Caliphate Medical Journal

A Publication of Nigerian Medical Association Sokoto State Chapter.

Vol 9, No. 3, July - September, 2021

ISSN: 2346-7193

In this Issue

CMJ

Also available @ www.cmj.nmasokoto.org

PATTERN OF CHEST RADIOGRAPHIC FINDINGS IN RELATION TO CD4 COUNT AMONG THE HAART NAÏVE HIV POSITIVE ADULTS IN SOKOTO NORTH-WESTERN NIGERIA

Umar FK¹, Saidu SA¹, Maaji SM¹, Yunusa GH¹, Sule MB¹, Gele IH¹, Akinnibosun-Raji OH¹, Abdullahi A¹, Haliru S², Amin HH², Mohammed Y³

¹Department of Radiology, Usmanu Danfodiyo University Teaching Hospital, Sokoto. Nigeria.

²Department of Internal Medicine, Usmanu Danfodiyo University Teaching Hospital, Sokoto. Nigeria.

³Department of Medical Microbiology Usmanu Danfodiyo University Teaching Hospital, Sokoto. Nigeria.

ABSTRACT

Background: HIV/AIDS epidemic has evolved to become a major task in global health with the greatest impact in sub-Saharan Africa, where most of the transmission occurs horizontally between sexually active individuals. The CD4 count being a reliable pointer of immunosuppression has a close relationship with the likelihood of developing some pulmonary diseases and other chest conditions in HIV patients, which can be picked on chest radiograph.

Aims and Objectives: To determine the pattern of chest radiographic findings in relation to CD4 count among the HAART naïve HIV positive adults in Sokoto.

Materials and Methods: One hundred and forty newly diagnosed HIV positive adults, yet to commence any antiviral treatment were recruited. They had chest radiographs done in the Radiology Department of Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, North-western Nigeria, using Silhouette VR System GE diagnostic x-ray equipment. The findings from the radiographs and the result of their CD4 counts were analysed using SPSS version 23.

Results: The CD4 count of the studied participants ranged from 69-1222 cells/μL with mean (± SD) of 448.3(± 287.0) cells/μL. Most of the participants 59(42.1%) had CD4 counts <200 cells/μL. Pulmonary consolidation was the predominant radiographic finding in the CD4 range of 200-499 cells/μL while a normal appearance was the commonest finding amongst participants with CD4 count ≥500 cells/μL. There was statistically significant association between the level of CD4 counts and the overall chest radiographic findings using chi-square test with a chi value of 23.993 and *p*-value of 0.000.

Conclusion: The study showed abnormal chest radiographic finding as the predominant pattern in patients with low CD4 counts (<500 cells/μL) that are HAART naïve.

Keywords: HIV, AIDS, CD4, Chest Radiograph, Adult.

Corresponding author

Farouk Kabir Umar,

Department of Radiology, Usmanu Danfodiyo University Teaching Hospital, P.M.B 2370 Sokoto, Nigeria.
Phone number: +2348039234144
Email: faroukkbr@gmail.com

Introduction

Human immunodeficiency virus (HIV) is believed to have originated from a type of chimpanzee in West Africa.^{1,2} The chimpanzee version of the immunodeficiency virus (called simian immunodeficiency virus or SIV) most likely was transmitted to humans and mutated into HIV when humans hunted these chimpanzees for meat and came into contact with their infected blood.² The earliest known case of infection with HIV-1 in a human was detected in a blood sample collected in 1959 from a man in Kinshasa, Democratic Republic of the Congo and over decades, the virus slowly spread across Africa and later into other parts of the world.¹ The pandemic was recognized in 1981 when the United States Centre for Disease Control and prevention (CDC) reported cases in gay men. Although the CDC first believed that the new disease was confined to homosexual men, by the end of the year cases had been reported in non-homosexual injection drug users and outside the USA.³ In 1983 the US food and drug administration approved a commercial test to detect the virus.³ HIV-2 causes a similar illness to HIV-1 but is less aggressive and restricted mainly to western Africa.²

HIV/AIDS epidemic has evolved to become the greatest challenge in global health with the greatest impact in sub-Saharan Africa, where most of the transmission occurs between heterosexuals. Nine countries in southern Africa account for less than 2% of the world's population but now they represent about one third of global HIV infections.⁴ Nigeria harbors about 9% of global HIV burden.⁵

Several factors have been implicated in the progression from early HIV infections to AIDS, including the CD4 count, biological properties of the virus itself, genetic

susceptibility, gender, and pregnancy, and risk activity, co-infection with other viruses, age, ethnicity, geographic location and smoking.^{2,6} More than half of the patients will develop pulmonary disease at some stage.²

