Original Article

Chest radiographic findings of pulmonary tuberculosis in human immunodeficiency virus-seropositive patients in a teaching hospital in Kano Northwest, Nigeria

Mohammed Sani Umar, Sunday Victory Daniel, Mohammed Abba Suwaid, Geofrey Luntsi[1], Jibrin Yusuf[2], Joseph Dlama Zira[2], Auwal Abubakar[1], Charbel Saade[3], Mustapha Barde

Department of Radiology, Aminu Kano Teaching Hospital/Bayero University Kano, Kano, [1]Department of Medical Radiography, University of Maiduguri, Maiduguri, Borno, [2]Department of Internal Medicine/Radiology, Abubakar Tafawa Balewa University Teaching Hospital Bauchi, Bauchi State, Nigeria, [3]Department of Medical Imaging Services, American University of Beirut, Beirut, Lebanon

Abstract

Background: Tuberculosis (TB) is one of the most common infections to occur in the course of human immunodeficiency virus (HIV) infection and remains a global emergency despite substantial investment in health services.

Aim: This study aims to determine the spectrum of chest X-ray findings in patients with HIV/TB coinfection.

Materials and Methods: A retrospective cross-sectional study of the clinical and radiographic features of pulmonary TB (PTB) in 244 confirmed HIV-seropositive patients aged 9 months to 80 years. Descriptive statistics was employed in analyzing mean percentages and frequencies. Level of statistical significance between clinical findings, radiographic findings, age group, and gender was determined using *z*-test. Statistical significance was set at $P \leq 0.05$.

Results: The study constituted of 104 (42.62%) males and 140 (57.38%) females with mean age of 31.62 ± 16.93 years. The major clinical features among HIV-related PTB patients in this study are cough in 56.6% patients, chest pain in 11.44% patients, weight loss in 10.26% patients, $P < 0.05$. Chest X-rays with normal findings were found in 60.0% patients, while primary patterns of PTB such as reticulonodular opacities occurred in 16.61% patients, typical post primary patterns such as background cystic/fibrotic changes were found in 3.39% patients, and miliary pattern in 2.73% patients. The age group 26–38 years was frequently involved in TB coinfections in both sexes, $P < 0.001$. The percentages of males and females with TB infection were 40.98% and 56.15%, respectively.

Conclusions: Normal chest X-rays constitute the major findings; primary and postprimary patterns of PTB account for the least findings with the age group 26–38 years as the most occurring (91, 37.30%). Females were more frequently involved in TB coinfection. The preponderance of normal radiographs does not exclude the presence of TB coinfection.

Keywords: Chest, human immunodeficiency virus, pulmonary, radiographs, tuberculosis

Address for correspondence: Mr. Mohammaed Sani Umar, Department of Radiology, Aminu Kano Teaching Hospital/Bayero University Kano, Kano, Nigeria. E-mail: umar.sani888@gmail.com

Submitted: 05-Sep-2018 **Accepted:** 30-Apr-2019 **Published:** 13-Mar-2020

Access this article online	
Quick Response Code:	Website: www.wajradiology.org
	DOI: 10.4103/wajr.wajr_33_18

How to cite this article: Umar MS, Daniel SV, Suwaid MA, Luntsi G, Yusuf J, Zira JD, *et al*. Chest radiographic findings of pulmonary tuberculosis in human immunodeficiency virus-seropositive patients in a teaching hospital in Kano Northwest, Nigeria. West Afr J Radiol 2020;27:27-32.

INTRODUCTION

Tuberculosis (TB) still remains a global pandemic despite substantial investment in healthcare services over the past two decades. It causes ill-health in approximately 10 million people each year and is one of the top ten causes of death worldwide.[1] It has been the leading cause of death from a single infectious agent, ranking above human immunodeficiency virus (HIV) and/or acquired immunodeficiency syndrome virus.[2] TB is the most common opportunistic disease and cause of death among those infected with HIV.[3,4] Similarly, HIV infection is one of the most important risk factors associated with an increased risk of latent TB infection progressing to active TB.[5,6] Moreover, the risk of developing TB is more than 40 times greater in people living with HIV than among people affected by risk factors such as undernutrition, diabetes, smoking, and alcohol consumption.[7]

