

ORIGINAL ARTICLE

Cranial Computed Tomography Assessment of HIV/AIDS Patients with Neurological Features

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ABSTRACT

Background: HIV/AIDS patients do have variable neurological manifestation of the disease that will require neuro-imaging for proper evaluation. Computed tomography is one of the neuro-imaging techniques that can be used for diagnostic work up of patients with neurological symptoms and signs.

Objective: To determine the spectrum of cranial computed tomographic findings in HIV/AIDS patients with neurological signs and symptoms and correlate with CD4 count.

Methodology: This is a retrospective analysis of 43 HIV/AIDS patients who presented with neurological signs and symptoms and had cranial computed tomography from December 2014 to June 2018 (43 months).

Results: The mean age of subjects studied was 29±17 years with age range of 21-47 years. There were 27 males and 16 females with male to female ratio 1.7:1. Nineteen (44.2%) patients presented with one neurological sign and twenty-four (55.8%) presented with more than one neurological sign. Thirty-six (83.7%) of patients had abnormal CT findings. Cranial computed tomographic findings were cerebral infarcts (27.9%), cerebral mass (18.6%), cerebral atrophy (16.3%), haemorrhage (7%). Others were meningeal enhancement (4.7%), brain oedema (4.7%) and white matter lesion (4.7%). Cerebral mass was the most common CT findings in patient with CD4 count less than 200cells/mm³. In subjects with CD4 count of 200-499 cells/mm³ and greater than 500cells/mm³, cerebral infarcts and atrophy were the commonest CT findings respectively. There was statistically significant association between CD4 counts and abnormal CT findings in relation to cerebral infarct and atrophy (cerebral infarcts, $p=0.02$ and cerebral atrophy $p=0.02$).

Conclusion: Cerebral infarcts was the commonest CT findings in this study. CT plays an important role in evaluation of HIV/AIDS patient with neurological features. CT scan should be a routine investigation in HIV/AIDS patients with low CD4 count presenting with neurological signs and symptoms in view of the abnormalities seen in them from our study.

Keywords: Cranial findings, computed tomographic, HIV/AIDS, CD4 count

INTRODUCTION

Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) remain the greatest epidemic in the modern world, with approximately two-thirds of the 36.9 million people currently living with HIV/AIDS worldwide are found in sub-Saharan Africa.¹ Sub-Saharan Africa bears the largest burden of HIV/AIDS morbidity and mortality worldwide.^{1,2}

Central nervous system (CNS) is a common site of HIV/AIDS infection with neurologic complications occurring in more than 40% of patients with HIV infection.² HIV infection associated with neurologic complications cause significant morbidity and mortality. Despite the on-going decline in HIV-associated CNS disease observed in very recent years, the mortality from these diseases remain high especially in Africa.² The prevalence of HIV-associated neurologic disease in Africa ranges from 34% to 42.5% in Nigeria to as high as 75% in South Africa.³

There are varieties of CNS abnormalities seen in patients with HIV infection. However, the spectrum of CNS abnormalities can be divided into three main categories: HIV associated lesions, opportunistic infection and neoplasm. Although there is considerable overlap in the imaging characteristic of different entities, some features are found to be very suggestive of a particular disease.^{3,4}

Diagnoses of CNS abnormalities may require the use of several imaging techniques including computed tomography, magnetic resonance imaging, single photon emission computed tomography, or magnetic resonance spectroscopy. Cranial CT scan is usually the first line imaging tool in the diagnosis of

CNS Complications of HIV/AIDS because it is fast, relatively available and affordable when compared to other imaging modalities. It is also a reliable imaging modality in the follow up of patients with related central nervous diseases.⁴

CD4 level is an important prognostic marker in HIV/AIDS patients and CD4 count is the most important factor in determining the urgency of antiviral chemotherapy (ART) and predicting the relative risk of developing opportunistic infections and neoplasm. Monitoring of CD4 count has an important value in monitoring disease progression, response to antiviral chemotherapy and gives an indication of the stage of disease.^{2,5,6} The ability of the HIV virus to cross the blood-brain barrier in the early course of the infection makes the CNS one of the major targets of HIV.⁵ Few studies have tried to correlate the CT findings to CD4. The objective of this study is to determine the spectrum of CT findings in patients with HIV/AIDS and correlate with CD4 count.

METHODOLOGY

Cranial CT findings of 43 HIV/AIDS patients with suspected CNS manifestation of HIV/AIDS who presented with neurological clinical signs and symptoms and were referred to the radiology department of University of Abuja Teaching Hospital, Abuja from December 2014 to June 2018 were reviewed retrospectively.

Patient's information which included age, gender, marital status, level of education, clinical presentation and use of antiretroviral therapy (ART) were retrieved from patient's medical files and request forms. The CD4 count at the time of examination was retrieved from the medical files of the patient.