The CD4 count being a reliable pointer of immunosuppression also has a close relationship with the likelihood of developing some pulmonary diseases and other chest conditions in HIV patients. The normal range for CD4 lymphocytes count is 800- 1000 cells/μL.⁷ The HIV positive patients with CD4 counts below 500 cells/μL are at higher risk of developing an opportunistic infection or neoplasm. The CD4 count is used routinely as the best predictor of disease progression and clinically to institute prophylactic therapy for opportunistic infections.⁷

Chest radiographic findings in HIV positive individuals ranging from normal chest finding to interstitial pulmonary infiltrates, reticulonodular shadows, bronchial wall thickening, consolidation, cavitation, plate atelectasis, nodules, lung collapse, enlarged lymph nodes, pleural effusion, pneumothorax, bullae, emphysema and cardiomegaly.⁸⁻¹³ These findings have been found to relate with CD4 count.

Akinola *et al* in the study involving 211 HIV positive patients attending an Antiretroviral Clinic in Lagos, South western Nigeria, revealed almost two-thirds (64.9%) of the cases having normal chest X-ray with their mean CD4 count as 277.65 ± 228.54 cells/μL. Pulmonary infiltrates were documented as the leading abnormal chest finding (26.1%). Patients with abnormal chest findings were found to have lower mean CD4 counts.⁸

Review of recent literature showed that CD4 count is associated with numerous pulmonary infections, thus presenting with different typical and atypical chest

radiographic findings along the strata of CD4 level.^{5, 14-17} A study conducted in Maiduguri, North eastern Nigeria by Ibinaiye and his colleagues to show the relationship between radiographic pattern of pulmonary tuberculosis and CD4 cell count in HIV positive individuals revealed low CD4 count to be a good predictor of atypical chest radiographic pattern.¹⁵ Desalu *et al* in a similar study in Yola, Nigeria to show the impact of immunosuppression on radiographic features of HIV positive related PTB among Nigerians revealed that cavities and pleural effusion are closely associated with CD4 counts greater than 200 cells/ μ L. They also noted that severe immunosuppression and CD4 count less than 200 cells/ μ L were significantly associated with the presence of mediastinal lymphadenopathy.¹⁶ Jones *et al* also documented that Pleural effusion in HIV patients is mainly due to a hypersensitivity reaction in the pleura.¹⁸ Computed Tomography serves as part of the diagnostic algorithm in HIV patients with chest radiographic manifestations because it provides a modest improvement mainly on equivocal findings. It is however not routinely done as a baseline investigation in the developing countries possibly due to the cost implication and relative higher radiation dose compared to chest radiography. CT is therefore mostly employed for specific indications that include assessment of complications, staging malignancy, guiding invasive procedures, detection of occult disease in symptomatic patients, assessment of mediastinum and characterizing non-specific radiographic disease patterns.¹⁹ This study attempted to present the pattern of baseline chest radiographic findings in relation to the CD4 count in the newly diagnosed HIV positive adults.

Materials and Methods

Ethical Approval: Obtained from the ethical committee of UDUTH with reference no; UDUTH/HREC/2017/NO.645

Study design: The study was descriptive and cross-sectional.

Study period: The study was conducted from 30th September, 2018 to 30th June 2019.

Study population: Confirmed HIV positive adults attending Antiretroviral Clinic of Usmanu Danfodiyo University Teaching Hospital Sokoto were enrolled into the study. These patients were referred to the clinic after testing positive on screening for HIV- infection from free voluntary testing in the dedicated laboratory or those from General Outpatient, Medical Outpatient, Surgical Outpatient and antenatal clinics as well as from other health facilities in the region.

Inclusion Criterion: All the newly diagnosed HAART naïve HIV positive adults aged between 16 to 60 years referred to Radiology Department from Antiretroviral Clinic UDUTH for routine baseline chest X-ray who consented for the study.

Exclusion Criteria: Exclusion criteria include Pregnant women, obvious congenital chest deformity, treatment for chest infections, those on antiretroviral drug therapy (HAART) or on immunosuppressive drugs, diabetes mellitus, chronic renal failure, nephrotic syndrome, sickle cell disease, long standing hypertension, occupational lung disease or “dirty lungs”.

Data Collection

The patients were recruited in the Radiology Department at the point of conducting the routine chest radiographic examination requested by the attending physician. The

patient was interviewed and a structured questionnaire containing information on patient's biodata and anthropometric measurements (weight and height) was correctly filled, after obtaining a written consent. Each patient's CD4 count result was retrieved from the laboratory or record file and then documented in the questionnaire.

