Radiological features of pulmonary tuberculosis in HIV-positive and HIV-negative adult patients in south-eastern Nigeria

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Abstract

Pulmonary tuberculosis (PTB) is the most common clinical presentation of tuberculosis. This study was carried out to appraise the radiological features of PTB in adult HIV-positive and HIV-negative patients. The chest radiographs of the patients were evaluated in the tuberculosis, leprosy, and endemic disease (TBL) clinic, Ebonyi State University Teaching Hospital (EBSUTH), Abakaliki, south-eastern Nigeria, from April 2004 to June 2006. Of the total of 117 individuals studied, 68 (58.1) were males and 49 (41.8%) females, indicating a male preponderance of 1.4:1. Up to 49.6% of the subjects had PTB/HIV co-infection. The highest prevalence of PTB/HIV co-infection was recorded among males aged 31–40 (12.8%), and females aged 21–30 (11.1%). The commonest radiological features observed were cavitory lesions (64.1%), patchy opacities (44.4%), and hilar opacities (38.5%). Bilateral cavitory lesions, patchy opacities and hilar opacities were more prominent than the right-sided or left-sided ones and appeared more frequently among individuals with PTB/HIV co-infection. Perihilar patchy opacities, consolidation and pleural effusion were seen in 19.6%, 6.0%, and 4.3% of all cases, respectively. There was no statistically significant difference in the association between the radiological features and patient category (χ^2 = 17.74, df = 18, p = 0.47). The chest radiography remains an important tool in the diagnosis of PTB and will continue to provide essential information for the management and follow-up of patients.

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Introduction

Tuberculosis (TB) has been declared a global public health emergency by the World Health Organization (WHO).[1] TB incidence has been rising all over the world, but is worse in developing countries. Human TB is a chronic bacterial infection caused usually by *Mycobacterium tuberculosis*, although similar disease can be due to other mycobacteria such as *M bovis* and *M avium*. In individuals who have compromised body immunity, such as in uncontrolled diabetes, human immuno-deficiency virus (HIV) infection, cancer, and lymphoma, normally opportunistic mycobacteria such as *M kansasii* and *M intracellularis* may cause infection.[2–4]

In Africa, due to the low standard of living, famine, and inadequate shelter with attendant overcrowding, the TB scourge has increased.[4] HIV infection has also contributed significantly to the resurgence of TB especially in sub-Saharan Africa.[5–8] Most cases of TB in patients with HIV infection are probably due to reactivation of TB infection often acquired many years before.[9] Pulmonary tuberculosis (PTB) is the most common clinical presentation of TB accounting for 74% of all cases.[10–12]

Radiology remains one of the important diagnostic modalities of TB infection.[13] In fact, WHO recommendations for diagnosis of PTB include, 'one sputum smear positive for acid fast bacilli (AFB) and radiographic abnormalities consistent with active PTB' for sputum positive PTB and 'symptoms suggestive of PTB and three negative smears for AFB and radiographic abnormalities consistent with active PTB' for sputum-negative PTB.[1] Sputum negativity does not exclude PTB especially when clinical symptoms and radiographic features are in support of the diagnosis.[1,13] In the follow-up of PTB patients, radiology is also very valuable both in the short-term and on a long-term basis. This is important as about 25% of radiologically stable PTB lesions could still have active disease.[14] There is a paucity of information on the radiological features of PTB in south-eastern Nigeria. Most of the documented studies on the radiological features of PTB in Nigeria were done in the south-west.[15,16] The objective of the current study was to assess the radiological features of PTB in Abakaliki, Ebonyi State, south-eastern Nigeria in order to provide scientific information that would have policy relevance and which will aid TB control programmes, in Nigeria.

Materials and methods

Study area

This study was conducted in Ebonyi State University Teaching Hospital (EBSUTH), one of the largest health institutions located in Abakaliki, the capital city of Ebonyi State, south-eastern Nigeria. The study area covers approximately 51 km^2 with a population of approximately 255 752. There are two distinct seasons – the wet and the dry; the former is from April to September and the latter from October to March. The average atmospheric temperature is 30 °C.

Ethical considerations

The study protocol was approved by the Department of Community Medicine, EBSUTH, Abakaliki. All work was performed according to the international guidelines for human experimentation in clinical research.[17]

Study population

This study was hospital-based, and was conducted at the EBSUTH, Abakaliki from April 2004 to March 2006. Individuals who visited the tuberculosis, leprosy and endemic disease (TBL) clinic of EBSUTH with symptoms suggestive of PTB and who had their chest radiograph report were considered for the study. Patients who met the following study inclusion criteria were enrolled into the study:

- patients aged 18 years and above;
- patients diagnosed with PTB and confirmed microbiologically;
- patients who underwent chest radiography at EBSUTH and had their reports when visiting the clinic.