The global impact of TB is extremely important considering the fact in 2016 about 6.3 million new cases of TB were reported.[8] Of the 10.4 million incident cases of TB in 2016, an estimated 1.9 million were attributable to undernourishment, 1.0 million to HIV infection, 0.8 million to smoking, and 0.8 million to diabetes. About 82% of the estimated incidence was reported to be living in sub-Saharan Africa.[9] A recently concluded national TB prevalence survey in Nigeria showed 560,000 cases in 2016 but only about 100,000 cases were reported according to the recent WHO global TB report 2017.[10,11]

The pandemic of HIV has been pointed out as one of the major causes of the worldwide increase in TB cases.[12,13] This is due to the fact that TB is one of the most common infections to occur in the course of HIV infection, either because of the reactivation of latent TB or as a result of new infection by the TB *Mycobacterium*, with a faster progression toward the active disease.[14] Respiratory infections, especially TB, are leading causes of illness and death in HIV-infected patients in sub-Saharan Africa.[15]

Patients with sputum-negative pulmonary TB (PTB) and extra PTB are difficult to diagnose and may be missed at all points of care. Clinical signs and symptoms in affected adults can be nonspecific and a high level of pretest clinical suspicion based on history is fundamental in the diagnostic workup. In most developing countries, diagnosis of PTB depends on the clinical symptoms, rapid molecular tests, chest radiography, tuberculin skin test, and sputum smear examination for acid-fast bacilli (AFB). Among diagnostic tools usually used for diagnosis of PTB, the chest X-ray plays an essential role, chiefly since it is widely available within the public healthcare system, even in poor populations.[16]

HIV infection leads to increased frequency of atypical radiographic features in patients with PTB with a tendency toward the pattern of primary disease.[17-20] However, there is a paucity of literature on chest radiographic findings of PTB in HIV-infected patients in this locality. This necessitates the study. This study was designed to give an indepth knowledgeof patterns of chest radiographic findings of HIV-related PTB patients in a tertiary facility in Kano, Northwestern Nigeria.

MATERIALS AND METHODS

This was a retrospective cross-sectional study. The study reviewed all request forms and result sheets from the archives of the Radiology Department and Virology Centre of Aminu Kano Teaching Hospital Kano, Nigeria from June 2017 to January 2015 of confirmed HIV-seropositive patients as detected by the enzyme-linked immunosorbent assay and clinically proven *Mycobacterium tuberculosi*s (MTB) as detected by the AFB and sputum smear GeneXpert MTB/RIF Assay. Patients on direct observation short course therapy and patients on antiretroviral therapy were also included in the study. Request forms and result sheets with incomplete results and patient's information were excluded from the study. Patients' information such as age, sex, clinical history, radiographic findings were recorded and tabulated.

Statistical analysis was performed using statistical package for the social sciences for windows (Version 20.0; SPSS, Chicago, IL, USA). *Z*-test was used to determine the level of statistical significance between clinical findings, radiographic findings, age, and gender at 95% confidence interval. Level of significance was determined using student *t*-test. Statistical significance was set at $P \leq 0.05$.

In line with Helsinki declaration, ethical approval (NHREC/21/08/2008/AKTH/EC/890) was obtained from Health Research and Ethics Committee of Aminu Kano Teaching Hospital.

RESULTS

A total of 244 result sheets of chest X-ray for HIV-seropositive-related PTB patients were assessed for the study. The study comprised 104 (42.62%) males and 140 (57.38%) females. The individuals were from the ages 9 months to 80 years, with mean age of 31.62 ± 16.93 years. Individuals within the age group of 26–38 years were predominant 91 (37.30%) in both sexes, while those

within the age group of 65 years and above had the lowest frequency of 11 (4.5%), $P < 0.001$, with 42 (9.43%) pediatric patients. The percentages of males and females with TB infection were 40.98% and 56.15%, respectively, as shown in Table 1.

The major clinical features among patients with HIV-related PTB in this study were cough (recurrent, progressive, persistent, severe, and chronic) in 193 (56.6%) patients, chest pain in 39 (11.44%) patients, weight loss 35 (10.26%), hemoptysis 21 (6.16%), night sweat 21 (6.16%), and 12 (3.52%, $P < 0.05$) greenish sputum among others. About 1.47% of the individuals were known as PTB patients and were receiving treatment. Only one patient had normal chest X-ray [Table 2].

The distribution of chest radiographic findings among HIV-related PTB patients is shown in Table 3. Normal study comprised the highest 177 (60.0%) which constituted 72 (24.41%) males and (105) 35.59% females, followed by reticulonodular opacities in 49 patients (16.61%), hilar lymphadenopathy in 11 (3.73%) patients, consolidations and background cystic/fibrotic changes representing 10 (3.39%) each, respectively, miliary opacities in 7 (2.37%) patients. There was preponderance in bilateral lung involvement. The least findings were right hydrothorax, thick-walled cavity, pleural effusion, and silhouette sign representing 1 (0.34%), respectively.

