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Original Article

Pattern of chest X-ray in smear positive tuberculosis patient

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Abstract

Background: Pulmonary tuberculosis (PTB) is a common lung infection in Bangladesh. Despite advancement in diagnostic methods, chest x-ray remains as mainstay of investigation. Radiographic manifestations of PTB are diverse and varied. To describe the various pattern of chest x-ray in smear positive tuberculosis patient in northern territory of Bangladesh was the objective of the study. **Materials & Methods:** A hospital based cross-sectional study was conducted at the TB clinic, Bogura. Total 133 smear positive PTB patients were consecutively interviewed and interpreted. **Results:** Chest X-ray finding was found variable and overlapping. Around one fourth (24%) patient had more than one findings and frequency of overlapping findings were consolidation (46%), large inhomogeneous opacity (26%), patchy opacity (20%), fibrosis (26%), dense homogenous opacity with air bronchogram (6%), bronchiectasis (6%), nodular opacity (12%), collapse (6%), cavity (9.77%), pleural effusion (2%). Twelve percent patient had found normal chest x-ray. Radiological lesion were found right lung (33%), left lung (26%) and in both lung in 29% cases and no lesion were seen in 12%. Scrutinizing in all cases upper & upper-middle zone involvement was most common and it was found in 55% cases. On the contrary, only lower zone involvement, only middle zone involvement, all zone involvement and no involvement was seen in 18%, 3%, 2% and 12% respectively. **Conclusion:** Smear positive pulmonary tuberculosis most commonly presents with upper and upper-middle zone consolidation and thereafter as a parenchymal involvement.

Key words : Smear Positive Tuberculosis, Tuberculosis, Chest x-ray pattern, Pattern of x-ray

Introduction

Tuberculosis (TB), the oldest infectious disease, a public health problem has become one of the top ten causes of death in worldwide.¹⁻³ According to World Health Organization (WHO) statistics, in 2016, 10.4 million people fell ill with TB, and 1.7 million died from the disease (including 0.4 million among people with HIV)³ and therefore it ranks as second major cause of adult mortality from an infectious disease worldwide, after human immunodeficiency virus (HIV).^{2,4} Among all, low- and middle-income countries suffered from over 95% burden.^{3,5} Surprisingly, Bangladesh (one of 30 'high TB-burden' countries), accounts for a disproportionately higher number of TB cases with annual occurrence of 362,000 new TB cases and costs for >73, 000 people

annually.⁶ In clinical practices, TB particularly pulmonary tuberculosis (PTB), is frequently encountered but rapid diagnosis and early PTB detection continues to be challenging for clinicians.⁷ Over decades, many tools have been invented; still no single tools are satisfactory mostly due to lack of sensitivity and specificity.^{8,9} Anyone with a cough that lasts ≥ 2 weeks with unexplained chronic fever and/or weight loss should be evaluated for TB.¹⁰ Sputum microscopy is an essential step in the investigation of patients who are suspected of PTB.^{11,12} Besides microscopy and other new technique, chest x-ray has been a part of TB diagnosis for over a century.^{9,13} Radiological presentation of TB may be variable in chest x-ray but in many cases is quite characteristic.¹⁴⁻¹⁶

Despite intra- and inter-reader variation of interpretation and relatively expensive test than examination of sputum smear, chest x-ray has become an important investigation, especially when clinical suspicion of tuberculosis exists but the sputum is negative.^{13,17} It also provide a guide to distinguish primary and post primary tuberculosis due to its various presentation and site predilection.¹⁸⁻²⁰ In addition, radiology can also provide valuable information regarding management, follow-up and for monitoring complications of these patients group.¹⁴⁻¹⁶

The initial suspicion of pulmonary TB is often based on abnormal chest radiographic findings in a patient with respiratory symptoms.²¹ The 'classic' picture is that of upper zone disease with infiltrate, striate opacities, occasionally cavitation along with virtually any radiographic pattern-from a normal film or a solitary pulmonary nodule to bilateral diffuse reticulo-nodular shadowing may be seen in chest radiograph.^{22,23} However, in limited cases typical chest x-ray infiltrates may be not be present.^{9,14,24} As there is limited data is available in Bangladesh regarding the variation of chest x-ray findings, the study was designed with an objective to reveal the various pattern of Chest x-ray in smear positive patient in Bangladesh.

