



Is There a Significant Renal Sonographic Difference between HIV/AIDS Positives and Negatives? A Developing Country Perspective

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Authors' contributions

This work was carried out in collaboration between all authors. Author CEO originated the study and performed the ultrasound scanning with author EOM. The statistical analysis was performed by authors CEO and OAA. All authors contributed to the conceptualization of ideas and interpretation of findings and reviewed the article. All authors read and approved the final manuscript.

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ABSTRACT

Background/Objectives: HIV/AIDS is a major health problem in the developing countries. It is a known cause of kidney failure especially in patients with HIV-Associated Nephropathy (HIVAN). Ultrasonography is a cheap and readily available imaging modality that is invaluable in evaluating the kidneys. Its value in pathological inference of HIV-associated renal diseases in developing countries is well known. Renal diseases in HIV/AIDS patients in developing countries are often underdiagnosed and often identified only at its end stage. In this study, we aim to identify, document and correlate the pre-intervention sonographic features of diseased kidneys of adult HIV/AIDS patients between the ages of 18 and 65 years.

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Methods: This study was conducted as a prospective & descriptive study to assess the sonographic features in kidneys of 219 HIV-seropositive adults aged between the ages of 18 and 65 years; matched (age & sex), with 219 controls. A 3.5-5.0 MHz curvilinear transducer on a mobile 'ALOKA' ultrasound machine was used in the study. Comparison of the findings between HIV-seropositive adults and the controls was done using the chi-square and student T-test analysis to determine any statistical significant difference.

Results: Of 219 HIV+ patients studied, 149(68%) were females with an overall mean age of 38.36 years. The modal age group was the 30 – 39 years with a frequency of 94(42.9%). Observed significant features of HIVAN include nephromegaly, increased parenchymal echogenicity and decreased corticomedullary differentiation.

Conclusion: The renal sonographic findings in HIV-seropositive research participants are similar to those from other studies within and outside Nigeria. Ultrasound can be a useful tool in the management and care of HIV/AIDS patients.

Keywords: HIV/AIDS; kidney; sonographic findings.

1. BACKGROUND

AIDS (Acquired Immunodeficiency Syndrome), caused by HIV (Human Immunodeficiency Virus), was first reported in the United States in 1981 and has since become a major worldwide epidemic [1]; the developing countries being more affected [2]. The first case of AIDS in Nigeria was reported in 1986 [3]. In line with World Health Organization guidelines, the Nigerian government adopted the ANC sentinel survey for assessing the epidemic. The survey data showed that the HIV prevalence increased from 1.2% in 1991 to 5.8% in 2001; with results from the last round of sentinel study showing the national prevalence to be 4.1% as at 2010 [4].

Similarly based on projected HIV estimates of 2013 about 3.3 million Nigerians now live with HIV. It is estimated that about 220,000 new HIV infections occurred in 2013; while a total of 210,031 died from AIDS. It is also estimated that about 1.5 million Nigerians with HIV required anti-retroviral drugs (ARV) in 2013 [4].

The regional picture showed that more than two-thirds (70%) of all people living with HIV, 25.8 million, live in the Sub-Saharan Africa –including 88% of the world's HIV positive children. In 2014 an estimated 1.4 million people in the region became newly infected. An estimated 790,000 adults and children died of AIDS, accounting for 66% of the world's AIDS death in 2014 [4].

The current statistics showed that nearly 37 million people around the globe are now living with HIV. About 2.6 million are under the age of 15 years. In 2014, an estimated 2 million people were infected with HIV. Of this population 220,000 were under the age of 15 years [4].

The kidneys are a common organ of predilection to HIV infection with end stage renal failure as the final outcome. HIV related renal diseases are common cause of morbidity and mortality in HIV/AIDS patients. HIV has been a known cause of kidney failure especially in patients with HIV-Associated Nephropathy (HIVAN).

The kidneys have also been established as a reservoir for HIV [5]. Distinct disease entities like HIV-associated nephropathy (HIVAN) have also been described [6-10]. Studies of the sonologic appearances in HIVAN have been correlated with histologic findings and shows that ultrasound alone is an acceptable single predictor of this disease. Based on this evidence, ultrasonography can be used solely to evaluate the kidneys especially in resource constrained environment like ours.

Ultrasonography as a cheap imaging modality will, therefore, be invaluable in evaluating the kidneys in our environment vis-à-vis the prevailing low socio-economic status of these patients. It is easy-to-perform, non-invasive and safe imaging technique that can also be used to guide biopsies needed for histological diagnosis. Ultrasonography is also widely available and, therefore, can be used to diagnose HIV-associated kidney problems especially in Nigeria where histopathological data is not easily available.

