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## Chest Radiographic Predictors of HIV/AIDS in Childhood Pulmonary Tuberculosis-An African Study

### Abstract

**Background:** Tuberculosis remains a major public health problem in Nigeria and the world at large. Substantial number of cases of tuberculosis occurs in children, especially in this era of HIV pandemic. Chest radiograph is an important examination in evaluation for pulmonary tuberculosis. There is paucity of literature on the chest radiographic features predictive of HIV in pulmonary tuberculosis patients.

**Objective:** To describe the pattern of chest radiographic features of children with tuberculosis. The chest radiographic features predictive of HIV in tuberculosis patients were also determined.

**Methods:** A review of chest radiographs of children below the age of 15 years, who were managed for tuberculosis at the University of Maiduguri Teaching Hospital, Maiduguri, Nigeria, over a period of four years was conducted.

**Results:** The chest radiographs of the 111 children with tuberculosis taken at presentation who were subsequently managed for tuberculosis were reviewed. The commonest chest radiographic feature was peri-hilar and basal infiltrates (broncho-pneumonic consolidations). The peri-hilar and basal infiltrates occurred with other radiographic features as well. Hilar adenopathy and miliary shadows were common among the children younger than 5 years. Other radiographic features included, reticulonodular opacities (12 cases) and cavitary lesions (9 cases). Reticulonodular chest radiographic feature was highly predictive of HIV infection.

**Conclusion:** Majority of children with tuberculosis had peri-hilar and basal infiltrates on chest radiograph. We recommend screening of children with peri-hilar and basal infiltrates on chest radiograph for tuberculosis, likewise, screening of all tuberculosis patients for HIV especially those with reticulonodular chest radiographic features

**Keywords:** Radiographic, Chest predictors, HIV, Pulmonary tuberculosis

### Introduction

Tuberculosis (TB) is a major public health problem especially in the developing countries of Asia and Africa.<sup>1,2</sup> The global resurgence of TB is mainly as a result of HIV pandemic and poor socio-economic condition of families and communities or states.<sup>2,4</sup> These factors make the children vulnerable to Human Immunodeficiency Virus (HIV) infection and malnutrition, which are important factors that

predispose to TB infection and disease in children.<sup>2-5</sup> The chest radiograph (CXR) is usually requested in the course of investigating a child presenting with cough. The early use of chest radiography in the decision tree is advocated in TB.<sup>6</sup> When the chest radiographic features are suggestive of pulmonary tuberculosis (PTB), it is important to know the HIV status of the patient especially in the resource-constrained settings with high HIV infection rates.

Chest radiograph is essential for the evaluation of every suspected case of TB, pulmonary or other forms. This is because the lungs serve as a portal of entry in more than 98% of cases of TB in children, even though about 25-30% of childhood TB is extrapulmonary.<sup>4</sup> Chest radiographic findings consistent with TB in adults and children have been reported.<sup>7-11</sup> In recent years, the role of computerized tomography (CT) scan in the evaluation of paediatric patients with TB disease has been studied. It has increased sensitivity when compared with chest radiographs. However, CT examination is not available in many parts of the developing economies, and where available, the cost is usually prohibitive to most people. The pattern of chest radiographic features of children with PTB in Maiduguri, Northeastern Nigeria in the era of HIV pandemic was retrospectively studied and the predictors of HIV were evaluated.

### Methodology

A review of chest radiographs of children below the age of 15 years, who were managed for PTB with or without HIV at the University of Maiduguri Teaching Hospital, Maiduguri, Nigeria, over a period of four years was conducted. Ethical clearance for the study was obtained from the research and ethical committee of the University of Maiduguri Teaching Hospital.

The patients were managed at the infectious diseases clinic and in-patients of the Paediatric Department. Bio-data of the patients including age, sex and address were collected. The HIV status of each of the patients was verified.

### TB Diagnostic Criteria

The diagnosis of children with TB was in line with the Stop TB Strategy, taking into consideration clinical presentation of TB. The International Standards for TB Care, WHO's TB treatment guidelines and WHO's TB/HIV clinical manual were used for guidance.<sup>12</sup> These guidelines thus include recommendations for HIV-infected children. The diagnosis of TB was made from a suggestive history, clinical examination and relevant investigations, e.g., the tuberculin skin test (TST), CXR and sputum smear for acid-fast bacilli. Although specimen for AFB

was not always possible, it was obtained in some patients, e.g., by sputum microscopy in children with suspected pulmonary TB who were old enough to produce sputum sample. A trial of treatment with TB medications was not done in this study as a method of diagnosing TB in children.