Serial axial slices of the brain were obtained at five millimetres interval using Toshiba Activion 16-slice CT scanners. Low osmolar intravenous contrast medium 40ml iopamidol was given to patients who do not have haemorrhage. The various findings on CT scan images were reviewed by consultant radiologists.

Ethical Consideration

Ethical approval was obtained from the ethical committee of University of Abuja Teaching Hospital, Gwagwalada.

Data Analysis

Data was analysed using SPSS version 17 Chicago and statistical test of association was carried out using Chi -square and *p*-value of 0.05 was considered statistically significant.

RESULT

The mean age of subjects studied was 29±17 years with age range of 21-47 years. There were 27 males and 16 females with male to female ratio 1.7:1 (Table 1). Among the studied population, 67.4% were married, 16.3% were single, 9.3% were divorced and 7.0% were widow/widower. Seventy two percent were on ART. Seventeen (39.5%) patients had CD4 count less than 200cells/mm³, 20(46.5 %) had CD4 count of 200- 499 cells/mm³ and 6(14.0%) had CD4 count greater than 500cells/mm³. The range of CD4 count was 99- 613cells/mm³ (Table 2).

Nineteen (44.2%) patients presented with a single neurological feature while 24(55.8%) had more than one neurological features. The commonest neurological features were headache (27.9%), limb weakness (23.3%), and convulsion (16.3%). (Table 3)

Table 1. Age and sex distribution of HIV/AIDS patients

Age group	Male		Female	
	Freq	%	Freq	%
20-24	2	4.6	3	7.0
25-29	4	9.3	2	4.6
30-34	7	16.3	5	11.6
35-39	6	14.0	4	9.3
40-44	5	11.6	2	4.7
45-49	3	7.0	0	0.0
Total	27	62.8	16	37.2

Table 2. Distribution of variables in HIV/AIDS patients

Risk factors	Freq	%
Marital status		
Married	29	67.4
Single	7	16.3
Divorced	4	9.3
Widow/widower	3	7.0
Educational status		
Formal	18	41.9
Informal	25	58.1
ART		
On ART	31	72.1
Not on ART	12	27.9
CD4 groups		
<200cells/mm ³	17	39.5
200-499cells/mm ³	20	46.5
>500cells/mm ³	6	14.0

ART= Antiretroviral therapy

Eighty- four percent of patients had abnormal cranial CT finding. The differences in the distribution among those that have normal and abnormal findings in the population studied was statistically significant (*p*=0.01). Common cranial computed tomographic findings were

cerebral infarcts (27.9%) Figure 2, cerebral mass (18.6%) Figure 3 and 4, cerebral atrophy (16.3%) Figure 1 and haemorrhage (7%) Figure 5. Table 4.

Table 3. Neurological symptoms and signs in HIV/AIDS patients

Neurological symptoms	Frequency	%
Headache	12	27.9
Limb weakness	10	23.3
Convulsion	7	16.3
Confusion	4	9.3
Neck stiffness and pain	3	7.0
Vomiting	3	7.0
Abnormal gait	2	4.7
Memory loss	1	2.3
Blurred vision	1	2.3
Total	43	10.0

All the 17(39.5%) subjects with CD4 count less than 200cells/mm³ had abnormal CT findings; cerebral mass was the most common CT finding accounting for 35.3% followed by cerebral infarcts (29.4%). Fifteen (75.0%) patients out of the twenty patients with CD4 count of 200-499cells/mm³ had abnormal CT with cerebral infraction the most common finding (Table 4). Among patients with CD4 count greater than 500cells/mm³ cerebral atrophy was the commonest CT finding. There was statistical significant association between CD4 counts and abnormal CT findings of cerebral infraction and atrophy in this study (cerebral infarcts, $p=0.02$ and cerebral atrophy). Also, there was positive correlation between CD4 counts and abnormal CT findings. Pearson Chi-Square= 37.148, $df= 6$, positive Spearman Correlation= 0.371(Table 4).

Table 4. CT findings with CD4 count in HIV/AIDS

Findings	Freq (%)	<200	200-499	>500	P-value
		(N=17) F (%)	(N=20) F (%)	(N=6) F (%)	
Normal	7 (16.3)	0 (0.0)	5 (25.0)	2 (33.3)	
Cerebral infarct	12(27.9)	5 (29.4)	6 (30.0)	1 (16.7)	0.02
Cerebral mass	8 (18.6)	6 (35.3)	2 (10.0)	0 (0.0)	0.49
Cerebral atrophy	7 (16.3)	2 (11.8)	2 (10.0)	3 (50.0)	0.04
Haemorrhage	3 (7.0)	2 (11.8)	1 (5.0)	0 (0.0)	0.92
White matter lesion	2 (4.7)	1 (5.9)	1 (5.0)	0 (0.0)	0.05
Meningeal enhancement	2 (4.7)	0(0.0)	2 (10.0)	0 (0.0)	0.52
Brain oedema	2 (4.7)	1 (5.9)	1 (5.0)	0 (0.0)	0.14