Radiological Examination

The recruited patients were briefed on chest radiographic examination and then sent to the radiographic examination room for the procedure. The examination was performed in the radiography room using Silhouette VR System GE diagnostic x-ray equipment (Model No: 2226680), manufactured in July 2007 at Japan. The patient was asked to remove the jewelry around the neck and chest and wear comfortable loose-fitting examination gown. Postero-anterior view of the chest examination were performed using a Focus- film distance (FFD) of 180cm and x-ray exposure factors of about 70kV, 12mA for 0.40 to 0.64 seconds, with a few of the patients requiring slight alteration according to their physique. Images were processed using either the manual or automatic processing units. In the few cases where preliminary review of the radiograph showed suspected hilar/mediastinal lesions, complimentary lateral view for further assessment was done.

The radiographs were viewed using an illuminated viewing box and then reported by the investigators and cross-checked by other consultant Radiologists in the department. The findings were documented in the questionnaire.

Data Management

Statistical Package for Social Sciences (SPSS) IBM version 23. Software was used to analysed the collated data. The analysis comprised of descriptive statistics using mean and standard deviation (SD) for normally distributed quantitative data and frequency and percentages for qualitative data. Multivariate analysis of variance was also done to show the association between CD4 count and radiological findings with the level of statistical significance set at 5% ($p < 0.05$).

Results

One hundred and forty patients studied constituted 96 (68.6%) females and 44 (31.4%) males with female to male ratio of 2.2:1. The CD4 count of the studied participants ranged from 69-1222 cells/ μ L with mean ($\pm$ SD) of 448.3($\pm$ 287.0) cells/ μ L. Majority of the participants 59(42.1%) had CD4 counts <200 cells/ μ L while 42(30.0%) participants had CD4 counts in the range of 200-499 cells/ μ L. Those with CD4 counts ≥ 500 cells/ μ L constituted the remaining 39(27.9%). This is as shown in Figure 1.

Fig1: A bar chart showing distribution of CD4 Count among the patients.

Pulmonary consolidation was the predominant radiographic finding in the CD4 range of 200-499 cells/μL while a normal appearance was the commonest finding amongst participants with CD4 count ≥ 500 cells/μL. Pulmonary infiltrates predominate the abnormal findings in those with CD4 count < 200 cells/μL as shown in Table 1.

Table 1: Distribution of Patients according to Radiographic Findings and CD4 count

Chest Findings	CD4 Count(cells/μL)			Total
	$<200(\%)$	200 -499(%)	$\geq 500(\%)$	
Normal	38(56.7)	7(10.5)	22(32.8)	67(100)
Consolidation	1(3.1)	21(65.6)	10(31.3)	32(100)
Pulmonary infiltrates	14(63.6)	6(27.3)	2(9.1)	22(100)
Cavity	1(10.0)	7(70.0)	2(20.0)	10(100)
Reticulonodular opacities	2(25.0)	6(75.0)	0(0.0)	8(100)
Lung collapse	1(50.0)	1(50.0)	0(0.0)	2(100)
Plate atelectasis	0(0.0)	1(100.0)	0(0.0)	1(100)
Emphysematous bullae	1(100.0)	0(0.0)	0(0.0)	1(100)
Hilar lymphadenopathy	2(25.0)	2(25.0)	4(50.0)	8(100)
Pleural effusion	1(20.0)	2(40.0)	2(40.0)	5(100)
Lung fibrosis	0(0.0)	3(100.0)	0(0.0)	3(100)
Cardiomegaly	3(50.0)	2(33.3)	1(16.7)	6(100)

There was statistically significant association between the level of CD4 counts and the chest radiographic findings using chi-square test with a chi value of 23.993 and p -value of 0.000 as shown in table 2.

Table 2: Chi-Square Test Showing the Association between CD4 level and abnormal finding.