In this study, we aim to identify, document and correlate the pre-intervention sonographic features of kidneys of adult HIV/AIDS patients in Enugu, Nigeria. We hope to identify renal diseases common in HIV/AIDS patients and demonstrate if there is indeed any significant difference with general population (control).

2. MATERIALS AND METHODS

This descriptive study was conducted prospectively at the HIV Clinic and the Department of Radiation Medicine, University of Nigeria Teaching Hospital Ituku-Ozalla, between November 2009 and August 2010 among 219 consecutive HIV positive patients seen in the HIV Clinic and 219 HIV negative sex and aged matched individuals, recruited amongst patient relatives, hospital staff and students for control.

To be selected for the study, patient must be HIV seropositive (confirmed at University of Nigeria Teaching hospital using Western blot or double ELISA techniques); must be between 18 and 65 years of age and must be in pre-intervention HIV-seropositive state.

Patient below 18 years or above 65 years of age and who have been commenced on antiretroviral therapy were excluded from the study. Inclusion criteria for controls were HIV- seronegative, no evidence of background renal disease and age between 18 and 65 years. Patient and control ultrasonography was conducted by two radiologists simultaneously reviewing each participant using portable ultrasound equipment with 3.5 – 5.0 MHz curvilinear probe ('ALOKA' Unit Model SSD-500; SN 190605).

Informed consent and approval by the institution's Health Research Ethics Committee was obtained before commencement of the study. The subject's age, gender, occupation, weight and height were documented in the Study Data Sheet.

A sample size of 79 was calculated using the HIV/AIDS prevalence of 5.4% in Enugu as at the time of study. But a larger sample size of 219 was used for a better statistical relevance.

Ultrasonography was performed on each subject by first placing them in the supine position. The kidneys were examined longitudinally and transversely along the sagittal and transverse planes using anterior and lateral abdominal wall approaches. During the scanning process, the location, outline, shape, size, cortical thickness, parenchymal echogenicity and presence of any abnormality in the plane of the kidneys were noted, measured if applicable and recorded. The liver and spleen were used as acoustic window on the right and left sides respectively. These organs also enabled comparison of the echogenicity of the parenchyma of the respective kidneys.

The grading of the renal cortical echogenicity was done using the standardized score [11,12]. Grade 0 indicated that cortex is less echogenic than the liver; Grade I indicated that cortex is equally echogenic with the liver; Grade II indicated that cortex is more echogenic than the liver and Grade III indicated that cortex is equally echogenic with the renal sinus.

The kidney was described as large (nephromegaly) when the cephalocaudal dimension is more than 128 mm for the left and 125 mm for the right [13] while it is small when the cephalocaudal dimension is less than 80 mm.

Decreased or loss of corticomedullary differentiation is said to be present when the normal demarcation between the cortex and the relatively more hypoechoic medulla is not clear cut or completely absent.

Additional posterior approach with the patient lying prone was also employed in some cases for further characterization of the kidney appearance.

The presence of the following renal abnormalities was documented when present: nephromegaly; increased parenchymal echogenicity; loss of corticomedullary differentiation; renal mass lesions and irregularity of the outlines.

Electronic calipers were used for all measurements on the ultrasound machine.

The data obtained from scanning the research participants were initially recorded on a subject data sheet and then later transferred to a computer where it was stored throughout the duration of the study before statistical analysis. Patient names were anonymized and given a study code to protect patient confidentiality.

2.1 Limitation of the Study

Non-availability of Doppler facility on the ALOKA mobile unit to interrogate renal vasculature.

SPSS version 16.0 for windows software was used for analysis of the data. Discrete variables were expressed as percentages and comparison was by chi-square to determine any statistical significant difference between the patients and the controls. Continuous variables were expressed as mean \pm standard deviation and student T- test analysis was done for comparison. Two tailed p-value < 0.05 was considered significant.

3. RESULTS

There were 149 (68%) females and 70(32%) males out of 219 HIV+ patients (Fig. 3); the overall mean age was 38.36±9.027 year old. The modal age group was the 30-39 years with a frequency of 94 (42.9%) (Fig. 2). The mean age for the control group was 37.97±11.982 year old (range = 18-64 years).

