

Different Radiological Manifestations of pulmonary Tuberculosis

Amir Suleman¹, Haidar Zaman², Syed Hassan Mustafa², Sabir Khan Khattak²,
Zafar Iqbal³, Muhammad Wasim Sajjad²

¹Department of Pulmonology, Ayub Teaching hospital, Abbottabad - Pakistan

²Department of internal Medicine, Ayub Teaching hospital, Abbottabad - Pakistan

³Department of Pulmonology, Lady Reading Hospital, Peshawar - Pakistan

Address for correspondence

Sabir Khan Khattak

Department of internal Medicine, Ayub Teaching Hospital, Abbottabad – Pakistan
Email: dr.sabirkhan@yahoo.com

Date Received: June 22, 2019

Date Revised: August 20, 2019

Date Accepted: Sep 11, 2019

Author Contributions

AS SKK conceived idea, AS ZI drafted the study, SKK HZ SHM collected data, SKK ZI MWS did statistical analysis & interpretation of data, AS ZI SKK critical reviewed manuscript, All approved final version to be published.

Declaration of conflicting interests

The Authors declares that there is no conflict of interest.

Abstract

Background: Tuberculosis is a major public health problem affecting around 9 million people and causing 2 million deaths each year. A number of investigations are carried out to diagnose pulmonary tuberculosis; these include sputum smear for acid fast bacillus, Gene Xpert and the bronchoscopy. However, due to low sensitivity and/or cost effectiveness, chest X-rays are still commonly used for diagnostic purposes. This study was performed to know the different radiographic findings in diagnosed cases of Pulmonary Tuberculosis.

Methodology: It was a cross sectional study performed on 144 diagnosed cases of pulmonary tuberculosis in the pulmonology unit of Ayub Teaching Hospital Abbottabad, from 1st September 2017 to 31st August 2018. Chest X-ray was performed on all patients included in the study and their findings were recorded in a pro forma.

Results: The study population comprised of 144 TB patients of either sex who had been newly diagnosed with TB. The youngest study participant was 18 years old and the age of the oldest study participant was 92 years with mean \pm SD age was 47.08 ± 18.37 . There were 72 males (50%) and 72 females (50%). Sputum smear was positive in 80 (55.6%) while negative in 64(44.4%). Pleural effusion was found in 44.4% of patients, while apical consolidation and cavitation found in 43.1% and 25% respectively.

Conclusion: Our study concluded that pleural effusion and consolidation were the most common radiographic findings followed by hilar lymphadenopathy and cavitation.

Key Words: Tuberculosis; Chest X-Ray; Radiographic findings; Pleural effusion; Consolidation

This article may be cited as: Suleman A, Zaman H, Mustafa SH, Khattak SK, Iqbal Z, Sajjad MW. Different Radiological Manifestations of pulmonary Tuberculosis. Pak J Chest Med 2019; 25 (4):156-160

Introduction

Tuberculosis (TB) is a disease, caused by Mycobacterium tuberculosis, which mainly affects the lungs. It is a serious public-health issue, with a burden of 9 million new cases and 2 million deaths approximated to occur, each year.^{1,2} TB is spread from person to person through the air. When people with lung TB cough, sneeze or spit, they propel the TB germs into the air. A person needs to inhale only a few of these germs to become infected.³ Tuberculosis does not infect every exposed individual; there are certain risk factors that increase the probability of

transmission. These include, but are not limited to, are the infectiousness of the tuberculosis source, the length of time an individual is exposed to the source, and the immune status of the individual.⁴

Primary infection, the initial phase, occurs in people without specific immunity, generally normal children and young adults who have not previously been exposed to Mycobacterium tuberculosis. The initial infection can occur at any time during childhood, but adolescence is the peak time of risk.⁵ Post primary, also known as adult type or secondary, tuberculosis, in contrast, occurs in people who have developed

immunity to primary tuberculosis and is due to reactivation of the primary complex.^{6,7}

Typical symptoms of active tuberculosis include low grade fever, productive cough, night sweats, weight loss, fatigue, weakness, easy fatigability and/or hemoptysis.⁸ However, these symptoms may only be present minimally in the initial stage and may then develop during the course of several weeks.⁸ Since, most of the symptoms are nonspecific, and develop insidiously; therefore the physicians must maintain a high index of suspicion for the diagnosis of TB. A number of investigations are helpful in diagnosing pulmonary tuberculosis. These include the sputum Acid Fast staining for Bacilli (AFB), the sputum culture, Gene Xpert and the Montoux test. But these investigations have certain drawbacks. Sputum smear results have a very low sensitivity while culture results are only available after several weeks.⁹ This limits the diagnostic efficiency of these conventional investigations.¹⁰

Due to of these drawbacks, radiology plays an important role in the initial investigation and evaluation of Pulmonary TB (PTB).^{11,12} For appropriate management of PTB, the radiologists often provide valuable information, while reducing the radiation exposure and costs to the patients.