There was no statistically significant difference in findings between male and female individuals ($P < 0.005$). However, females were more frequently involved in TB.

Table 4 shows the distribution of radiographic findings in relation to age group. Of the 295 radiographic findings reported in this study, the age group 26–38 years had most occurring 109 (36.9%) findings constituting normal study (23.4%) being the highest followed by reticulonodular opacities (5.4%), blunting of costophrenic angles (1.7%), and 1.4% background cystic/fibrotic changes ($P < 0.001$) among others. Elderly patients within the age group of 65 years and above had the least radiographic findings of 18 (6.1%) which comprised mainly of reticulonodular opacities (2.4%); normal study (1.4%); consolidations (1.4%); cystic/fibrotic changes (0.7%) and about 0.3% apical opacities ($P < 0.001$).

Table 1: Frequency distribution of human immunodeficiency virus/tuberculosis coinfection based on age and gender of individuals

Age group	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)	*P*
0-12	19 (7.79)	23 (9.43)	42 (17.21)	0.0000
13-25	12 (4.92)	23 (9.43)	35 (14.34)	0.0008
26-38	33 (13.52)	58 (23.77)	91 (37.30)	0.0001
39-51	26 (10.66)	22 (9.02)	48 (19.67)	0.0000
52-64	9 (3.69)	8 (3.28)	17 (6.97)	0.0000
65+	5 (2.05)	6 (2.46)	11 (4.51)	0.0000
31.62±16.93	104 (42.62)	140 (57.38)	244 (100)	
Gender	**TB positive, *n* (%)**	**TB negative, *n* (%)**	**Total, *n* (%)**	***P***
Male	100 (40.98)	4 (1.64)	104 (42.62)	0.0001
Female	137 (56.15)	3 (1.23)	140 (57.38)	0.0001
Total	237 (97.13)	7 (2.87)	244 (100.00)	

DISCUSSION

The recent increase in the prevalence of TB globally, particularly in Africa has been attributed to the increase in number of HIV-infected patients.[1-5] There is a rising incidence of TB, especially PTB in HIV-infected patients as well as a high rate of HIV in patients suffering from TB in Nigeria and other parts of the world.[12] The diagnosis of active PTB is a major challenge, especially in individuals with severe immunosuppression, such as those coinfected with HIV. Such patients characteristically demonstrate an atypical radiographic pattern, for example, middle and lower lung involvement, absence of cavity formation, presence of lymphadenopathy and pleural effusions, or a miliary pattern.[21]

The mean age of the patients enrolled in this study (31.62 ± 16.93 years) is in line with other studies done in Nigeria such as Ahidjo *et al*. in Maiduguri, North East Nigeria (33.9 ± 8.42 years),[6] Desalu *et al*. (35.1 ± 8.4 years),[12] and Peters *et al*. in Calabar, South South Nigeria (34.60 ± 1.2 years).[16] It is also in line with some studies performed among African countries such as Said *et al*. in Bagamoyo, Rural Tanzania,[7] Kisembo *et al*. in Kampala, Uganda,[15] and other countries of the world such as Bermudez *et al*. in Cuba,[2,5,11] and Hadadi *et al*. in Iran who reported similar findings among HIV-related PTB patients.[22] The similarity in the reported findings may be attributed to the fact that HIV infection is more common among people in the productive and sexually active age groups. Overcrowding is another factor associated with high risk of airborne transmission of PTB among productive and sexually age groups. The study locality is one of the major densely populated cities in Nigeria with an estimated population of over 9.4 million people as stated by the National Bureau of Statistics of the Federal Republic of Nigeria.[23] As such person to person transmission of MTB may occur by aerosol droplets generated by a person with the active disease which are inhaled into the large and small airways, where infection can be established. It may also be due to use of high dose of corticosteroids among the sexually active age groups.