3.1 Sonographic Findings

The renal sonographic findings in the study are summarized in Table 1. Nephromegaly was seen in 23(10.5%) HIV+ patients and 8 (3.7%) controls ($\chi^2 = 7.79$; $p = 0.005$). The increase in size were in lengths ($t = 7.60$; $p = 0.000$) and thicknesses ($t = 4.08$; $p = 0.000$). There was no significant difference in the widths of the kidneys in the two groups (Table 3).

A total of 24 (11%) HIV+ patients had increased renal parenchymal echogenicity in comparison with 12(5.5%) of the controls ($\chi^2 = 4.36$; $p = 0.036$). Decreased or absent corticomedullary differentiation was seen in kidneys of 24 (11%) HIV+ patients and 12(5.5%) controls ($\chi^2 = 4.36$; $p = 0.036$).

Of the 24 HIV+ patients with increased renal parenchymal echogenicity, 6 had enlarged kidneys while the remaining 18 patients had normal-sized kidneys.

The grading of renal cortical echogenicity using the standardized grading score [14,15] showed 195(89%) HIV+ patients and 207(94.5%) controls having Grade 0 echogenicity ($\chi^2 = 4.36$; $p = 0.037$). Grade I echogenicity was seen in 17(7.8%) HIV+ patients and 10(4.6%) controls while 5(2.3%) HIV+ patients and 2(0.9%) controls had Grade II echogenicity. Grade III echogenicity was seen in 2(0.9%) HIV+ patients and none were seen in the control.

Of the 219 HIV+ patients, only 7(3.2%) had renal mass lesions (6 cases of cortical cysts and a case of renal calculi) whereas 12(5.5%) of the controls had mass lesions (8 cases of cortical cysts, 3 cases of renal calculi and a case of hypoechoic sinus mass).

There were 7(3.2%) HIV+ patients and 4(1.8%) controls that had irregular renal outlines with no significant difference.

4. DISCUSSION

HIV/AIDS is a major public health problem in sub-Saharan Africa including Nigeria. It has caused and is still causing a lot of havoc in the lives of its victims and by extension the economic and social aspects of the society. Most health institutions in Nigeria and other sub-Saharan African countries lack adequate equipment to effectively evaluate HIV/AIDS patients and the complications that often arise from the condition.

