Echocardiographic Study of Left Ventricular Function in HIV-Infected Nigerians

Kelechukwu Uwanuruochi, B J Onwubere[1], B C Anisiuba[1]

Departments of Medicine, Federal Medical Centre, Umuahia, Abia, [1]Medicine, University of Nigeria Teaching Hospital, Enugu, Nigeria

Correspondence: Dr. Kelechukwu Uwanurochi, Department of Medicine, Federal Medical Centre, Umuahia, PMB 7001, Nigeria.
E-mail: kcgrace2002@yahoo.com

ABSTRACT

Context: Left ventricular function in HIV/AIDS patients from South-East Nigeria has not been reported. **Aims:** We sought to determine the prevalence and spectrum of left ventricular function abnormalities in patients with HIV infection in the University of Nigeria Teaching Hospital (UNTH), Enugu, South-East Nigeria. **Settings and Design:** This was a descriptive, cross-sectional study of patients with HIV/AIDS at UNTH, Enugu from September 2006 to July 2007. **Methods and Material:** Sixty-six HIV-infected patients being managed at the antiretroviral therapy clinic and who had no other cardiovascular risk factor other than HIV infection were consecutively recruited. They were matched for sex, and age with seronegative healthy controls. Clinical and echocardiographic evaluation was carried out to assess the left ventricular function. **Statistical Analysis Used:** The findings were analyzed with statistical package for social sciences (SPSS) version 10.0. **Results:** The patients consisted of 29 males and 37 females aged between 23 and 62 years. Left ventricular systolic dysfunction was identified in 9 (13.6%) of 66 HIV-infected patients and 1 (4.3%) of 23 controls ($P = 0.201$) while left ventricular diastolic dysfunction (reversed fi lling pattern) was identifi ed in 19 (28.8%) and 3 (13.0%) of the HIV-infected patients and controls, respectively (0.021). Left ventricular hypertrophy was seen in 2 (3.0%) patients but in only 1 (4.3%) control ($P = 0.647$), while left ventricular dilatation was absent in all the patients and controls. **Conclusions:** Systolic function does not vary significantly between our patients with HIV/AIDS and sero-negative controls. This calls for further investigation of cardiac function in Nigerian HIV/AIDS patients.

Key words: Echocardiographic; HIV-infected Nigerians; left ventricular function

Introduction

Cardiac involvement did not feature prominently in the early stages of the HIV epidemic. It was first reported by Austran *et al*. in 1983.[1] However, over the years, there has been a clear and growing body of evidence for cardiac dysfunction in a significant proportion of HIV patients.[2,3] Most studies have come from Europe and North America. Okeahialam and Anjorin[4] in Jos have reported 9% of AIDS patients being in overt congestive cardiac failure while Ige *et al*.,[5] has also reported that systolic dysfunction is significantly more frequent in HIV-infected children. A few other studies have also been conducted in Nigeria.[6,7] There has been no published report from South-East Nigeria. Our study sought to verify the pattern and prevalence of echocardiographic left ventricular function abnormalities in our local HIV population.

Access this article online	
Quick Response Code:	Website: www.wajradiology.org
	DOI: 10.4103/1115-1474.146145

Materials and Methods

This was a descriptive and a cross-sectional study of patients with HIV/AIDS seen at the clinics and wards of University of Nigeria Teaching Hospital (UNTH), Enugu, from September 2006 to July 2007. UNTH is a tertiary hospital located in Enugu, the regional capital of the former Eastern region and presently the capital of Enugu state. Enugu is an educational, governmental, industrial and trade centre located at the foot of the Udi Plateau at the intersection of roads from Aba, Onitsha and Abakaliki. UNTH receives referrals from the entire South-eastern and neighboring states.

Ethical review: The project was reviewed and approved by the University of Nigeria Teaching Hospital Ethical Committee.

Sample size: Applying Fisher's formula[8], $n = z^2pq/d^2$, with n = minimum sample size, z = 95% confidence

level i.e. 1.96, and using level of precision (d) as 0.075,[9] P = maximum prevalence reported in a study of a similar population[10] (13.6%), and q = 1-p, a minimum sample size of 80 was obtained.

Patient selection: Patients aged 15 years and above with confirmed HIV-positive serology were eligible. The patients were recruited prior to commencement of anti-retroviral therapy. The exclusion criteria included all patients that had medical history of cardiovascular disease, patients who were on medications with cardiovascular effects, patients that were pregnant or in the puerperal period, patients who smoked or abused alcohol and those who had diseases that affect the cardiovascular system.