Figure 1. Noncontrast computed tomography of the brain showing prominent sulci, sylvian fissure and dilated ventricles (cerebral atrophy)

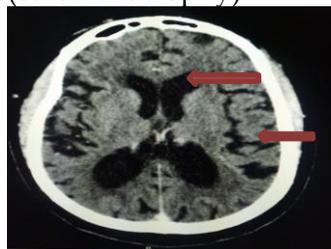


Figure 2. Noncontrast computed tomography image of the brain showing an extensive hypo dense lesion in the left parietal lobe. (cerebral infarct)



Figure 3. Contrast enhanced CT showing multiple ring enhancing lesions in the brain



Figure 4. Contrast enhanced CT showing solitary ring enhancing lesion in the brain with surrounding perilesional oedema.

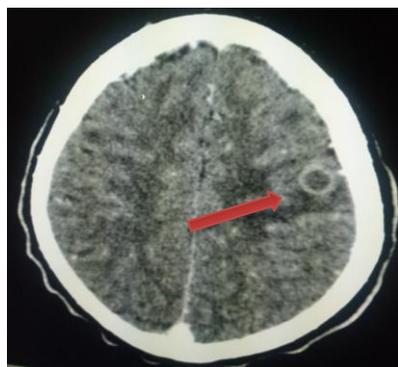


Figure 5. Non contrast enhanced CT showing hyperdensity in the left thalamocaudate lobe with surrounding perilesional oedema (cerebral haemorrhage)



DISCUSSION

The objective of neuro-imaging in assessment of HIV/AIDS patients is to detect any abnormality and also to establish

base line for subsequent management. Diagnoses of CNS complications are made by combining neurological signs and symptoms, neurological examinations and radiological imaging of the brain using MRI and CT. The ability of the HIV virus to cross the blood-brain barrier in the early course of the infection makes the CNS one of the major targets of HIV.⁵ In a study by Masliah where brain autopsies of patients with AIDS were reviewed at University of California, 63% had abnormal pathology.⁶

This study revealed that of the 43 subjects studied a large proportion were male. High male preponderance was documented in a study by Eze *et al.* on brain computed tomography of patients with HIV/AIDS and in a study by Adeolu *et al.* on computed tomographic (CT) findings in HIV-positive Nigerian patients presenting for neurosurgical evaluation.^{7,8} Our study however differ from what was obtained by Lopel *et al.*⁹ Majority of the patients were young in this study and in their most productive years of life with age range between 21-47years (mean 29±17 years), similar finding was obtained in other studies.^{7,8}

Eight -four percent of HIV/AIDS subjects in this study had abnormal cranial CT. This finding further buttresses the high incidence of HIV associated neurologic disease in Sub-Saharan African. The prevalence of CNS diseases in HIV/AIDS patient was reported as 42.5% in Nigeria and 75% in South Africa.³ However the very high CT abnormalities in this study may probably be due to improvement in CNS disease diagnostic ability in the country due to recent installation of CT scan machines. Before the advent of CT and MRI in our environment, physicians rely on patient's clinical signs and symptoms in make

diagnosis of CNS disease. The most common presenting neurological symptom was headache. Similar finding was documented by other studies^{10,11}. Headache is usually a nonspecific symptom and may be related to variety of causes including system infection, migraine, ocular pathology or sinusitis; however, this symptom should always be properly investigated especially in HIV/AIDS patients, because this may be the only symptom of life-threatening CNS disease. In our study headache was the major complain of patients with cerebral mass, haemorrhage and atrophy.

The most common finding seen on CT scan in our study was cerebral infarcts which was seen in all the CD4 count groups but more in subjects with CD4 count 200-499cells/mm³. Our finding is in variance with what was obtained in other studies that reported cerebral atrophy as the commonest CT finding but similar to finding documented by Eze.^{7,12,13} It is not clear why cerebral infarcts are more common in high CD4 count in this study. However, it has been shown that HIV related vasculitis of the cerebral vessels may be responsible for this.

HIV vasculitis is an immunologically mediated process causing inflammation of the wall of the vessels resulting in destruction of the elastic lamina and subsequent fibrosis. This can lead to stenosis and/or aneurysmal dilation resulting into infarcts and haemorrhages in the brain. It is a known fact that the degree of immunosuppression is a predictor of certain opportunistic diseases and the more advanced HIV-infection and a lower CD4 count the more likelihood of presenting with these opportunistic infections and neoplasm.¹⁴ Toxoplasmosis is the commonest opportunistic infection in HIV/AIDS patient and lymphoma the most

common neoplasm. Cerebral mass was the most common CT abnormality seen in HIV/AIDS patients with CD4 of less than 200cells/mm³ in this study.