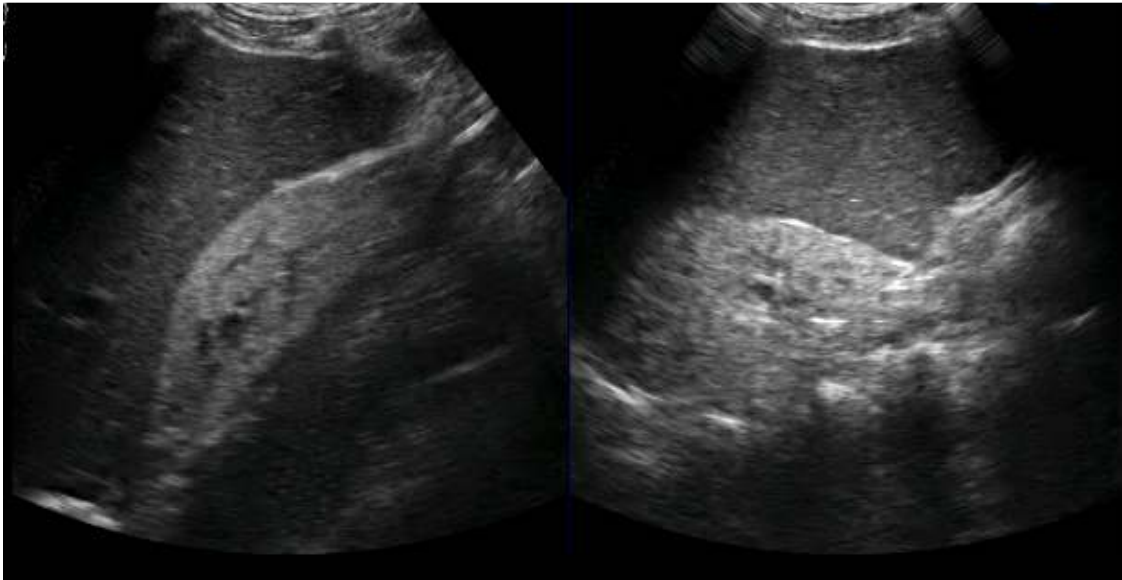


Fig. 1. HIV Nephropathy – bilateral echogenic kidneys in a 26 year old male

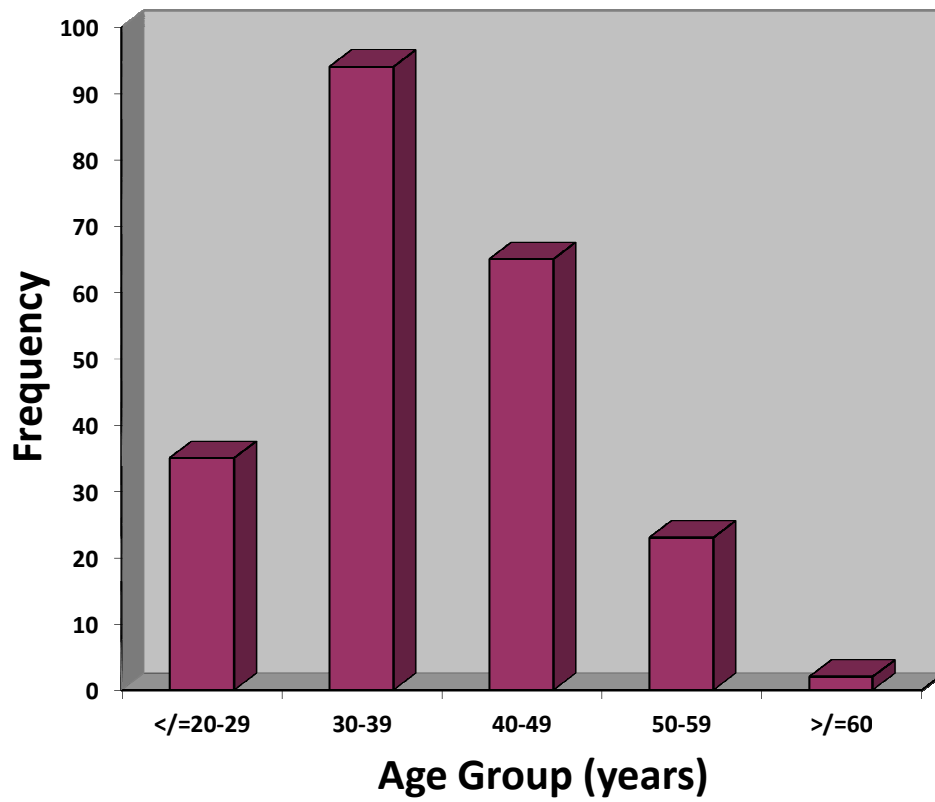


Fig. 2. Age group distribution of 219 HIV-positive patients

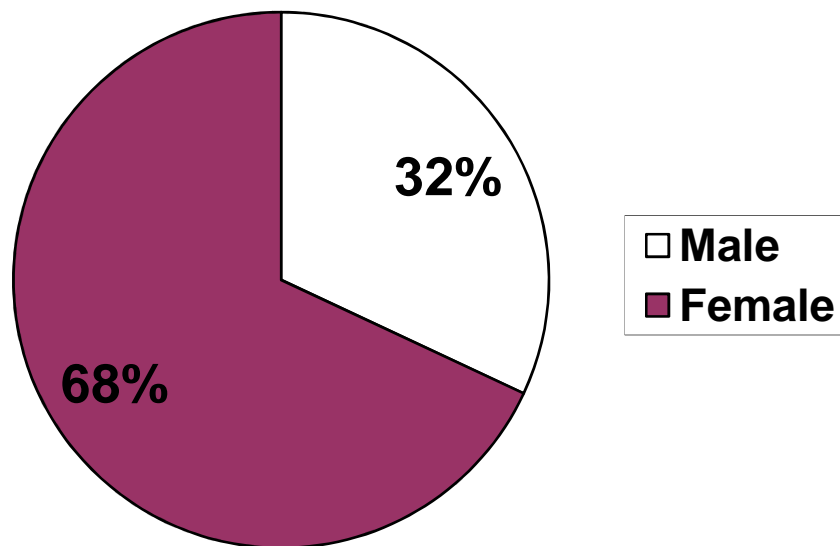


Fig. 3. Sex distribution of 219 HIV-positive patients

Table 1. Summary of renal sonographic findings in 219 HIV+ and 219 HIV-research participants

Sonographic findings	HIV+ patients (N=219)		HIV- control (N=219)		χ^2 -value	P-value
	Frequency	Percent (%)	Frequency	Percent (%)		
Nephromegaly	23	10.5	8	3.7	7.79	0.005*
Increased parenchymal echogenicity	24	11.0	12	5.5	4.36	0.036*
Decreased or lost corticomedullary differentiation	24	11.0	12	5.5	4.36	0.036*
Mass lesions	7	3.2	12	5.5	1.38	0.241
Irregular outline	7	3.2	4	1.8	0.84	0.360