Clinical evaluation: The clinical evaluation and collection of samples were carried out at the antiretroviral therapy clinic of UNTH, Enugu. Patients were invited to participate in this cross-sectional study. Study subjects were interviewed by the investigator using a standard proforma to obtain demographic data and clinical history including history of hypertension, diabetes, among other risk factors. Physical examinations including blood pressure measurements using a standard sphygmomanometer (ACCOSON: cuff 12 × 25 cm) was carried out. HIV screening (by enzyme immunoassay), confirmatory (by Western-Blot electrophoresis), fasting blood sugar and CD4 cell counts of patients were part of investigations for patients benefiting from the antiretroviral therapy scheme. The CD4 cell counts were obtained using the flow cytometry method. Control cases of similar age and sex distributions were recruited from member of the hospital community and among those undergoing medical fitness screening. Echocardiography was done using the Hewlett-Packard SONOS 2000 machine and transducer of frequency 3.5 MHz. M mode, 2-dimensional, pulsed wave and continuous wave Doppler assessment was done with the subject in the left lateral position. Measurements were taken according to guidelines for two-dimensional echocardiography of the American Society of Echocardiography Committee on Standards.[11] The parasternal long axis (PLA) view was taken at third or fourth intercostal spaces. The M-mode tracing of the left ventricle was obtained from the PLA view with the cursor at a level just below the mitral valve leaflets. Doppler recording was obtained with the sample volume located between the tips of mitral leaflets. Parameters that were measured include the aortic root diameter, left atrial diameter, left ventricular end-diastolic dimension, left ventricular end-systolic dimension, septal wall thickness, posterior wall thickness, left ventricular isovolumic relaxation time, left ventricular deceleration time, and peak velocities of early (E) and late (A) ventricular filling. Using standard criteria[11], the following measurements were derived: Left ventricular end-diastolic volume, Left ventricular end-systolic volume, Stroke volume, Ejection fraction, Fractional shortening, Left ventricular mass, Left ventricular mass index and Early to late diastolic peak velocity ratio.

Standardized criteria for defining abnormalities

For left ventricular hypertrophy, a partition value of 125 g/m^2 was used for men and 110 g/m^2 for women.[12]

Isolated (without dilatation) left ventricular systolic dysfunction was diagnosed in the presence of fractional shortening of less than 28% and normal left ventricular dimensions.[13]

In this study, diastolic dysfunction was diagnosed as impaired relaxation with an E/A ratio < 1. Note must however be taken that the various indices of LV diastolic function have incremental value and utilization of multiple parameters is therefore desirable in the assessment of LV diastolic dysfunction.[14]

Statistical analysis

We analyzed our data using the Statistical Package for Social Sciences (SSPS) version 15. The level of significance was $P < 0.05$.

Results

A total of 89 individuals made up of 51 (57.3%) females and 38 (42.7%) males took part in the study. The demographic and clinical features of the subjects and controls are described in Table 1.

The gender distribution of the study population is described in Table 2.

Comparison of echocardiographic parameters between the study subjects and the controls is shown in Table 3, while spectrum of left ventricular abnormalities is given in Table 4. Sample of the echocardiographic images obtained are shown in Figures 1 and 2. The CD4 count results were obtained for 45 patients. The count ranged from 6.00 to 1293.00/µl with a mean of 202.67 ± 225.29/µl. T-cell lymphocyte subset was analyzed for the patients. Systolic and diastolic function was compared across the subsets. There was increased fractional shortening and impaired relaxation in both CD4 subsets compared to seronegative controls [Table 5]. When correlated, e/a ratio significantly correlated with the pulse (r = -0.305, P = 0.006).

Discussion

The observed hemodynamic differences between our patients and the seronegative controls could be attributed to sepsis from immunosuppression and dehydration from chronic diarrhea. Excessive sympathetic stimulation from autonomic imbalance, increased metabolic demand in febrile illnesses and myocarditis would also all contribute to an increase in pulse rate.[4]

In all, 13.6% of our patients had systolic dysfunction unlike 4.3% of controls but this was not statistically significant. In a

