

Five Chest Radiographic Features Imputed To Primary Pulmonary Tuberculosis among Smear Positive Patients in Uyo, Nigeria

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Abstract

Pulmonary tuberculosis (PTB) is sub-classified into primary or post-primary. This classification is based on the disease being recently transmitted or remotely acquired respectively. To evaluate the five radiographic features imputed to primary PTB in Uyo, Nigeria. The study was carried out in University of Uyo teaching

hospital (UUTH), Uyo, Nigeria from January, 2013 to February, 2015. Chest radiographs were only taken in posterior-anterior view using standard protocols. All patients who have positive chest radiographic features of primary PTB and have had Ziehl-Neelsen sputum positive smears are included in this study. Outcome to be measured are the five radiographic features of primary PTB namely lung parenchymal consolidation, miliary lesions, atelectasis, hilar lymphadenopathy and pleural effusion. Statistical analyses will be performed using SPSS 13. A total of 64 patients had chest radiographic features of primary PTB with 40 males and 24 females giving M:F ratio of 1.66. The number of positive radiographic features (144) exceeded the number of patients (64). In descending order of frequency of primary PTB radiographic features, it is lung parenchymal consolidation (n=56, 38.89%), miliary lesions (n=48, 33.33%), hilar lymphadenopathy (n=20, 13.89%), atelectasis (n=16, 11.11%) and pleural effusion (n=4, 2.78%). Bilateral lung lesion and multi-zonal lung lesions predominate. In conclusion, the commonest chest radiographic features of primary pulmonary tuberculosis in Uyo, Nigeria in descending order were lung consolidation, miliary lesions, hilar lymphadenopathy, atelectasis and pleural effusion.

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1. Introduction

Pulmonary tuberculosis (PTB) is an infection of the lungs by *Mycobacterium tuberculosis* (MTB) mainly through inhalation of droplet nuclei that contain the bacilli. PTB has been categorized as primary or post-primary (Koh et al., 2010). The later is also called reactivation or secondary PTB. The basis of this classification is hinged on the time between the initial infection with MTB and the onset of clinical disease (Geng et al., 2005). The exact distinguishing interval ranges from 1 to 5 years (Geng et al., 2005). About 5% of people will come down with active disease within two years of exposure to MTB (Koh et al., 2010). This is what is termed as primary PTB since there was no previous exposure to the bacteria.

Primary PTB occurs mainly in the extremes of age especially in infancy and childhood (Koh et al., 2010). This is not unconnected with the low immune status at these periods. However, recrudescence of primary PTB in adults is seen recently due to emergence of human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) (Koh et al., 2010). This group of patients have impaired cell-mediated immunity and are thought to be more likely infected with development of active disease (This official statement of ATS, 2000).

1.1 Rationale for the choice of chest radiography
PTB has posed a massive threat to global health (Warner et al., 2014; Uduma et al., 2013). Ninety-five percent of tuberculosis cases occur in developing countries, where few resources are available to ensure proper treatment and where HIV infection may be common (This official statement of ATS, 2000). This informs our use of cheap and readily available radiological tool (chest radiography) to evaluate the radiographic patterns of primary PTB in our environ. Some chest radiographic features are known to be common with primary PTB. These features are pulmonary parenchymal opacity (consolidation), hilar or mediastinal lymphadenopathy, segmental atelectasis, pleural effusion and miliary lesions (Koh et al., 2010; Geng et al., 2005; This official statement of ATS, 2000; Eduwem et al. 2015. Gupta et al., 2015)

2. Objectives of Research

To evaluate the five chest radiographic features imputed to primary pulmonary tuberculosis in Uyo, Nigeria.

To identify the commonest chest radiographic features in primary pulmonary tuberculosis in Uyo, Nigeria.

3. Justification of Research

Evaluation of the chest radiographic features of primary pulmonary tuberculosis will give an insight into the problem of primary tuberculosis in our local environ. The findings would be expected to highlight the commonest chest lesions, thus guiding preparedness for management.

4. Materials and Methods

The period under investigation extends from January, 2013 to February, 2015. The site of study is University of Uyo teaching hospital (UUTH), Uyo. This is located in Akwa Ibom state, South South geopolitical zone of Nigeria in Africa. It is a tertiary care hospital that attends to the health needs of Uyo, Akwa Ibom state, Nigeria as well as other cities of the state and neighbouring states.