CD4 count (cells/μL)	Chest Radiographic findings			Test statistics
	N	Normal Frequency (%)	Abnormal Frequency (%)	
< 200	59	38(64.4)	21(35.6)	$\chi^2 = 23.993$ $p = 0.000^*$
200 -499	42	7(16.7)	35(83.3)	
≥ 500	39	22(56.4)	17(43.6)	

$\chi^2 = 23.993$, $p = 0.000$, *Statistically significant

Discussion

The CD4 count has been reported as the best indicator of immediate state of immunologic competence and also the strongest pointer of HIV-related complications in patients.¹⁹ Chest radiograph being one of the tools to assess the cardiopulmonary and pleural complications has limitations of presenting overlapping appearances. However, certain basic radiographic patterns can be recognised which should raise suspicion of certain underlying diseases.¹⁹ Recognition of these dominant radiographic patterns in the HIV/AIDS patients is key to establishing an accurate and helpful differential diagnosis. Knowledge of how CD4 lymphocyte count is correlated with the radiographic appearance can further limit the differential diagnoses in the patient with HIV infection because certain infections and neoplasms are uncommon above a specific CD4 lymphocyte count.²⁰

The index study found hilar/mediastinal lymphadenopathy to be more prevalent in the patients with CD4 counts ≥ 500 cells/μL which is unlike the findings by Desalu *et al*¹⁶ in Yola Nigeria and Jones *et al*¹⁸ in California USA, who reported hilar/mediastinal lymphadenopathy to be more in the severely immunocompromised group (CD4 count < 200 cells/μL). This could be attributed to the fact that majority of the subjects in the latter two studies were hospitalized and chronically ill patients, while those in the present study were relatively stable and entirely outpatients.

The current study found that majority of the study participants with chest radiographic findings of pulmonary consolidation and/or cavity had CD4 count between 200-499 cells/μL. This is in agreement with previous studies as

documented in a review article by Shah *et al*²⁰ showing that HIV positive patients with chest radiographic findings of pulmonary consolidation or cavity more often have a CD4 lymphocyte counts above 200 cells/μL.²⁰ Desalu *et al*¹⁶ further reiterated that bacterial pneumonia specifically by *Streptococcus pneumoniae* and *Haemophilus influenza* is the most likely diagnosis of pulmonary focal consolidation in patients with the aforementioned level of CD4 count. They further documented that primary pattern of *Mycobacterium tuberculosis* should be included in the differential diagnoses of patients with consolidation at CD4 count less than 200 cells/μL. This however occurred only in one patient among the participants in this index study, unlike the findings of Ahidjo *et al*²¹ and Olatunji *et al*²² where majority of their patients with consolidation lie within this group. Involvement of patients with suspected HIV/PTB co-infection by the three latter studies may have been responsible for the differences observed.

This study found pulmonary interstitial infiltrates as the predominant abnormal findings in those with CD4 count less than 200 cells/μL. This is in agreement with existing literature which reported presence of interstitial infiltrates in CD4 count less than 200 cells/μL to be indicative of pneumocystis carinii pneumonia (PCP).^{23,24} PCP produces a pneumonia in 60% of patients with AIDS and is responsible for up to one-third of deaths in this population.²⁴ Emphysematous bullae being also a prominent feature of PCP, was found in only one patient among those in the current study and falls within the aforementioned CD4 group. This is similar to the findings of Akinola *et al*.⁸

This study also observed significant number of normal radiographic finding in the extremes of the CD4 groups (< 200 and ≥ 500 cells/μL) which is in keeping with the literature.^{8,10,25} The finding of normal radiograph in HIV infected patients with extremely low CD4 count was believed to be due to host's weak immunity that could not mount a granulomatous or non-granulomatous reaction to invading organism.^{12,19}

Conclusion

The study showed abnormal chest radiographic finding as the predominant pattern in patients with low CD4 counts (< 500 cells/μL) that are HAART naïve.

References

1. www.theaidsinstitute.org/education/aids-101/where-did-hiv-come Assessed on 20/04/2017.
2. Christopher H, Edwin R, Nicholas AB. Infection and Immune failure, In: Principles and Practice of Medicine. 19th ed. London. Churchill Livingstone; 2002:120-132
3. Merson MH, O'Malley J, Serwadda D, Apisuk C. The history and challenge of HIV prevention. The Lancet 2008; 372:475-488. [https://doi.org/10.1016/S0140-6736\(08\)60884-3](https://doi.org/10.1016/S0140-6736(08)60884-3)
4. De Cock KM, Jaffe HW, Curran JW. The evolving epidemiology of HIV/AIDS. AIDS 2012; 26:1205-1213. <https://doi.org/10.1097/QAD.0b013e328354622a>
5. Awofala AA, Ogundele OE. HIV epidemiology in Nigeria. Saudi J Biol Sci 2016; 79: 68-72.
6. Brettle RP, Leen CL. The natural history of HIV and AIDS in women. AIDS 1991; 5:1283-1292. <https://doi.org/10.1097/00002030-199111000-00001>
7. Afione C, Della Sala A, Frank L. Pulmonary manifestations in patients with AIDS. Revista argentina de radiología 2011; 75:4
8. Akinola RA, Balogun TM, Adeniyi AA, Onakoya JA, Fabeyibi IO. Spectrum of Chest X-Ray Findings among Human Immunodeficiency Virus Positive Individuals in a Nigerian Tertiary Hospital. SAARC J TUBER LUNG DIS HIV/AIDS 2014; 10:27-34. <https://doi.org/10.3126/saarc.v10i2.9710>
9. Oguntuyinbo AE, Nzeh DA, Salami AK, Babatunde AS. The chest