Table 1: Demographic and clinical features of study population

Parameter	Subjects	Controls	*t*	Sig.
Age	33.75±7.04	30.43±10.29	1.686	0.096
Height	1.65±0.076	1.63±0.083	1.339	0.184
Weight	55.45±10.64	64.85±14.66	−3.272	0.002
BMI	20.39±3.87	24.39±3.53	−4.306	0.000
BSA	1.58±0.18	1.75±0.25	−3.216	0.002
Systolic BP	111.68±14.33	119.05±11.43	−2.128	0.036
Diastolic BP	74.80±9.68	74.52±10.11	0.111	0.912
Pulse	99.20±22.72	75.95±14.98	4.364	0.000
Respiratory rate	24.54±6.95	24.50±4.35	0.021	0.983

BMI=Body mass index, BSA=Body surface area, BP=Blood pressure

Table 2: Gender distribution of study subjects

Gender	Cases	Control	Sig	Chi-square
Male	29	9	0.767	0.088
Female	37	14		
Total	66	23		

Table 3: Comparison of echocardiographic parameters

Parameter	Cases	Controls	*t*	*P*
ao	2.68±0.43	2.53±0.36	1.409	0.163
lad	3.33±0.64	3.33±0.48	−0.014	0.989
pw	0.67±0.19	0.66±0.21	0.206	0.837
ivs	0.74±0.22	0.75±0.22	−0.187	0.852
lvedd	4.31±0.56	4.92±0.65	−4.273	0.000
lvesd	2.63±0.63	3.20±0.57	−3.804	0.000
lvmi	100.22±43.32	129.99±61.33	−2.402	0.019
fs	39.37±11.06	35.19±6.62	1.701	0.093
efr	60.34±14.65	57.99±10.09	0.710	0.480
e/a	1.17±0.37	1.45±0.49	−2.784	0.007
dt	35.01±59.49	7.93±25.90	2.105	0.038
ivrt	27.60±44.37	10.08±33.96	1.712	0.091

ao=Aortic root diameter, lad=Left atrial diameter, pw=Posterior wall thickness, ivs=Septal wall thickness, lvedd=Left ventricular end-diastolic dimension, lvesd=Left ventricular end-systolic dimension, Lvmi=Left ventricular mass index, fs=Fractional shortening, efr=Ejection fraction, e/a=Early to late diastolic peak velocity ratio, dt=Left ventricular deceleration time, ivrt=Left ventricular isovolumic relaxation time

Table 4: Spectrum of left ventricular function abnormalities

Features	HIV/AIDS (*n*=66)	Controls (*n*=23)	χ^2	*P*
Left ventricular hypertrophy	2	1	0.210	0.647
Systolic dysfunction	9	1	1.193	0.201
Diastolic dysfunction	19	3	3.383	0.021
Left ventricular abnormality	26	3	4.800	0.028

HIV=Human immunodeficiency virus, AIDS=Acquired immunodeficiency syndrome

recent report, Danbauchi *et al*.,[15] found systolic dysfunction in 19 of 40 patients with stage III/IV HIV/AIDS. The higher prevalence in their study is expected considering that they reviewed patients at the later stages of the clinical profile.

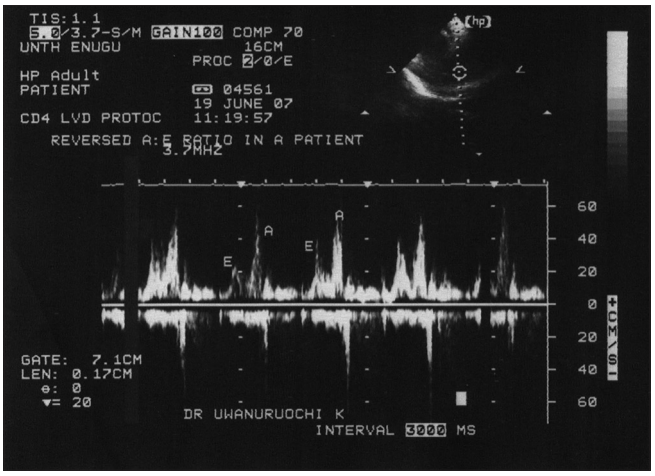

Figure 1: Reversed A:E ratio in a patient

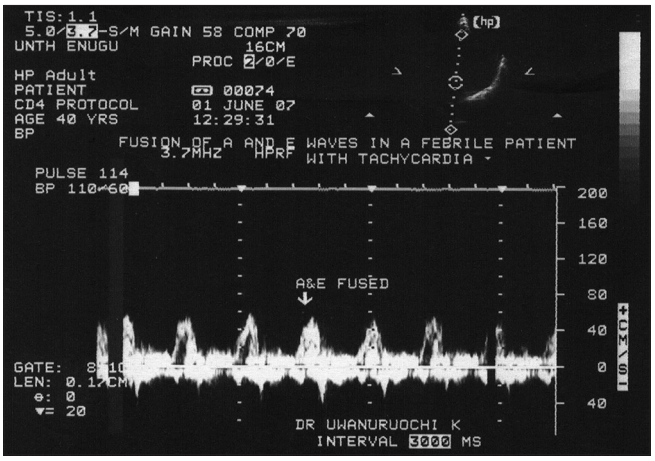

Figure 2: Fusion of A and E waves in a febrile patient with tachycardia. (Note pulse 114/minute)