Individuals with extrapulmonary TB were excluded from the study. All enrolled subjects underwent HIV screening and the HIV status of infected individuals was confirmed by immunoblot analysis. The informed consent of all study participants was obtained with the assurance that all information obtained would be treated with utmost confidentiality and was for the purpose of the research only.

Patient evaluation

All enrolled subjects were seen at the TBL clinic of EBSUTH. Each participant's chest radiography report was evaluated to assess the radiological features. All participants were thereafter placed on directly observed treatment, short course (DOTS) treatment according to the specifications of WHO.[1,11]

Statistical analysis

The chi-square test was used in assessing the associations between categorical variables; a p value of 0.05 or less considered statistically significant.

Results

Of the total of 117 individuals studied, 68 (58.1%) were males and 49 (41.8%) were females indicating a male preponderance of 1.4:1. Of the total of 68 males studied 45.6% had PTB/HIV co-infection and of the 49 females studied 55.1% had PTB/HIV co-infection. The highest prevalence of PTB/HIV co-infection was recorded among males aged 31-40 (78.9%), and females aged 31-40 (66.7%) (see Table 1).

The commonest radiological features observed were cavitory lesions (64.1%), patchy opacities (44.4%), and hilar opacities (38.5%) (see Table 2). Among the commonest radiological features, bilateral cavitory lesions, patchy opacities, and hilar opacities were more prominent than the right-sided or left-sided ones and appeared more frequent among individuals with PTB/HIV co-infection compared with individuals with PTB only. Perihilar patchy opacities, consolidation, and pleural effusion were seen in 19.6%, 6.0%, and 4.3% of all cases, respectively. Other less common features – including hilar lymphoadenopathy, pneumothorax and pulmonary calcification – are presented in Table 2. There was no statistically significant difference in the association between the radiological features and patient category ($\chi^2 = 17.74$, degrees of freedom (df) = 18, $p = 0.47$).

Table 1 Age and sex-related distribution of patients with PTB only and with PTB/HIV co-infection in Abakaliki, Nigeria

Age (years)	Total no. investigated	Males			Females		
		PTB only no. (%)	PTB/HIV no. (%)	Total no.	PTB only no. (%)	PTB/HIV no (%)	Total no
≤20	3	3 (100)	0 (0)	3	0 (0)	0 (0)	0
21–30	36	9 (56.3)	7 (43.7)	16	7 (35.0)	13 (65.0)	20
31–40	31	4 (21.1)	15 (78.9)	19	4 (33.3)	8 (66.7)	12
41–50	14	3 (50.0)	3 (50.0)	6	3 (37.5)	5 (62.5)	8
≥51	33	18 (75.0)	6 (25.0)	24	8 (88.9)	1 (11.1)	9
Total	117	37 (54.4)	31 (45.6)	68 (58.1)	22 (44.9)	27 (55.1)	49

Discussion

PTB remains a major contributor to the disease burden in developing countries. A male preponderance of PTB was observed in this study which was consistent with the findings of previous investigations in Alor Setar, Malaysia,[18] Warsaw, Poland,[19] and Abakaliki, Nigeria,[20] where male to female infection prevalence ratios were 3:2, 2:1, and 2:1, respectively. In contrast, a female preponderance was observed in an earlier report in western Nigeria.[21] In south-eastern Nigeria, males appear to be less likely than females to access

health services, be notified under DOTS and to adhere to treatment;[20] these may have contributed to the male preponderance, as was also reported in Nepal.[22]

In sub-Saharan Africa where the HIV epidemic is still the most severe, TB is reportedly exacerbated by HIV infection. This is evident from the present study were as high as 49.6% prevalence of PTB/HIV co-infection was observed. A number of recent studies have reported high rates of PTB/HIV co-infection and noted that HIV infection can be complicated by PTB.[2,5,6] In these studies the importance of radiology for the purpose of accurate diagnosis of PTB was demonstrated.