4.1 Radiographic techniques

Chest radiographs were taken in the posterior to anterior view only using the standard protocol. The X-ray machine employed for this study is Toshiba radiographic system (RADREX), model MRAD A32S, manufactured in October, 2012. The printer used is Carestream model, Dry view 5850 laser imager, manufactured on 24th June, 2007. Imaging parameters for the chest radiography were as follows: image size, 17 × 14-inch film-screen cassette; maximum tube currents, 650 mA; usual exposure amount, 1 or 2 mAs; tube voltage, 100-120 kVp; focal spot size, 1.2 mm; focal film distance, 100-183 cm. Pediatric imaging parameters were adjusted accordingly.

4.2 Inclusion criteria

All patients who have positive chest radiographic features of primary pulmonary tuberculosis and have had a positive smear from sputum samples performed with Ziehl-Neelsen staining method are included in this study.

Demographic data and clinical features will be collected. Chest radiographs will be analyzed by a minimum of two radiologists for radiographic diagnostic features of primary PTB. When multiple radiographs are available, the radiograph performed on first visit will be chosen for analysis.

4.3 Main outcome to be measured

Main outcome to be measured are the aforementioned features of primary PTB as defined below. Consolidation is defined as a homogeneous increase in pulmonary parenchymal opacity that obscures the margins of vessels and airway walls (Uduma et al., 2013, Koh et al., 2010). Hilar adenopathy is considered if there is a dense lobulated enlarged hilum. Atelectasis is a dense parenchymal band lesion with segmental

lung volume loss. Pleural effusion is homogenous opacification of lower lung lobe with obscuration of ipsilateral hemi-diaphragm and cardiac border. There may be meniscus sign depending on the volume of the effusion. Miliary lesions are same sized innumerable tiny round opacities with wide and symmetrical distribution throughout both lungs accompanied by obliteration of the vascular markings (Koh et al., 2010). These tiny opacities vary in size from pin-prick size to 1 - 2 mm in diameter. Lesions are considered to be in the upper lung zone if cephalad to the pulmonary hila and in the lower lung zone if caudad to the hila (Uduma et al., 2013).

4.4 Exclusion criteria and statistical analysis

Excluded in this study will be Ziehl-Neelsen smear negatives, extra-pulmonary tuberculosis, poor or un-diagnostic radiographs. Immune status of enrollee and previous treatment regimen will not be considered in this study. Statistical analyses will be performed using commercially available software (SPSS 13.0; SPSS, Chicago, IL).

A total of 64 patients were observed to have chest radiographic features imputable to primary PTB. Males were 40 in number and females were 24 giving a male to female ratio of 1.66. 15.62% (n=10) were seen below the second decade of life whereas no case was observed after the 6th decade of life. The highest (n=16, 25%) cases were seen in 40-49 age range with M:F ratio of 1.67 (see table 1). The number of positive radiographic features exceeds the number of patients with 144 radiographic features seen in 64 patients. The commonest feature is lung parenchymal consolidation (n=56, 38.89%), followed by miliary lesion (n=48, 33.33%), hilar lymphadenopathy (n=20, 13.89%), atelectasis (n=16, 11.11%) and pleural effusion (n=4, 2.78%) (see table 2). Bilateral lung lesion is the commonest lesion (38%) followed by right lung lesion (34%) and left lung lesion (28%) (see figure 1). Similarly, multi-zonal lung lesion is the commonest, followed by upper zonal lung lesion, mid-zonal lung lesion and lower lung zonal lesion (see figure 2).

Results

Table 1: Studied Population Of Patients Who Had 5 Radiographic Features of Primary PTB.

Age Range	Males	Females	Total
0-9	4	6	10
10-19	2	0	2
20-29	4	8	12
30-39	6	0	6
40-49	10	6	16
50-59	2	4	6
60-69	12	0	12
70-79	0	0	0
80-89	0	0	0
90-99	0	0	0
TOTAL	40	24	64

Table 2: Different Components Of 5 Radiographic Features of Primary PTB

Radiographic features of primary PTB	Frequency (%)
Lung Consolidation	56 (38.89%)
Miliary Lesions	48 (33.33%)
Lymph Node	20 (13.89%)
Atelectasis	16 (11.11%)
Pleural Effusion	4 (2.78%)
Total	144

Figure 1: Lung Localization Of Radiographic Features Of Primary PTB.

