease progression in female subjects thereby making them less susceptible to chronic kidney diseases. However, this was contrary to the findings of another study which focused on the disparity in chronic kidney diseases prevalence among males and females in 195 countries which found out that the global burden of chronic kidney disease is more prevalent in female subjects compared to male subjects [22]. Other factors which dispose male subjects to kidney diseases in this study were attributed to lifestyle including diet and excessive intake of alcoholic drinks[16].

This study also found out that kidney diseases were more common in the adults and middle-aged group especially between 37-52 years (table 6). Also, the predominant kidney disease in this age group was hydronephrosis. However, in the present study, age does not have any significant correlation (table 5) with kidney diseases (r =0.020; P=0.690). This means that people of all ages in this locality should be mindful of kidney diseases as they can occur at any age. This finding has been collaborated by Elaine *et al*, 2019 [23], where the researchers opined that kidney diseases can occur at any age. Also, another related study had reported that renal deterioration and hydronephrosis can occur at any age but is more common as age increases[24] similar to the findings of the present study. Therefore, physicians should include routine medical checks for kidney function in the locality based on the prevalence of kidney diseases in the area. Also, the locals are advised to adopt a healthy diet and fluid intake to mitigate the menace of kidney diseases.

This research was to cover all hospitals and centers in Nnewi metropolis, Anambra state, southeast, Nigeria but due to poor documentation of patients result in some of the health facilities, it was limited to only one university teaching hospital and one private diagnostic and research center in Nnewi town. It is therefore recommended that patients request forms and clinical history should be properly completed on the clinical request forms. This should be documented properly either manually or electronically and relevant staff trained adequately. Considering the menace of hydronephrosis in the locality, we suggest that a more detailed study be conducted to ascertain the accuracy of ultrasound in the diagnosis of hydronephrosis in the locality with a view to creating awareness and ensure better diagnosis and management of the condition.

Conclusion

Common sonographic patterns of kidney diseases in the population studied were those of hydronephrosis, nephrolithiasis, renal cysts, nephrocalcinosis, and renal parenchyma disease grade 1 especially among male subjects. The most common sonographic pattern of kidney diseases

were those of hydronephrosis and nephrolithiasis. Age and sex had no significant effect on sonographic patterns of kidney diseases.

Conflict of interest- All the authors declare no conflict of interest

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