Materials & Methods

This research was a hospital based cross-sectional study and was conducted at TB clinic, Bogura for the period of two years extending from June 2012 to May 2014. Patients attending in the hospital with a cough of more than 3 weeks and/or symptoms of haemoptysis were suspected for TB and were screened subsequently. A spot specimen was collected at the first attendance day, an early morning sputum was collected the next day at home and a third spot specimen collected when the patient brought his/her morning sputum to the hospital. Each sputum specimen was examined using ZN smear microscopy. Smear positive cases, >16 years of age were approached for inclusion of the study. Person is on anti-tubercular therapy, having extra pulmonary TB and/or multidrug resistant TB, respiratory illness that

can cause structural damage of lung were considered as criteria of exclusion. They were described about the purpose and procedure of the study. They were ensured that they are free to participate and they will not get any financial benefits from this study other than usual management. Informed written consent was taken from each subjects. Ethical measures was followed in according to the Helsinki declaration. Furthermore, highest level of confidentiality was maintained. Following signing consent form, they were requested to perform chest x-ray of chest P/A view. Each X-ray was interpreted by two separate experienced radiologist and blinding was done. In case of borderline interpretation or inconclusive findings or disputed interpretation were excluded from the study and consecutive sample was collected. Within the time frame, total 133 smear positive PTB patients were consecutively interviewed. Data collection was done by the lead researcher and were recorded in a separate case record form. Data analysis was done by SPSS 23.

Results

Out of total 133 smear positive TB cases were included into the study. Mean age was 42 ± 16.49 (SD) years and age of the patients ranged from 16 to 86 years. Most frequent age group was in between 36 to 45 years (28.60%). Of all, 85 (63.91%) were male and 48 (36.09%) were females with male-female ratio of 1.77:1. Table-I show the age and sex distribution of patients.

Table-I. Age and Sex of the respondents (N=133)

Variable	Frequency	Percentage (%)
<i>Age group</i>		
16-25	24	18.00
26-35	27	20.30
36-45	38	28.60
46-55	17	12.80
56-65	13	9.80
66-75	8	6.00

76-86	6	4.50
	133	100
Mean ±SD	42 ±16.49 years	
Sex		
Male	85	63.91
Female	48	36.09

Most of the patients had family income below 20,000 taka (60.15%). Table-II enlists the details of monthly family income of the participants.

Table-II: Monthly family income of patients (N=133)

Monthly Family Income	Frequency	Percentage
< 20,000	80	60.15
20,000-40,000	40	30.08
>40,000	13	9.77

The most prevalent symptom was cough (79.70%) followed by loss of weight (72.18%), fever (69.92%) and loss of appetite (69.92%). Besides these, most prevalent sign was wasting (60.15%). Table-III shows the prevalence of symptoms and signs of smear positive tuberculosis patients.

Table-III: Symptoms and signs of the patients (N=133)

Symptoms	Frequency	Percentage among total patients (%)
Productive Cough	106	79.70
Loss of Weight	96	72.18
Fever	93	69.92
Loss of Appetite	93	69.92
Malaise	85	63.91
Night Sweats	72	54.14
Haemoptysis	53	39.85
Shortness of Breath	40	30.08
Chest pain	35	26.32
Signs		
Wasting	80	60.15
Anemia	19	14.29
Clubbing	11	8.27
Lymphadenopathy	13	9.77

Temperature (in Fahrenheit)

Normal	59	44.36
99 to 100	51	38.35
101 and above	23	17.29

Chest X-ray finding was variable and overlapping. Main findings are categorized and listed in Table 4. These categories are not exclusive. Because, 33 patients (25%) had more than one finding in their x-ray. The most prevalent x-ray finding was consolidation (46.62%). Among them 26.32% patients had non-homogenous opacity, 14.29% patients had patchy opacity and 6.02% patients had dense homogenous opacity with air bronchogram (6.02%). Interestingly, 12.03% cases with normal radiographic presentation was found.