Chart Title

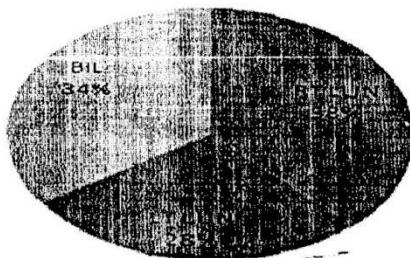
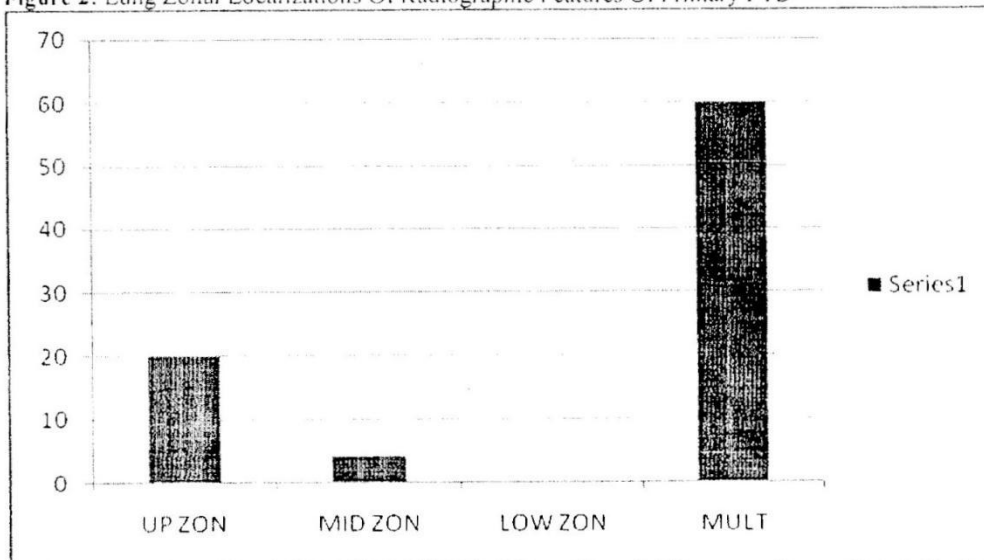


Figure 2: Lung Zonal Localizations Of Radiographic Features Of Primary PTB



(UP ZON-upper zone, MID ZON-middle zone, LOW ZON-lower zone, MULT-multiple zones)

Discussion

The radiographic appearances of primary pulmonary tuberculosis are limited but somewhat characteristic. In this study, the two most frequent radiographic features of primary PTB are lung parenchymal consolidation and miliary lung lesions (see table 2). This is not surprising as lung consolidation is the radiographic manifest of Ghon focus which is the pathological signpost of advent of primary PTB. Lung consolidation is easily detectable as it appears radiographically as a subtle or segmental change in lung radiopacity (Gupta et al., 2015). Miliary lesion on the other hand is the consequence of haematogenous permeation of the bacilli leading to lung parenchymal involvement outside the initial site of pulmonary involvement (Dong et al., 2010). Despite the pinprick dimension of these opacities, the multiplicity of these lesions with concomitant wide spread make missing out these lesions even by the unwary to be almost unpardonable. However, there are cases that are so microscopic that their visibility is only shown by chest computed tomogram (Dong et al., 2010).

One would have expected the highest incidence of primary PTB to be in the extremes of age (This official statement of ATS, 2000; Newton et al., 2008; Geng et al. 2005). Though there is still some sizeable incidence in these extremes of age in this study, but the highest incidence is in the adolescence and adulthood (see table 1). This may not be unconnected with any co-existing immunosuppression like HIV, AIDS and diabetes mellitus (This official statement of ATS, 2000; Gupta et al., 2015; Geng et al. 2005). HIV and AIDS have been known to have a rising incidence among adolescents and adults. Primary PTB as

pointed out previously is a disease that become active in a short period after inoculation or infection as a result of poor or delayed cell mediated immunity. Correlation of primary PTB and HIV/AIDS is outside the scope of this study. In this study, there is male to female ratio of 1.6:1. This male predominance has been seen in other studies (Edumwem et al., 2015) This may be linked to the greater ambulence of men emanating from their breadwinning posture in African setting with attendant increased susceptibility to airborne diseases.