- radiographs of suspected and confirmed HIV/AIDS patients-pattern of radiological features in Ilorin. *TropJHealth Sci* 2008; 15:71-77. <https://doi.org/10.4314/tjhc.v15i1.36760>
10. Atalabi OM, Oladokun R, Adedokun B, Obajimi MO, Osinusi K. Baseline chest radiographic features among antiretroviral therapy naïve human immuno-deficiency virus positive children in a pediatric care program. *W AfrJRadiol* 2012; 19:5-13.
11. Staitieh B, Guidot DM. Noninfectious pulmonary complications of human immunodeficiency virus infection. *Am J Med Sci* 2014; 348: 502-511.
12. Akinbami AA, Adegboyega AO, Oshinaike OO, Adebola PA, Enabulele C, Dosunmu OA, Adediran A. Chest X-ray findings in HIV patients in relation to the CD4 count. *Nig Q J Hosp Med* 2010; 21:306-311.
13. Adeyekan AA, Onunu AN, Ukou BA, Okugbo SO. Chest Radiographic Patterns in HIV Associated Kaposi's Sarcoma in Benin City, Nigeria. *W AfrJRadiol* 2011; 18:57-62.
14. Kitara DL, Pirio P, Acullu D, Opira CP. TB co-infection with HIV/AIDS: a unique radiological presentation at Lacor hospital-a post conflict northern Uganda. *AfriJ Infect Dis* 2015; 9:21-28.
15. Ibinaiye PO, Tahir NM, Saad ST, TahirA, Ahidjo A, Yusuf H, et al. Relationship between the radiographic pattern of pulmonary tuberculosis and CD4 cell count in patients with human immune deficiency virus infection. *Archives of International Surgery* 2014; 4:85-89.
16. Desalu OO, Danfulani M, Gambo Z, Salawu F, Damburam A, Midala J. Impact of immunosuppression on radiographic features of HIV related pulmonary tuberculosis among Nigerians. *Turk Thorac J* 2009; 1: 112-117.
17. Chamie G, Luetkemeyer A, Walusimbi-Nanteza M, Okwera A, Whalen CC, Mugerwa RD, Havlir DV, Charlebois ED. Significant variation in presentation of pulmonary tuberculosis across a high resolution of CD4 strata. *Int J TubercLung Dis* 2010; 14:1295-1302.
18. Jones BE, Young SM, Antoniskis D, Davidson PT, Kramer F, Barnes PF. Relationship of the manifestations of tuberculosis to CD4 cell counts in patients with human immunodeficiency virus infection. *Am J RespirCrit Care Med* 1993; 148:1292-1297.
19. Allen CM, AL-Jahdali HH, Irion KL, Al Ghanem S, Gouda A, Khan AN. Imaging lung manifestations of HIV/AIDS. *Ann Thorac Med* 2010; 5:201.
20. Shah RM, Kaji AV, Ostrum BJ, Friedman AC. Interpretation of chest radiographs in AIDS patients: usefulness of CD4 lymphocyte counts. *Radiographics* 1997; 17:47-58.
21. Araoye OA. Research Methodology with Statistics for Health and Social Sciences. 2nd ed. Ibadan: Nathadex Publishers; 2004: 117-119.
22. Olatunji AA, Olatunji PO, Salako AA. Radiographic chest findings and immunological status in HIV-positive patients with tuberculosis coinfection in a sub-urban Nigerian tertiary hospital. *Indian J Tuberc* 2016; 63:74-78.
23. Ahidjo A, Yusuph H, Tahir A. Radiographic features of pulmonary tuberculosis among HIV patients in Maiduguri, Nigeria. *Ann Afr Med* 2005; 4:7-9.
24. Hoover DR, Saah AJ, Barcellar H. Clinical manifestations of AIDS in the era of Pneumocystic prophylaxis. *N Engl J Med* 1993; 329: 1922-1926.
25. Singh RP, Kashyap AK, Puri S, Whig J. Pulmonary manifestations in HIV seropositive patients and their correlation with CD4 counts in a tertiary care Centre of North India. *JKScience* 2013; 15:140-144.