Some other workers have reported wide-ranging figures for systolic dysfunction, such as 6.5% prevalence noted by Cardoso and colleagues[16] and 85.7% prevalence reported by Longo-Mbenza and colleagues.[17] The differences may be attributed to differences in characteristics of the study population and in definition of cardiac abnormality.

Diastolic dysfunction was noted in 28.8% of HIV-infected patients. On a similar note, Danbauchi *et al*.,[15] observed that 12 of 40 patients (30%) with stage III HIV/AIDS had diastolic dysfunction. Longo-Mbenza *et al*.,[18] from Congo found diastolic dysfunction in 85.7% of patients with HIV infection. Tachycardia has been noted to reduce compliance[19], and this is likely to be the major mechanism by which ventricular filling is impaired in HIV/AIDS.

The lack of systolic dysfunction in many of our patients is explained by increased cardiac contractility in many patients, driven by increase in sympathetic activity due to attendant problems of anemia, dehydration from diarrhea, and fever. A sample echocardiographic image of such a

Table 5: Systolic and Diastolic function parameters compared across CD4 subsets and Controls

Parameters	T-cell lymphocyte subsets		Controls (No=23)	*F*	*P*
	CD4<200 (No=26)	CD4>200 (No=19)			
efr	63.98±14.21	63.47±11.02	59.08±10.47	0.171	0.316
fs	41.73±10.66	41.73±10.26	35.54±6.63	03.449	0.038
e/a	1.15±0.36	1.18±0.32	1.44±0.49	3.874	0.026

patient. Hyperdynamic left ventricular performance with enhanced contractility in patient subsets has also been reported by Lipshultz *et al*.[20] Of course with progression of disease and ongoing infections, it is expected that some patients will go on to develop cardiomyopathy with impaired contractility.

Overall, the prevalence of left ventricular function abnormalities in this study was 39% in HIV/AIDS and 13.0% in control group. Prevalence rates have varied in different reports, depending not only on the population studied but also on the definition of cardiac abnormality as well as method of patient assessment. Herskowitz *et al*.,[21] from Maryland in the United States reported a prevalence rate of 17.5% but this did not include patients with diastolic dysfunction. Levy *et al*.,[22] in Washington on the other hand reported a 23% prevalence of left ventricular dysfunction among AIDS patients. Their definition of left ventricular dysfunction, however, included left ventricular dilatation as well as hypokinesia.

The 13.0% prevalence rate in our controls is not surprising as Longo-Mbenza *et al*.,[18] also found 13.8%, 6.9%, and 3.5% prevalence rates for diastolic dysfunction, left ventricular hypertrophy and ventricular dilatation, respectively, in their seronegative control population.

Limitations

Diagnosis of diastolic dysfunction was based on E/A ratio. Color Doppler was not used in this study. These are limitations on the assessment of LV diastolic dysfunction. The exclusion criteria also did not include the use of herbal medications, some of which have cardiovascular side effects.

Conclusion

We report on the left ventricular function in HIV/AIDS patients seen in Enugu, South-East Nigeria. The prevalence of echocardiographic abnormalities compared to age- and sex-matched controls were 13.6% versus 4.34% for left ventricular systolic dysfunction (P = 0.201), 28.8% versus 23.04% for left ventricular diastolic dysfunction (0.021), 3.0% versus 4.34% for left ventricular hypertrophy (P = 0.647) and 39.4% versus 13.04% for overall left ventricular abnormalities (P = 0.028). Left ventricular dilatation was absent in our patients.