### Chest Radiography

The chest radiographic technique for positioning used were antero-posterior (AP) for younger children and postero-antero- for older children (PA). In PA position, the patient faces the film chin up with the shoulders rotated forward to displace the scapulae from the lungs. Exposure is made on full inspiration for optimal visualization of the lung bases, centering at T5 where applicable. In older females the breasts were compressed against the film to prevent them obscuring the lung bases. An FFD of 180cm was used which reduces magnification and produces a sharper image. The chest X-rays were reported by 2 radiologists with consensus. While in AP projection the patient faces the X-Ray tube and the film behind.

### Statistical Data Analysis

Data obtained was entered into a computer, analysis was done using SPSS version 16.0 (version 16.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics was used for analysis of categorical variables presented in form of frequency distribution tables and percentages. The means and standard deviations were calculated for continuous variables. Association between the various chest radiographic pattern and HIV status were analysed using Chi-square. HIV predictors among the radiographic features of PTB were determined using univariate analysis. The sensitivity, specificity, positive and negative predictive values were determined for the radiographic features of PTB.

### Results

A total of 116 children were managed for TB during the study period. The chest radiographs of the 111 children with pulmonary TB taken at presentation who were subsequently

managed for PTB were reviewed. The radiographs of the other 5 patients were not obtained, and hence excluded from subsequent analysis. The mean age  $\pm$ SD was  $3.85 \pm 2.11$  years with a range of 4 months to 14 years. The commonest chest radiographic pattern (Table 1) among children with PTB was peri-hilar and basal infiltrates (broncho-pneumonic consolidations). They occurred in same radiograph with other radiographic features as well accounting for more radiologic features than the sample size.

The chest radiographic pattern varied with age. While broncho-pneumonic consolidation occurred commonly among the younger age groups ( $\leq 5$  years), lobar pneumonic consolidation was commoner among the older children ( $>5$  years),  $p = 0.003$ . Hilar adenopathy and miliary shadows were also commoner among the children younger than 5 years. The distribution of chest radiographic pattern and the age of the patients are shown in Table 2.

The chest radiographic appearance of the HIV positive and negative children is shown in Table 3. Only reticulonodular chest radiographic feature was statistically significant in suggesting HIV infection, while miliary shadows were commoner among the HIV- infected children compared to the non-infected children, although not significant statistically. Sensitivity, specificity, positive and negative predictive values of reticulonodular and bronchopneumonic chest radiographic features predictive of HIV infection is shown in table 4. While reticulonodular chest radiographic feature has a high specificity and positive predictive values, bronchopneumonic radiologic feature did not exhibit either.

**Table 1:** Distribution of chest radiographic features of children with PTB

Radiographic features	Number of patients (per cent)
*Peri-hilar and basal infiltrates	78
Reticulonodular shadows	12
Cavitary lesions	9
Lobar consolidation	9
Hilar adenopathy	6
Miliary opacities	6
**Pleural effusion	5
Total	125

\*Peri-hilar and basal infiltrates: Occurred alone and with other radiographic features

\*\*Pleural effusion: Occurred with Lobar consolidation.

**Table 2:** Distribution of chest radiographic features with age among children with PTB.

The corrected and aligned table 2 was as sent by one of the authors earlier.

Radiographic features	Age groups (years)		
	<u>&gt;5</u>	<u>&lt; 1</u>	<u>1-5</u>
*Peri-hilar and basal infiltrates	50	8	0
Lobar consolidation	2	2	5
Reticulonodular opacities	2	6	4
Cavitary lesions	1	2	6
Miliary shadows	0	5	1
Hilar adenopathy	1	4	1
**Pleural effusion	1	2	2
<b>Total</b>	<b>7</b>	<b>71</b>	<b>27</b>

## Chest Radiographic Predictors of HIV/AIDS

\*Peri-hilar and basal infiltrates: Occurred alone and with other radiographic features. \*

\*Pleural effusion: Occurred with Lobar consolidation.