The chest radiographic findings suggesting PTB are widely known. These include the characteristic upper lobe infiltrates, cavitory lesions, and hilar or perihilar opacties.[23,24] These features were the most common in this present study. Cavitory formation with surrounding infiltrative changes remain the main radiological features of PTB especially in adult patients in Nigeria[19] and other parts of the world.[5,6,23] The findings in this study also revealed that cavitory lesions were the commonest radiographic feature. These cavities were more often bilateral like the opacities, which suggested that more than one lobe was involved in most of the cases; in agreement with a previous report.[25] In many patients with primary progressive disease and those with HIV infection, it was noted that radiographic findings were more subtle and may show lower-lobe infiltrates or a miliary pattern.[25]

Interestingly, it was observed in this study that where

Table 2 Radiological features of patients with PTB only and with PTB/HIV co-infection in Abakaliki, Nigeria

Radiological features	Patients with PTB only				Patients with PTB/HIV co-infection				
	Total observed	No. with R	No. with L	No. with B	Total observed	No. with R	No. with L	No. with B	Grand Total (%)
Cavitory lesions	36	11	0	25	39	6	8	25	75 (64.1)
Patchy opacities	31	8	1	22	21	3	4	14	52 (44.4)
Hilar opacities	22	4	1	17	23	2	1	20	45 (38.5)
Perihilar patchy opacities	7	1	1	5	16	1	1	14	23 (19.6)
Consolidation	5	4	1	0	2	1	1	0	7 (6.0)
Pleural effusion	2	2	0	0	3	3	0	0	5 (4.3)
Reticulonodular opacities	2	1	0	1	2	1	0	1	4 (3.4)
Honey comb pattern	3	0	0	3	1	0	1	0	4 (3.4)
Hilar lymphoadenopathy	1	0	1	0	2	0	0	2	3 (2.6)
Patchy reticulonodular opacities	1	0	0	1	2	1	0	1	3 (2.6)
Homogeneous opacities	2	1	1	0	0	0	0	0	2 (1.7)
Diffuse nodular opacities	1	1	0	0	1	0	1	0	2 (1.7)
Pneumothorax	0	0	0	0	1	1	0	0	1 (0.9)
Pulmonary calcification	1	0	0	1	0	0	0	0	1 (0.9)
Patchy and streaky opacities	0	0	0	0	1	0	0	1	1 (0.9)
Haziness	1	1	0	0	0	0	0	0	1 (0.9)
Hilar and perihilar opacities	0	0	0	0	1	0	0	1	1 (0.9)
Streaky opacities	1	0	0	1	0	0	0	0	1(0.9)
Widespread opacities	0	0	0	0	1	0	0	1	1 (0.9)

Key: R, right side, L, left side, B, Bilateral

cavities occurred on only one side, it was more common on the right side, especially in patients with PTB only. This was consistent with an earlier report.[15] Cases with PTB/HIV co-infection presented with slightly more frequency of cavitory lesion than those with only PTB. This was contrary to two previous reports which had indicated that individuals co-infected with PTB and HIV were less likely to have cavitory lesions than those with only PTB.[5,25] However, consolidation was more likely to occur in patients with PTB only, than their counterparts with PTB/HIV co-infection, which was in agreement with the report from China.[5] Pleural effusion occurred in 4.3% of cases in this study. This was less than the 7% reported by Miller and MacGregor[26] and the 9% reported by Kolawole et al.[15]

Lymphadenopathies have been reported by other workers as an unusual mode of presentation of PTB in adults,[21,26] and in this study lymphadenopathy was found in the hilar areas in three of the cases, consistent with previous reports.[21,26] PTB is an important differential diagnosis of honeycomb lung as demonstrated in four of the cases in this study. This had also been reported in a previous study.[21]

It is important to state that the radiological features of adult PTB patients in Nigeria have not changed significantly but the pattern of distribution, particularly of sex distribution and cavity formation, may be changing. Prognosis of PTB infection is good if diagnosed and treated early, together with control of underlying conditions, and clinicians should be aware of atypical radiological manifestations of the disease when co-existing with HIV infection. Furthermore, due to an altered immunological response in HIV-positive individuals, an atypical radioclinical pattern may occur. However, it has been noted that the changing landscape in which tuberculosis occurs, as well as the global resurgence, and the changed spectrum of the clinical and radiological presentation, justify a renewed interest of radiologists in the imaging features of PTB.[27] Radiology will continue to provide essential information for the management and follow-up of these patients as it has been described as an extremely valuable tool for monitoring complications.[24] However, the time of presentation of patients to the health facility and the presence of other pulmonary conditions – such as occupational lung diseases, sarcoidosis, and chronic obstructive airway disease – could influence X-ray findings in patients with PTB,[3,24,28,29] as in the present study. It is pertinent to state that even with the typical X-ray findings, sputum should always be examined. This is because radiological manifestations of PTB are heterogeneous.[30] Nevertheless, since HIV-related PTB could be atypical in its radiological appearance, there is, therefore, the need for the use of molecular epidemiological techniques, which will enable definite classification of the TB episodes as either primary or post-primary disease. This would enhance appropriate treatment approach especially in settings with a high prevalence of PTB and HIV infection.

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