References

1. Austran B, Gorin I, Leibowitch M, Laroche L, Escande JP, Hewitt J, *et al*. AIDS in a Haitian woman with cardiac Kaposi's sarcoma and Whipple disease. Lancet 1983;1:767-8.
2. Barbaro G. Cardiovascular Manifestations of HIV infection. J R Soc Med 2001;94:384-90.
3. Rerkpattanapipat P, Wongpraparut N, Jacobs LE, Kotler MN. Cardiac manifestations of acquired immunodeficiency syndrome. Arch Intern Med 2000;160:602-8.
4. Okeahialam BN, Anjorin FL. Echocardiographic study of the heart in AIDS. The Jos experience. Trop Card 2000;26:3-6.
5. Ige OO, Oguche S, Bode-Thomas F. Left ventricular systolic function in Nigerian children with human immunodeficiency virus infection. Congenit Heart Dis 2012;7:417-22.
6. Olusegun-Joseph DA, Ajuluchukwu JN, Okany CC, Mbakwem AC, Oke DA, Okubadejo NU. Echocardiographic patterns in treatment-naïve HIV-positive patients in Lagos, south-west Nigeria. Cardiovasc J Afr 2012;23:e1-6.
7. Godsent I, Basil O, Solomon D, Augustin O, Michael I. Determinants of HIV-related cardiac disease among adults in north central Nigeria. Heart Asia 2013;5:130-5.
8. Araoye MO. Reseach Methodology with statistics for health and social sciences. First Edition. Ilorin: Nathadex Publishers; 2003. p. 117-21.
9. Sani MU. Electrocardiographic pattern of patients with AIDS in JUTH, Jos. FMCP Part 2 Dissertation, West African College of Physicians; 2002.
10. Danbauchi SS, Sani BG, Alhassan AM, Oyati AI. Echocardiographic features of HIV/AIDS subjects on 1-2 years of ARV drugs in Nigeria. Available from: http://www2.umdnj.edu/shindler/hivecho.html. [Last accessed on 2014 Oct 17].
11. Henry WL, De Maria A, Gramiak R, King DL, Kisslo JA, Popp RL, *et al*. Report of the American Society of Echocardiography Committee on Nomenclature and standards in 2-D Echocardiography. Circulation 1980;62:212-7.
12. Adebiyi AA, Ogah OS, Aje A, Ojji DB, Adebayo AK, Oladapo OO, *et al*. Echocardiographic partition values and prevalence of left ventricular hypertrophy in hypertensive Nigerians. BMC Med Imaging 2006;6:10.
13. Report of the WHO/ISFC task force on the definition and classification of cardiomyopathies. Br Heart J *1980;*44:672-3.
14. Vasan RS, Levy D. Defining diastolic heart failure: A call for standardized diagnostic criteria. Circulation 2000;101:2118-21.
15. Danbauchi SS, Sani SG, Alhassan MA, Oyati AI. Cardiac manifestations of stage III/IV HIV/AIDS compared to subjects on ARV in Zaria, Nigeria. Nig J Cardiol 2006;3:5-10.
16. Cardoso JS, Moura B, Martins L, Mota-Miranda A, Rocha Gonçalves F, Lecour H. Left ventriular dysfunction in HIV-infected patients. Int J Cardiol 1998;63:37-45.
17. Longo-Mbenza B, Tonduangu K, Muvova D, Phuati MB, Seghers KV, Kestelot H. A clinical study of cardiac manifestations related to acquired immunodeficiency syndrome (AIDS) in Kinsaha. Arch Mal Couer Vaiss 1995;88:1437-43.
18. Longo-Mbenza B, Seghers LV, Vita EK, Tonduangu K, Bayekula M. Assessment of ventricular diastolic function in AIDS patients from Congo: A Doppler echocardiographic study. Heart 1998;80:184-9.
19. Yalçin F, Thomas J. Diastolic dysfunction: Pathogenesis, therapy and the importance of doppler echocardiography. Tr J Med Sci 1999;29:501-5.
20. Lipshultz SE, Chanock S, Sanders SP, Colan SD, Perez-Atayde A, McIntosh K. Cardiovascular manifestations of HIV infection in infants and children. Am J Cardiol 1989;63:1489-97.

21. Herskowitz A, Vlahov D, Willoughby S, Chaisson RE, Schulman SP, Neumann DA, *et al*. Prevalence and incidence of left ventricular dysfunction in patients with HIV infection. Am J Cardiol 1993;71:955-8.
22. Levy WS, Simon GL, Rio SJ, Ross AM. Prevalence of cardiac abnormalities in HIV infection. Am J Cardiol 1989;63:86-9.

How to cite this article: Uwanuruochi K, Onwubere BJ, Anisiuba BC. Echocardiographic study of left ventricular function in HIV-infected Nigerians. West Afr J Radiol 2015;22:27-31.

Source of Support: Nil, **Conflict of Interest:** None declared.