Table-IV: Pattern of Chest X-ray presentation in smear positive tuberculosis patients (N=133)

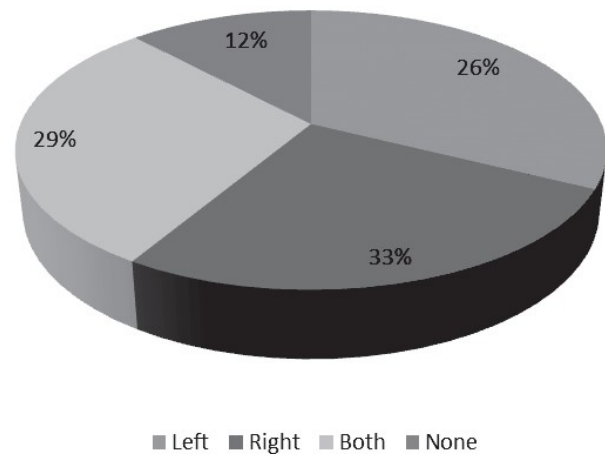
Chest X-ray Findings	Number of Cases	Percentage (%)
Normal	16	12.03
Consolidation	70	46.62
Inhomogeneous opacity	35	26.32
Patchy opacity	27	20.30
Dense homogenous opacity with air bronchogram	8	6.02
Fibrosis	35	26.32
Nodular opacity	16	12.03
Cavity	13	9.77
Collapse	8	6.02
Bronchiectasis	8	6.02
Pleural Effusion	3	2.26

Among 33 patients who had more than one finding in X-ray. Among them most common finding was opacity with cavity (4.51%) followed by dense homogenous opacity with cavity (3.76%) and fibrosis with collapse (3.76%). Other patterns of dual radiographic findings are listed in table V.

Tabl-V: Pattern of Chest X-ray in patients with more than one finding. (n=33)

Chest X-ray findings	Number of Patients	Percentage (%)
Patchy opacity with cavity	6	4.51
Dense homogenous opacity with cavity	5	3.76
Fibrosis with collapse	5	3.76
Fibrosis with bronchiectasis	3	2.26
Nodular with inhomogeneous opacity	3	2.26
Nodular opacity with collapse	3	2.26
Dense homogenous opacity with pleural effusion	3	2.26
Fibrosis with nodular opacity	3	2.26
Fibrosis with cavity	2	1.50
Total	33	25

Considering which lung is affected in chest x-ray it was found that both of the lungs were affected in 29% cases. Whereas, right lung was affected in 33% cases and left lung was affected in 26% cases. About 12% patients had normal chest X-ray. These findings are illustrated in figure 1.

**Figure:1- Affected lung found in chest x-ray in smear positive patient (N=133)**

Zones of lung affected in the patients were also explored (table 6). The most common involvement was upper zone alone in 27.82% cases. Combined upper and middle zone involvement was second common finding and it was found in 27.07% cases. All zones were involved in 2.26% cases.

Table-VI: Affected zone seen in chest x-ray in smear positive tuberculosis patient.

Chest X-ray findings	Number of Patients	Percentage (%)
None	16	12.03
Upper	37	27.82
Middle	4	3.01
Lower	24	18.05
Upper and middle	36	27.07
Middle and lower	13	9.77
All zone	3	2.26
Total	133	100%

Discussion

Although the gold standard for the diagnosis of pulmonary tuberculosis is isolation of mycobacterium tuberculosis from respiratory secretions but chest x-ray is equally important in the diagnosis. Typically, *Mycobacterium tuberculosis* involves the upper zone of lung and presents as consolidation and/or nodules with or without cavitation in the chest x-ray. But, studies have shown that TB can assume various pattern of presentation in the x-ray of chest which are usually described as atypical presentation²⁵. In this study pattern of chest x-ray presentation of tuberculosis was explored in 133 smear positive patients.