A diagnosis of cerebral mass was made for lesions which presented with similar features on CT, ranging from multiple or single hypodense ring enhancing lesion with surrounding peri-lesional oedema. These appearances on CT have many differential diagnoses including cerebral abscess, toxoplasmosis, glioblastoma multiforme, lymphoma, tuberculoma, cerebral fungi infection, cytomegalovirus infection progressive multifocal leuco-encephalopathy, therefore using only CT for diagnosis may be inappropriate.⁷ In view of the above differential diagnosis, further imaging with MRI and sometimes biopsy of cerebral mass may be necessary for appropriate diagnosis. MRI and biopsy were not done because facilities for these were not available in our centre. Empirical treatment with antibiotics was given to four patients with cerebral abscess whose recovery was successfully. Two patients with cerebral toxoplasmosis also recovered after therapy.

In this study, positive CT findings occurred among all the CD4 groups despite that 72.1% were on ART. This can be explained by the fact that HIV/AIDS is a progressive disease despite initiation of therapy. Also, this study did not look at the duration for which the patients have been on drug therapy, again it is possible these patients might have started ART at different periods.

CONCLUSION

This study has shown the relevance of imaging in HIV/AIDS patients with neurological signs and symptoms. More cranial pathologies were seen in patients with CD4 count less than 200cells/mm³ with

cerebral mass the most common. There was a positive correlation between CD4 count and abnormal CT findings. It is therefore recommended that HIV/AIDS patients with low CD4 count and neurological signs and symptoms should undergo routine brain CT in view of the high potential to develop cranial abnormalities.

REFERENCES

1. UNAIDS Global HIV & AIDS statistics -2018 fact sheet (accessed 4 December 2018). Available from: <http://www.unaids.org/en/resources/fact-sheet>
2. Reginal K. Central nervous system complications in HIV 2018 [accessed 4 December 2018, last updated 12 April 2018]. Available from <https://emedicine.medscape.com/article/1167008-overview>
3. Akali NH, Bwala SA, Nyandaiti YW, Danesi MA. NeuroAids in sub-Saharan Africa: A clinical review. *Ann Afr Med* 2013; 12:1-10
4. Şenocak E, Oğuz KK, Özgen B, Kurne A, Özkaya G, Ünal S *et al.* Imaging features of CNS involvement in AIDS. *Turkish Society of Diagn Interv Radiology* 2010; 16:193-200
5. Smith AB, Smirniotopoulos JG, Rushing EJ. From the archives of the AFIP: Central nervous system infections associated with human immunodeficiency virus infection: radiologic-pathologic correlation. *Radiographics* 2008; 28(7):2033-2058. doi:10.1148/rg.287085135.
6. Masliah E, DeTeresa RM, Mallory ME, Hansen LA. Changes in pathological findings at autopsy in AIDS cases for the last 15years. *AIDS* 2000; 14(1):69-74.
7. Eze KC and Eze EU. Brain computed tomography of patients with HIV/AIDS before the advent of subsidized treatment program in Nigeria. *Niger Med J* 2012 53: 231-235.
8. Adeolu AA, Malomo AO, Shokunbi MT, Shokunbi WA, Obajimi MO, Komolafe EO. Cranial computed tomographic (CT) findings in HIV-positive Nigerian patients presenting for neurosurgical evaluation. *West Afr J Med* 2006 ;25(1):69-74
9. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: Systematic analysis of population health data. *Lancet* 2006; 367:1747-1757.
10. Beerhe T, Melkamu Y, Amare A. The pattern and predators of mortality of HIV/AIDS patients with neurologic manifestation in Ethiopia: a retrospective study. *AIDS Research and Therapy* 2012; 9:2-7.
11. Luma HN, Tchaleu BC, Temfack E, Doualla MS, Ndenga DPN, Mapoure YN *et al.* HIV-Associated Central Nervous System Disease in Patients Admitted at the Douala General Hospital between 2004 and 2009: A Retrospective Study 2013, Article ID 709810 <http://dx.doi.org/10.1155/2013/709810>.
12. Graham III CB, Wippold II FJ, Pilgram KT, Fisher EJ, Smoker WRK. Screening CT of the brain determined by CD4 count in HIV-positive patients presenting with headache. *American Journal of Neuroradiology* 2000; 21:451-454.
13. Rothman RE, Keyl PM, McArthur JC, Beauchamp NJ, Danyluk T, Kelen

- GD. A decision guideline for emergency department utilization of noncontrast head computed tomography in HIV-infected patients. *Academic Emergency Medicine* 1999; 6(10):1010-1019.
14. Ho EL, Jay CA. Altered mental status in HIV-infected patients. *Emerg Med Clin North America* 2010; 28(2):311-323.