Table 2: Clinical history of patients with human immunodeficiency virus/pulmonary tuberculosis in the study

Clinical history	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)	*P*
PTB on treatment	1 (0.29)	4 (1.17)	5 (1.47)	0.051
Cough (progressive, recurrent, persistent, severe, chronic)	81 (23.75)	112 (32.84)	193 (56.60)	0.000
Weight loss (progressive, persistent)	15 (4.40)	20 (5.87)	35 (10.26)	0.000
Chest pain	17 (4.99)	22 (6.45)	39 (11.44)	0.000
Greenish sputum	8 (2.35)	4 (1.17)	12 (3.52)	0.001
Dyspnea	6 (1.76)	7 (2.05)	13 (3.81)	0.000
Hemoptysis	10 (2.93)	11 (3.23)	21 (6.16)	0.000
Night sweat	9 (2.64)	12 (3.52)	21 (6.16)	0.000
Herpes zoster	0 (0.00)	0 (0.00)	0 (0.00)	0.000
Anterior chest swelling	0 (0.00)	1 (0.29)	1 (0.29)	0.184
Lymph node swelling	0 (0.00)	1 (0.29)	1 (0.29)	0.184
Total	147 (43.11)	194 (56.89)	341 (100.00)	

PTB – Pulmonary tuberculosis

Table 3: Chest radiographic findings of patients with human immunodeficiency virus/pulmonary tuberculosis coinfection in the study

Radiographic findings	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)	*P*
Normal study	72 (24.41)	105 (35.59)	177 (60.00)	0.00
Reticulonodular opacities	25 (8.47)	24 (8.14)	49 (16.61)	0.00
Streaky opacities	3 (1.02)	0 (0.00)	3 (1.02)	0.17
Miliary opacities	4 (1.36)	3 (1.02)	7 (2.37)	0.00
Hilar lymphadenopathy	5 (1.69)	6 (2.03)	11 (3.73)	0.00
Right hydrothorax	0 (0.00)	1 (0.34)	1 (0.34)	0.18
Left lung collapse	2 (0.68)	0 (0.00)	2 (0.68)	0.17
Apical opacities	2 (0.73)	2 (0.68)	5 (1.69)	0.00
Lower/midzone opacities	2 (0.68)	0 (0.00)	2 (0.68)	0.17
Blunting of costophrenic angles	5 (1.69)	3 (1.02)	8 (2.71)	0.00
Consolidations	8 (2.93)	2 (0.73)	10 (3.39)	0.05
Background cystic/fibrotic changes	4 (1.36)	6 (2.03)	10 (3.39)	0.00
Thick-walled cavity	0 (0.00)	4 (0.34)	4 (1.36)	0.16
Mediastinal shift	3 (1.02)	1 (0.34)	4 (1.36)	0.03
Pleural effusion	1 (0.34)	0 (0.00)	1 (0.34)	0.18
Silhouette sign	1 (0.34)	0 (0.00)	1 (0.34)	0.18
Total	138 (46.78)	157 (53.22)	295 (100.00)	

Table 4: Pattern of chest radiographic findings in relation to age group in the study

Radiographic findings	0-12	13-25	26-38	39-51	52-64	65+	Total	*P*
Reticulonodular opacities	6	7	16	11	2	7	49	0.000
Streaky opacities	0	0	3	0	0	0	3	0.184
Miliary opacities	0	2	1	3	1	0	7	0.010
Hilar lymphadenopathy	2	2	3	4	0	0	11	0.003
Right hydrothorax	0	0	0	1	0	0	1	0.242
Lung collapse	0	0	0	2	0	0	2	0.198
Apical opacities	0	1	2	1	0	1	5	0.005
Lower/midzone opacities	0	0	2	0	0	0	2	0.198
Blunting of costophrenic angle (right/left/both)	0	0	5	2	1	0	8	0.055
Consolidations	0	2	3	0	1	4	10	0.008
Background cystic/fibrotic changes	0	2	4	1	1	2	10	0.002
Thick-walled cavity	2	0	0	2	0	0	4	0.072
Mediastinal shift	0	1	1	2	0	0	4	0.032
Pleural effusion	0	0	0	0	1	0	1	0.242
Silhouette sign	0	0	0	1	0	0	1	0.242
Normal study	34	26	69	31	13	4	177	0.001
Total	44	43	109	61	20	18	295	0.001

The gender distribution of patients in this study showed 140 (57.38%) for females and 104 (42.62%) for males, giving male:female of 1:1.3. This demonstrates that there is no wider margin of prevalence of HIV-related PTB among gender wise. This is in line with the study done by Bohara,[4,5,8,15] Peters *et al*. (male:female of 1:1.1),[16] and Olatunji *et al*. (male:female of 1:1.9).[14] However, it is in contrast with the study of Ahidjo *et al*. in Maiduguri,[6] North East Nigeria who reported male to female ratio of 1.3:1, Desalu *et al*. (male:female of 1.4:1)[12] and Bermudez *et al*.[2,11,24] The variation in the reported values may be attributed to the fact that most of the people in this part

of the country are polygamous in nature, suggesting the likelihood that the females got infected by their husbands.[6] Lack of information and good knowledge about HIV infection is another contributing factor as HIV infection is more pronounced among the less privileged.