* = Statistically significant; NB: Since some patients had more than one finding, the total frequency is greater than the number of patients

Table 2. Renal cortical echogenicity of 219 HIV+ and 219 HIV-research participants using standardized grading score [14,15]

Cortical echogenicity	HIV+ patients (219)		HIV- control (219)		χ^2 -value	P-value
	Frequency	Percent (%)	Frequency	Percent (%)		
Grade 0	195	89.0	207	94.5	4.36	0.037*
Grade 1	17	7.8	10	4.6	1.93	0.164
Grade 2	5	2.3	2	0.9	1.31	0.253
Grade 3	2	0.9	0	0	2.01	0.156

* = Statistically significant

This study highlighted renal sonographic findings that may help in achieving working diagnosis. An empirical treatment can thus be commenced especially in this environment where cost may preclude definitive tissue diagnosis.

Females constituted 68% of 219 HIV+ patients studied with 32% males and an overall mean age of 38.36±9.027 years. The preponderance of females agrees with the findings by Obajimi et al. [14]. This could be due to the fact that HIV/AIDS is more prevalent among females and this in line with our own findings [2]. This finding is contrary to another study by Tshibwabwa et al. [15] that showed a higher male prevalence with no obvious explanation and a lower mean age.

The association between renal abnormality and HIV infection has been established since the early days of the disease. Rao et al. [16] in 1984, described progressive nephropathy in adults with HIV/AIDS, characterized by proteinuria and renal failure. HIV-associated nephropathy may develop in patients with asymptomatic HIV infection, AIDS-related complex or AIDS [9]. The sonographic correlates of this disease are nephromegaly and increased cortical echogenicity [10,17].

In this study, nephromegaly was seen in 23 HIV-positive patients ($p = 0.005$). Increased parenchymal echogenicity was also seen in 24 HIV-positive patients ($p = 0.036$). These agree with the study by Obajimi et al [14] which showed that the number of HIV+ patients with nephromegaly and increased cortical echogenicity was more than double the number of the controls. A number of studies outside Nigeria have also shown nephromegaly and increased cortical echogenicity in HIV+ patients [18-22].

Only 24% of HIV+ patients with increased parenchymal echogenicity had nephromegaly, the remaining patients had normal-sized kidneys. This also agrees with the study by Obajimi et al. [14] that noted increased parenchymal echogenicity in normal-sized kidneys. However, this contrasts with some other studies [23-25] which found nephromegaly to be associated with HIV-nephropathy and reported to be most common among black males [22]. The higher female prevalence in the present study group may have accounted for this observation i.e. increased parenchymal echogenicity without concurrent nephromegaly.

Table 3. Renal measurements of 219 HIV+ and 219 HIV-research participants

Renal dimensions	Right kidney				Left kidney			
	HIV+	HIV-	t-value	P-value	HIV+	HIV-	t-value	P-value
Length	Mean ± SD 10.87±1.00	Mean ± SD 10.48±1.57	3.10	0.002*	Mean ± SD 11.28±1.05	Mean ± SD 10.56±0.93	7.60	0.000*
AP diameter	4.08±0.52	4.10±0.64	0.36	0.720	4.34±0.61	4.29±0.65	0.83	0.407
TS diameter	5.77±0.60	5.61±0.57	2.86	0.004*	5.99±0.87	5.70±0.59	4.08	0.000*

* = Statistically significant; AP = Anteroposterior; TS = Transverse

In the study, it was noted that enlarged kidneys in HIV+ patients were generally due to increase in thickness and length rather than width when compared with the control. This is partly in agreement with the study by N'Gbesso et al. [21] which showed that enlarged kidneys were generally due to increased thickness rather than length or width.

Decreased or absent corticomedullary differentiation was observed in 11% of HIV+ patients ($p = 0.036$). This is in keeping with a study by Di Fiori et al. [20] which noted decreased corticomedullary definition in 38% of cases studied.

5. CONCLUSION

Sonographic findings in kidneys of adult HIV/AIDS patients in UNTH Enugu include nephromegaly, increased parenchymal echogenicity and decreased corticomedullary differentiation. These findings are similar to findings in other studies within and outside Nigeria. Ultrasound, in the hand of an experienced sonologist, will be of immense help in the management and care of these patients especially in developing countries, where histopathological assessment is limited. However, providing adequate histopathologic correlation would improve the quality of sonographic diagnosis and treatment of HIV/AIDS patients.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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