

Chest Radiographic Pattern of Pulmonary Tuberculosis

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ABSTRACT

Background: Pulmonary tuberculosis (PTB) is a bacterial infection exhibiting significant rates of illness and death, causing 2-3 million annual fatalities all over the world. Developing countries are mostly affected, and the disease is associated with different chest radiographic patterns of presentations, which include pulmonary fibrosis, pleural effusion, lung consolidation, cavitation, hilar/mediastinal lymphadenopathy and disseminated miliary disease.

Objective: The study was conducted to evaluate the radiographic presentation/pattern of PTB in adult patients with pulmonary tuberculosis.

Methodology: This prospective study was conducted over a six-month period at the Radiology Department of the University of Abuja Teaching Hospital (UATH) Gwagwalada-Abuja, Nigeria. One hundred and thirty-two (132) adults who were bacteriologically proven to have pulmonary tuberculosis were recruited into the study and their digitally processed chest radiographs were reviewed directly on a computer console. Abnormal radiographic pulmonary features on the chest radiographs were identified and recorded on a data sheet.

The data were analysed using SPSS software version 25.0. Armonk and results presented on tables and bar charts. The significant findings were highlighted, and P-values ≤ 0.05 were considered statistically significant.

Results: Various radiographic features/pattern of PTB were demonstrated, which include: consolidations, pleural effusion, cavity, lymphadenopathy, millitary TB, lung collapse and lung destruction. Consolidations was the largest, constituting 106 (56.4%), while lymphadenopathy and lung destruction each accounted for 2 cases (1.1%).

Conclusion: The radiographic pattern of PTB was evaluated and shows that lung consolidation is the most common pattern, with lung destruction and hilar lymphadenopathy being the least common. Thus on reporting chest radiograph those findings should be considered in PTB diagnosis.

KEYWORDS: Pulmonary tuberculosis, chest radiograph, radiographic pattern

INTRODUCTION

Pulmonary tuberculosis (PTB) is a bacterial infection caused by Mycobacterium tuberculosis. It is transmitted from one person to another by inhaling infected respiratory droplets often during coughing, singing, or ingestion of contaminated food such as milk products.¹

PTB is a highly contagious disease that contribute significantly to chronic pulmonary disease and is one of the leading causes of death worldwide.

The disease typically affects the lungs (pulmonary TB) but can affect other organs and sites of the body. Most people (about 90%) who develop the disease are adults, with more cases among men than women. It has been reported that PTB kills an estimated 2-3 million people annually. In Nigeria, which is ranked fourth among the 22 high-burden countries in the world and had the highest number of new cases in Africa with over 300 cases per 100,000 population.⁴ The disease is highly prevalent in Nigeria, with a high disease burden on the patients, their families, and society at large.⁵ The study was conducted to evaluate the radiographic presentation/pattern of PTB in adult patients with pulmonary tuberculosis.

MATERIALS AND METHODS

The study was a prospective study conducted in the Department of Radiology, University of Abuja Teaching Hospital, Gwagwalada, over a 6 months period involving a total of 132 patients aged 18-70 years with clinically and laboratory confirmed PTB. Serial recruitment of diagnosed PTB patients who met the inclusion criteria and had been referred to the Radiology department for chest X-rays from the hospital clinics was conducted for the study.

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The inclusion criteria for the study were adult patients aged 18-70 years who were bacteriologically proven to have PTB, had a BMI of 18.5-25kg/m² and had, consented to the study. The exclusion criteria were PTB patients aged 18 years or younger or 70 years or older. A sample of 132 patients was recruited for this study. A non-random, convenient, consecutive recruitment technique was used, in which patients who were readily available, confirmed to have pulmonary tuberculosis, and willing to participate in the study were recruited from the hospital various clinics. Serial identification number were assigned to these patients who met the entry criteria until the sample size reached 132.