The classical symptoms and clinical signs of PTB in HIV-seropositive patients such as low-grade fever, night sweats, cough, loss of appetite, chest pain, and hemoptysis demonstrated in this study are in consonance with the findings of other studies in Nigeria, African countries and other countries of the world such as Ahidjo *et al*.[6] reported productive cough (100%), oral thrush (87%), weight loss (83%), night sweats (78%), fever (75%), chest pain (50%), and herpes zoster (5%). Peters *et al*. reported chronic cough (89%), chest pain (74%), dyspnea (62%), nonproductive cough (11%), and cough with hemoptysis (18%).[16] Bermudez *et al*.[2,4,7,22] among others also reported similar findings. The similarity in the reported findings may be attributed to the adoption of the same diagnostic standards and classification of HIV-related PTB in adults and children by the American Thoracic Society and Centre for Disease Control and Prevention.[17] However, findings such as oral thrush and dermatological manifestations as reported by Ahidjo *et al*.[6] were not reported in this study.

The most common chest radiographic pattern in HIV-related PTB patients in this study was normal chest X-rays (60%); whereas primary and postprimary radiological findings such as hilar lymphadenopathy, hydrothorax, background cystic/fibrotic changes, apical opacities, lower/midzone opacities, lung collapse, and pleural effusion accounted for the least. The reported finding is similar to those of Ahidjo *et al*.,[6] who reported normal radiographs in 15 (25%) patients, hilar adenopathy in 5 (8%) patients, pleural effusion in 10 (16.7%), lower/mid-zone opacities 7 (11.6%), and reticulonodular opacities in 2 (3%) patients. Olatunji *et al*. in Sagamu,[14] South West Nigeria reported normal radiographs in 68.5% patients, features of TB in 27.8%, and pneumonia in 2.7%. The high rate of normal radiographic findings in this study may be related to immune status, as immunosuppressed patients may not mount adequate immune response to MTB. However, it is in contrast with the study by Awoyemi *et al*. in Ibadan,[10] who reported low incidence of normal chest X-rays in 2 (11%); miliary pattern in 2 (11%); pleural effusion in 2 (11%); hilar adenopathy in 2 (11%), localized and diffused lesions in 7 (37%) individuals respectively and pulmonary cavities in 3 (16%). Bermudez *et al*. in Cuba,[2] also reported low prevalence of normal chest X-rays (25%) with predominance of the primary radiological patterns.

The prevalence of thick-walled cavitations in this study is very low and accounted for 1.36%. Whereas the study by Olatunji *et al*.[14] reported cavitations in 31 (37.8%) patients with less CD4 cell count below 200 cells/mm^3. Ahidjo *et al*. reported apical opacities with cavitations in 9 (15%).[6] This might have been the patients involved in our study had higher CD4 cell count at point of presentation.

Age is also a factor which influence the clinical and radiographic features of TB.[17] However, the distribution of radiographic features of PTB according to age group were not reported by Ahidjo *et al*. among others.[6,10] The distribution of radiographic findings according to age group in this study in decreasing order shows that the age groups 26–38, 0–12, 39–51, and 13–25 years demonstrate predominance in normal chest X-rays with 23.38%, 11.52%, 10.50%, and 8.81%, respectively ($P \leq 0.005$). However, patients between 26–38 years shows predominance in reticulonodular opacities, 39–51 years shows predominance in miliary pattern and consolidations mostly seen in the elderly (65 years and above).

CONCLUSIONS

Normal chest X-rays constitute the major findings. TB coinfections have more preponderance in females. Although this study provides spectrum of findings in TB and HIV co-infection in a resource-constrained setup in a developing country with high prevalence of the two disease conditions, it has some limitations which are subject to future studies. These includes: CD4 cell count was not performed which would have helped in clinical staging of HIV infection, lack of mycobacterial culture, other associated risk factors were not documented such as cigarette smoking, alcoholism, chronic renal failure to mention but a few and possibility that presence of other respiratory infections such as bacterial pneumonia which may influence the pattern of abnormalities seen on the radiographs were not considered.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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