A mean age of 42 ± 16.49 years was noted and most of the people suffering from smear positive tuberculosis remained in age group 36-54 years. In the study entitled "*Chest X-ray and bacteriology in the initial phase of treatment of 800 male patients with pulmonary tuberculosis*", Ozsahin SL et al²⁶ showed that mean age group 39 ± 14 years, which is almost similar to the findings of this study. Badie MB et al¹⁹ in a similar study done in Iran found a higher mean age but they also showed that patients of pulmonary tuberculosis who are HIV infected were relatively younger than non-HIV patients. The variation of age distribution in different studies is attributable to the study design.

In this study, a male-female ratio of 1.77:1 was noted. Although a predominance of male had been seen in this study, other studies reported differing ratios. A study done in Bangabandhu Sheikh Mujib Medical University and Dhaka Shihsu Hospital by Karim T et al²⁷ included children infected with pulmonary TB and found a male predominance. On the other hand Sant'Anna, Schmidt, March et al²⁸ found female predominance in their study involving adolescent subjects. These findings show that gender alone does not have predictor significance in the different radiological pattern of tuberculosis.

Living in densely populated unclean environment along with poverty are important factors in the development of pulmonary TB²⁹. In support of this fact, a high prevalence of TB was noted in patients within low income category (60.15%) in this study.

Various presentation of clinical symptoms were found in this study and most prevalent symptoms were

productive cough, followed by weight loss, fever, loss of appetite, malaise, night sweats, hemoptysis, shortness of breath and chest pain. The findings are consistent with the study done by Karim T et al²⁷ except that fever was predominant symptom in their study and cough was predominant in this study. Fever was reported by approximately 70% subjects in this study which is discordant with that of Singh J³² and Akbar MS³³. It was comparatively less common (55%) in Khan NA series³⁴ and this was most probably due to the chronicity of the cases and that they were undergoing treatment. As a rule every case of active pulmonary tuberculosis exhibits some degree of pyrexia, which is one of the important clinical criteria of disease activity³⁵. Cough was the most prevalent complaint in this study (80%) which was dissimilar to the series by Khan NA³⁴ and Akbar MS³³ (about 62% and 47% respectively). In Singh J series it was top of the list (100%)³².

Considering the findings of general examination wasting, anemia, clubbing and enlarged cervical lymph nodes were found in different percentage which is consistent with the study done in Bangladesh²⁷ in 2006 to 2009 and closely similar to the study done by Kim WS et al³⁶. Regarding chest x-ray pattern most prevalent finding were consolidation (70%) in the form of non-homogenous opacity, patchy opacity and dense homogenous opacity with air bronchogram; which is almost similar to the findings of the study Sant'Anna et al²⁸ who reported consolidation in approximately 80% cases in the form of infiltration and condensation. But, different studies showed percentage variation in respect to radiologic patterns.^{20,27} Both lungs were affected in 29% cases and right lung and left lung was affected in 33% and 26% cases respectively. Pattern of involvement of different sites and lobes also varied from study to study^{25,30,31}. Twelve percent patients had normal Chest X-ray. This finding is different in a study conducted in 800 patients by Ozsahin SL et al²⁶ who reported only one case of normal chest x-ray. Whereas, more normal chest skiagram was found in another study done in Bangladesh²⁷. The most common finding was upper zone involvement, which is the typical zone of lung involved in pulmonary TB.^{18,24} But, in line with the trend²⁵ towards increase in atypical pattern, atypical zonal involvement was also noted in 33.09% cases.

Conclusion

As tuberculosis presents with different presentations and diagnosis is done in different pathological state, therefore radiological presentation is variable in different individual. No uniform and distinct pattern of radiological involvement in smear positive tuberculosis is found yet. And limited cases may not represent the actual clinical and radiological presentation of smear positive pulmonary tuberculosis but definitely it gives as an idea about the presentation of pulmonary tuberculosis in the context of our country.

Ethical consideration

The researchers were duly concerned about the ethical issues related to the study. Formal ethical clearance was taken from relevant site before commencing the study. Confidentiality was maintained properly and these data were not used other than the study.

Conflict of Interests: The authors declare that there is no conflict of interests regarding the publication of this paper.

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