ETHICAL CONSIDERATION

Approval for the study was obtained from the Health Research Ethics Committee (HREC) of University of Abuja Teaching Hospital (UATH), Gwagwalada-Abuja, Nigeria with protocol number: UATH/HREC/PR/272. All the participants who met the criteria consented to the study prior to commencement of the research work and the study was conducted in accordance with the Declaration of Helsinki. To ensure high level of confidentiality, anonymity was strictly maintained and a written informed consent to publish the findings of this research to any journal was also obtained from all the participants.

FUNDING DECLARATION

No funding from any source and the authors bore the funding of the research.

DATA ANALYSIS

The data obtained were analysed and processed using the statistical package for social sciences (SPSS) version 20.0. All results were expressed as mean $\pm$ SD and presented in tables, graphs and charts as appropriate. Statistical parameters such as the mean, the student t-test, and correlation analysis were used for the association between the different variables. P values of 0.05 or less were considered statistically significant.

Standard chest X-rays were taken in posterior-anterior (PA) view by a radiographer in the Radiology Department using a static X-ray machine (G.E. X-ray machine model XS-1A, USA-2021).

Chest radiographs of the recruited patients were reviewed and the radiographic findings documented appropriately in the structured questionnaire/proforma.

RESULTS

A total of 132 patients were recruited in the study with an age range of 18-70 years. The majority of participants (37) were aged 30-39, constituting 28% of the research participants and the least affected group with pulmonary tuberculosis were among those below 20 years of age, constituting

5.3%. 88 participants were males, as against 44 females, giving a male to female ratio of 2:1. The mean age of patients with PTB was 38.8 ± 14.0 (mean $\pm$ SD) as shown Table 1.

Table 1: Frequency distribution table showing age-group distribution, gender, mean SD, CI and range of the research participants.

Age group (Years)	Gender		Total, n(%)
	Male, n(%)	Female, n(%)	
<20	4(4.5)	3(6.8)	7(5.3)
20-29	20(22.1)	11(26.1)	31(23.5)
30-39	25(27.8)	12(28.5)	37(28.0)
40-49	20(22.7)	7(14.8)	27(20.1)
50-59	7(8.5)	6(13.6)	13(10.2)
≥ 60	13(14.2)	4(10.2)	17(12.9)
Total	88(100.0)	44(100.0)	132(100.0)
Mean $\pm$ SD, median, CI, range:	38.8 $\pm$ 14.0,	37.0, 37.1-40.5, 18-70	
Gender:			
Male			88(66.7)
Female			44(33.3)
TOTAL			132(100)

SD-Standard deviation CI-Confidence interval

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Single or multiple radiographic patterns were reported, with the single pattern constituting the most common presentation, involving 81 participants (61.4%), while 46 (34.8%) and 5 (3.8%) showed two and three radiographic features, respectively, as shown in Table 3

Table 2: number of radiographic findings and their related frequency of occurrence

Radiographic findings among adult with pulmonary tuberculosis	Frequency(N=132)	Mean±SD
One (1) feature	81(61.4%)	8.49±1.44
Two (2) features	46(34.8%)	8.38±1.14
Three (3) or more features	5(3.8%)	7.90±2.27
F		0.489
P-value		0.615

F-Analysis of variance

Consolidation was the predominant PTB feature in 106 participants (56.4%), followed by lung cavity in 33 participants (17.6%). 14.4% of the participants had pleural effusion and 7.4% had a miliary pattern, while lung collapse was observed in 2.1% of the participants. 1.1% each had destroyed lung syndrome and hilar/paratracheal lymphadenopathy (Figure 1).