6.1 Lung lesion multiplicity and localization

The number of radiographic lesions of PTB exceeds the number of patients with primary PTB. This is because of multiplicity of lesions in a single patient. For example, lung consolidation were commonly found to be co-existing with ipsilateral hilar lymphadenopathy. This same reason of lesion multiplicity also explains bilaterality of lesions exceeding unilaterality. In terms of pure unilaterality, frequency of right lung lesion exceeded left lung lesion by 1.3 : 1. In terms of descending order of lung zonal localization of primary PTB in this study, it is multiple lung zonal lesions, upper zonal, middle zonal and lower lung zonal lesions. The upper zonal lesion exceeding lower lung zonal lesion was also observed in other studies (Koh et al., 2010; Gupta et al., 2015). The input from miliary lesions (a diffuse lesion) in this study skewed the findings from upper zonal lesions as traditionally would have been expected to multiple lesions. MTB as an aerobe would prefer the region of the lungs with the highest ventilation like the upper zone (Eduwem et al., 2015).

6.2 Significance of study

The significance of this study is the identification and characterization of the five known features of primary PTB and by extension primary PTB cases. Invariably, these patients are more likely to have impaired immunity. This would necessitate critical intervention which will ultimately slow down transmission to the populace (Gillespie et al. 2014).

6.3 Study limitation

This study has some limitations that were inadvertently introduced. Our studied subjects were limited to patients sent for chest radiography, therefore may not be generalizable to the entire community. Selection bias may have been introduced since some radiographs were disqualified due to poor film quality or inadequate bio-data. Some mediastinal/ hilar lymphadenopathy or minimal pleural effusion may have been missed as only chest postero-anterior view was used. Similarly, some lesions may have been under-reported, for example the oversight of mild parenchymal abnormalities of consolidation (Koh et al., 2010). It is not improbable that some Ziehl-Neelson positive cases of PTB were not captured in this study, as they may have presented as normal chest radiographs. This is because it has been documented that radiographs may be normal or show only mild or nonspecific findings in patients with active disease (Eduwem et al., 2015). Similarly, false positives may have been included unwittingly as BCG vaccination occasionally affect host immune response, thus altering the chest radiographic picture of PTB (Eduwem et al., 2015). One major quagmire we had was what to do with radiographs that had co-existent features of primary and post-primary PTB. The consensus was exclusions since our concern was just purely the five radiographic features imputable to primary tuberculosis

Conclusion

In conclusion, this research highlights that the commonest chest radiographic features of primary pulmonary tuberculosis in Uyo, Nigeria in descending order of involvement were lung parenchymal consolidation, miliary lesions, hilar lymphadenopathy, atelectasis and pleural effusion.

Similarly, multiplicity and bilaterality of radiographic lung lesions in a single patient predominate.

Recommendations

Concerted effort by government will be necessary to reduce the burden of primary pulmonary tuberculosis. Further effort should also be

channelled to stem any cause of immune suppression which invariably predispose to primary PTB.

Multi-centre study with correlation to immune suppression like HIV instead of a single institution study will yield even more information on the problem of primary pulmonary tuberculosis.

Funding and Policy Aspects

Government and international agencies should readily fund the above mentioned widespread research.

In addition, patients detected with primary pulmonary tuberculosis should have an avenue for free and speedy access to medications to avert the lesions (for example miliary lesions overwhelming the lungs in the face of impaired immunity).

Authors' Contribution and Competing Interests

UFU conceived the research. OIG and AEK did the laboratory investigations prior to radiographic examinations. UV, EJU and EP categorized and referred the enrollee for investigations and imaging. UFU and EDU analyzed the radiographs. Data were collated and analyzed by UFU, AEK, OIG, UV. All authors read and made inputs into the final manuscript.

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