**Table 3:** Association between radiographic features and HIV status

Variable	HIV Positive	HIV Negative	Remove column	Chi square	P value
Bronchopneumonia (Peri-hilar and basal infiltrates)					
Yes	50(68.5)	28(65.1)		0.140	0.708
No	23(31.5)	15(34.9)			
Lobar pneumonia					
Yes	3(4.1)	6(14.0)		3.664	0.056
No	70(95.9)	37(86.0)			
Milliary					
Yes	4(5.5)	2(4.7)		0.038	0.846
No	69(94.5)	41(95.3)			
Pleural effusion					
Yes	1(1.4)	4(9.3)		4.128	0.042
No	72(98.6)	39(90.7)			
Reticulonodular only					
Yes	11(15.1)	1(2.3)		4.738	0.030
No	62(84.9)	42(97.7)			

**Table 4:** Measures of performance of Reticulonodular and bronchopneumonic chest radiographic features predictive of HIV infection

**Align table 4**

Chest Radiographic Feature	_____	
	Reticulonodular	Bronchopneumonic
Sensitivity	15.1	61.6
Specificity	97.7	55.8
Positive PV	91.7	70.3
Negative PV	40.4	
46.2		

PV: Predictive value.

**Discussion**

The significance of chest radiograph in the management TB in general and pulmonary TB in particular, cannot be over emphasised. The predominance of peri-hilar and basal infiltrates among the radiographs of children with PTB is very important. This is because; such radiodiographic findings may be interpreted as cases of bronchopneumonia (non-tuberculous) and thus, the diagnosis of PTB may be not be made. Therefore, it is important to consider PTB as a differential of bronchopneumonia, especially in the presence of other suggestive clinical features of TB. Similar observation was also made by Shennan and Kibel.<sup>5</sup>

The fact that broncho-pneumonic infiltrates were commoner among the younger age group is similar to observations made by Taqi *et al* in Zaria and Erinle in Ilorin.<sup>11,13</sup> Likewise, the finding that milliary pattern was observed among the younger children is in consonance with earlier reports.<sup>13-14</sup>

The proportion of children with intra-thoracic radiographic adenopathy in this study was however low, compared to other reports.<sup>11,13</sup> In a multi centre study, including the area of present study, of 116 adults with PTB, 38(32.7%), had intra thoracic adenopathy.<sup>14</sup> However, similar to our finding, a study of children with TB disease in California from 1985 to 1995, where, 6% of children aged 0 to 4 years, 8% of those aged 5 to 14 years, and 0.5% of adolescents were reported to have intra-thoracic adenopathy.<sup>7</sup> The modest

proportion of intra-thoracic adenopathy in this study may be attributed to the fact that; the radiographs of the patients were anterior-posterior(AP) or posterior-anterior(PA) views only, lateral views were not included. Lateral view chest radiographs have been reported to demonstrate intra thoracic adenopathy more than AP or PA views.<sup>16</sup> Another possible reason for the few cases of intra-thoracic adenopathy is the fact that the study group consisted of ill children, while children with hilar adenopathy are usually not too ill.<sup>4</sup> Sometimes children with hilar adenopathy due to PTB are discovered only by contact tracing.<sup>4,14</sup> HIV infection is an important cause of immune suppression in children. These patients might have probably contributed to the atypical radiographic features in this study, as previously reported.<sup>11,17</sup>

The occurrence of more lobar consolidation among the HIV negative patients compared to the HIV positive patients was probably due to the depressed immunity in the latter group compared former. The reverse is true in the case of milliary pattern. The higher rate of milliary TB among the younger HIV infected children corroborates the fact that, these group are at increased risks of severe forms of TB disease.<sup>2,4,5,14</sup>

HIV-infected patients with PTB differed significantly in their clinical and radiographic presentation from non-HIV-infected patients with PTB.<sup>18</sup> There is dearth of literature on chest radiographic predictors of HIV in

childhood PTB, previous studies were clinical and mainly on predictors of PTB in HIV patients or amongst adults.<sup>18-19</sup> Our study revealed that, among the radiographic findings, only reticulonodular opacities was statistically significant in suggesting HIV infection, while milliary shadows were commoner among the HIV infected children compared to the non-infected children, although not significant statistically. In adults, milliary pattern was seen more in HIV positive patients than HIV negative patients in a study conducted in Uganda.<sup>18</sup> Sang-Man Jin and co-workers found that HIV infection in PTB patient is a strong independent predictor of milliary TB.<sup>20</sup> Reticulonodular chest radiographic feature has a high specificity and positive predictive values, but however its sensitivity is low. This means that once it is seen, the patient is more likely to be HIV positive.

Although open PTB is not common in children, it is of great importance that cases of TB be identified as early as possible in children as well, and treatment offered with a view of controlling the disease. Chest radiograph is a key in identifying minors with PTB. We recommend the consideration of PTB as a differential of bronchopneumonia, especially in the presence of other clinical features.

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