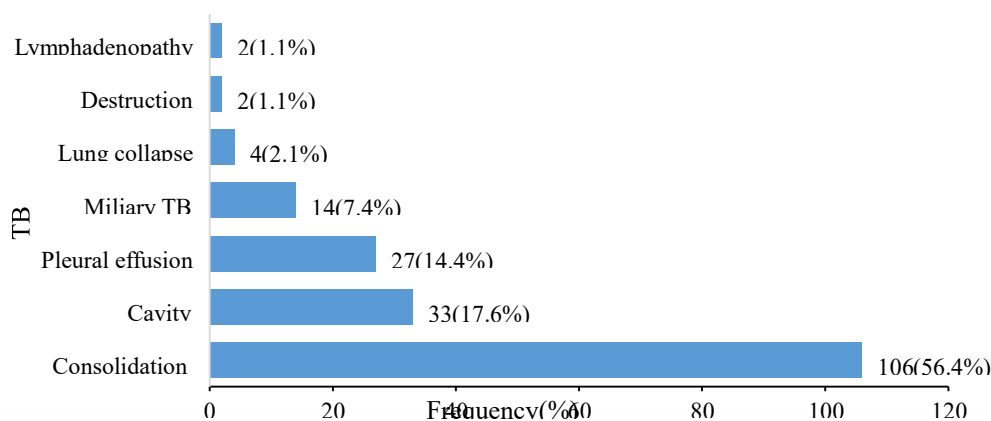


Figure 1: Bar chart showing the pattern of findings in patients with PTB.

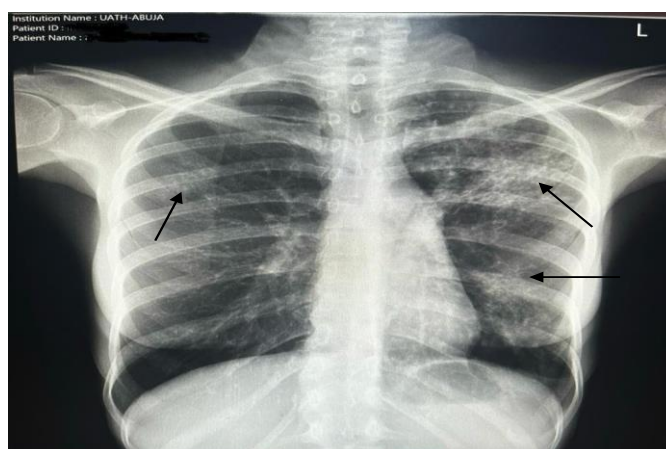


Figure 2: plain Chest radiograph showing patchy reticulonodular opacities (black arrows) consistent with consolidation.

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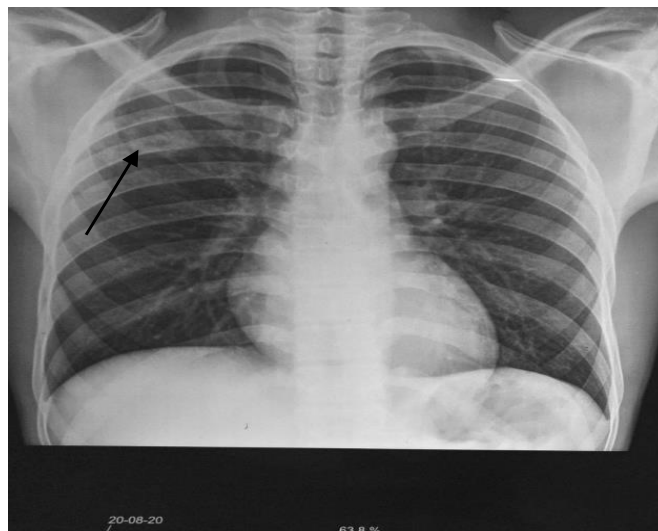


Figure 3: plain Chest radiograph showing a thick walled cavitary lesion in the right upper lung zone (black arrows)

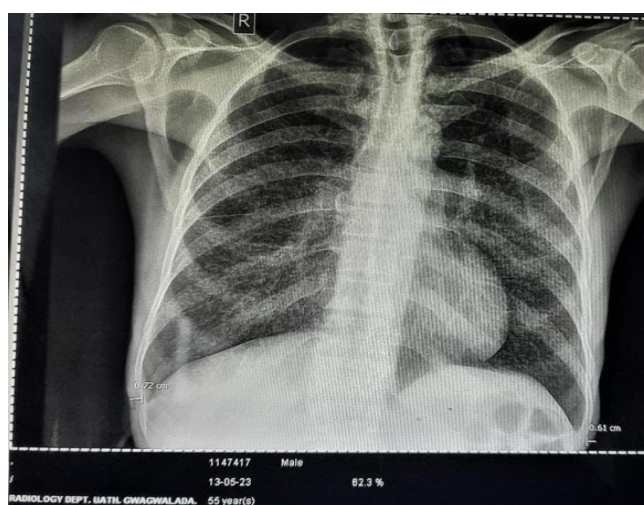


Figure 4: plain chest radiograph shows generalized diffuse miliary pattern with marked thinning of the lateral chest wall soft tissues consistent with wasting.

DISCUSSION

PTB is a chronic lung disease which often present with different radiographic patterns on chest radiograph. The disease is associated with significant weight loss.⁶ The majority of the subject in this research were males in the age range of 30-39 years, accounting for 27.2% of all male participants and 69.7% of total participants. This finding might be due to the severity of PTB disease,⁷ as men's health seeking behaviour is mainly influenced by the severity of a disease. Although, research evidence suggest that men generally are less likely to seek healthcare in comparison to women.⁷

Socio-economic status is also associated with appropriate health seeking behaviour among men. Men in this environment have a high level of responsibility to their families for provision and thereby serve as bread winners, and by direct extension, are the custodians of the household cash.⁸ In Northern states of Nigeria, as in most parts of Nigeria, women commonly have less power and autonomy than men in making decisions about their own healthcare as men often control the household's cash, making it difficult for women to pay for healthcare or for transportation to healthcare facilities.⁸ Thus, women suffering from an illness report less frequently for healthcare as compared to men.⁸

Seven abnormal radiographic patterns of PTB manifestation on chest radiograph were identified (consolidation 56.4%, cavitation 17.6%, pleural effusion 14.4%, millitary 7.4%, lung collapse 2.1%, hilar lymphadenopathy 1.1% and lung destruction 1.1%). Other patterns such as pleural thickening were not demonstrated in our study as compared to similar related studies. This discrepancy in our findings may be attributed to the imaging modality employed for the diagnosis by other authors. Ito et al⁹, ashu et al, Rizz et al¹⁰ and Heusel et al¹¹ shows that pleural thickening was an additional radiographic pattern seen in cross-sectional radiologic imaging modality (computed tomography (CT), magnetic resonance imaging (MRI)) give more information of abnormal partern in patient with PTB than conventional chest X-ray which was the investigating tool we used in this index study. Thus, according to Rizzi et al¹⁰ MRI can be used to diagnose PTB in pregnant women as an alternative to both conventional x-rays and computed tomography.

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Consolidation was the dominant radiographic presentation accounting for about 56.4% followed by a cavitary lesion accounting for 17.6%. The least observed features were hilar lymphadenopathy and lung destruction, observed in 1.1% of participants. Other radiographic patterns were pleural effusion (14.4%), miliary pattern (7.4%) and lung collapse (2.1%). Madhukar et al., in a similar study reported patchy consolidation as the most common radiographic presentation of PTB. Also, similar findings of consolidation as the commonest pattern of presentations were recorded by many author¹. However, Ahidjo et al² in a similar study recorded a different pattern as the commonest; these variations in findings could be attributed to the nature of the study as their study was conducted on HIV-related PTB patients and likely the different geographical variation of where the study was conducted, likely accounting for the variation in the radiographic pattern with our study. The frequency of occurrence of different radiographic pattern among participants shows that 81 individuals (61.4%) had only one characteristic radiographic pattern of PTB while 46(34.8%) and 5(3.8%) showed two and three characteristic radiographic pattern respectively. It was worth noting that no group of individuals demonstrated more than 3 characteristic patterns.

CONCLUSION

The most common abnormal chest radiographic pattern in pulmonary tuberculosis patients was consolidation, and the most common age group affected was those between 0 and 30 years of age. There was no statistically significant relationship between sex and abnormal chest radiograph patterns.

REFERENCES

- 1) WHO global tuberculosis report. World health organization. 2022; 1
- 2) Ford ES, Mannino DM, Redd SC, Mokdad AH, Mott JA. Body mass index and asthma incidence among USA adults. *Eur Respir J*. 2004;24(5):740–4.
- 3) Ibrahim M, Chom N, Hamidu A, Atalabi M, Grace I, Tabari AM. Radiographic evaluation of lateral chest wall soft-tissue thickness in adult pulmonary tuberculosis patients in Zaria, Nigeria. *Sub-Saharan African J Med*. 2016;3(1):15.
- 4) Van Crevel R, Karyadi E, Netea MG, Verhoef H, Nelwan RHH, West CE, et al. Decreased Plasma Leptin Concentrations in Tuberculosis Patients Are Associated with Wasting and Inflammation. *J Clin Endocrinol Metab*. 2002 Feb 1;87(2):758–63.
- 5) Obiora WCO, Ajobiwe HF, Ajobiwe JO, Ogundejì AA, Umeji LC. Prevalence of Pulmonary Tuberculosis in Unisex Adults at the National Hospital, Abuja, Nigeria. *Sch J Appl Med Sci*. 2020 Jun 30;8(6):1597–604.
- 6) Anna V, Gidado M. Post-2015 Development Agenda: Nigeria Perspectives - Tuberculosis. *Copenhagen Concensus Cent*. 2015;1.
- 7) Ogunyemi A, Egemba T, Onigbogi O. Health-seeking Behaviour and Self-rated Health of Adult Men in an Urban Local Government Area in Lagos, Nigeria. *Ann Heal Res*. 2021;7(2):153–164.
- 8) Sunday O. Decision-making Power and Healthcare Seeking Behaviour Among Women in Northern States of Nigeria. *ResearchGate*. 2022;10–1.
- 9) Ito I, Ishida T, Togashi K, Niimi A, Koyama H, Ishimori T, et al. Differentiation of bacterial and non-bacterial community-acquired pneumonia by thin section computed tomography. *European Journal of Radiology*. 2009; 72:388–395.
- 10) Rizzi EB, Schinina V, Cristofaro M, Goletti D, Palmier F, Bevilacqua N, et al. Detection of pulmonary tuberculosis: Comparing MR imaging with HRCT. *BMC Infectious Diseases*. 2011; 11:243 –49.
- 11) Heussel CP, Kawzor HU, Heussel G, Fisher B, Mildnerberger P, Thelen M. Early detection of pneumonia in febrile neutropenic patients: Use of thin section CT. *American Journal of Roentgenology*. 1997; 169:1347–575
- 12) Madhukar P, Mark P N, Catherine C. Tuberculosis diagnostics: State of the art and future directions. *Tuberc Tuber Bacillus* Second Ed. 2016;(69):363–78.
- 13) Bahalla AS, Goyal A, Guleria R, Kumari A. Chest tuberculosis: Radiological Review and Imaging recommendations. *The Indian Journal of Radiology and Imaging*. 2015; 25(3):213–225.
- 14) Balowa MB. Chest radiographic patterns among HIV positive and HIV negative adults with pulmonary tuberculosis at Mwanayamala Hospital TB clinic. A dissertation: Muhimbili University, September, 2012.
- 15) Akhigbe RO, Ugwu AC, Ogoedom MP, Maduka BM, Jayeoba BI. Abnormal chest radiographic patterns in patients with pulmonary tuberculosis in lagos state, Nigeria: single centre study. *Int. J Med. Health research*. 2019; 5(1): 36 – 40.
- 16) Ahidjo A, Yusuph H, Tahir A. Radiographic Features of Pulmonary Tuberculosis among HIV Patients In Maiduguri. *Nigeria Annals of African Medicine*. 2005; 4(1):7–9.