Therefore this study was performed with the intent to know the spectrum of radiological patterns of pulmonary tuberculosis and to compare the results with other investigations performed internationally. In addition, it provided valuable information regarding the different radiological presentations that would help physicians in diagnosing and evaluating the PTB patients at the earliest.

Methodology

This cross sectional study was performed on all

Tuberculosis (TB) patients admitted in the pulmonology units or presenting to the pulmonology OPD of Ayub Teaching Hospital Abbottabad. The study was conducted from 1st September 2017 to 30th August 2018. 144 patients were included through non probability consecutive sampling. Tuberculosis was diagnosed on the basis of positive sputum smear, Gene Xpert, or positive culture of bronchoalveolar lavage. Patients having concurrent pulmonary embolism, septicemia, chronic heart failure, sarcoidosis, and idiopathic pulmonary fibrosis were excluded from the study to control confounding.

After getting approval from the hospital ethics committee, data was collected from all the patients diagnosed with pulmonary TB. An informed consent was taken from the patient or his/her next of kin. A detailed history was taken and complete physical examination was performed. Then X-ray chest of every patient was performed by radiology department of Ayub teaching hospital and reporting was done by 2 chest physician. After reporting, frequency of different radiological presentation was calculated among the patients. Data was recorded into a pro forma by the trainee. Strict exclusion criteria were followed to control confounding. Data was analyzed by using SPSS 20.0. Quantitative variables like age, ESR were described as mean + standard deviation. Categorical variables like gender and radiological presentation were described as frequencies and percentages.

Results

The study population comprised of 144 TB patients of either sex who had been newly diagnosed with TB. The youngest study participant was 18 years old and the age of the oldest study participant was 92 years with mean ± SD age was 47.08±18.37. There were 72 males (50%) and 72 females (50%). Sputum smear was positive in 80 (55.6%) while negative in 64(44.4%).

Table1: Different radiological pattern

Presentation	Frequency	Percent
Pleural effusion	64	44.4%
Apical consolidation	62	43.1%
Hilar lymph node	46	31.9%
Cavitation	36	25.0%
Middle zone consolidation	30	20.8%
Apical fibrosis	24	16.7%
Fungus ball	18	12.5%
Lower zone consolidation	12	8.3%
Miliary shadow	10	6.9%

Gene Xpert and bronchoscopy was performed on 122(84.7%) and 68 (47.2%) patients, and was positive in 36.1% and 33.3% of patients respectively.

Pleural effusion was the most common radiological manifestation found in 64 (44.4%) patients, followed by apical consolidation (62, 43.1%) (Table 1).

Table 2: Gene Expert and Bronchoalveolar lavage

Gene Xpert	Smear Finding			
	Positive for AFB	Negative for AFB	Not Done	Total
Positive	30	0	22	52
Negative	10	28	32	70
Not Done	8	0	14	22
Total	48	28	68	144

Discussion

Tuberculosis (TB) is a major health hazard and a major cause of mortality and morbidity particularly in developing countries. 13 8.8 million people developed active TB and 1.6 million died of the disease in 2005 alone.¹⁴

Our results found that pleural effusion was the most common (44.4%) radiological finding among patients with pulmonary tuberculosis. However, this is considerably higher than a study performed in USA where only 24% of patients had Pleural Effusion.¹⁵ One important finding in our study was that pleural effusion was found significantly higher among patients who were sputum smear negative (81.25%, $p = 0.00$).

Also, the preference of the organism to infect the upper zone of the lungs in our study is in agreement with reports in the literature. Apical consolidation was found in 43.1% compare to 20.8% and 8.3% patients having middle and lower zone consolidation respectively.

Woodring et al also studied different radiological findings in tuberculosis patients. They found that pulmonary consolidation and hilar lymphadenopathy was found in 50% and 35% of the patients respectively.¹⁵ This is comparable to our study as we found consolidation in 43.1% and hilar lymph nodes enlargement in 31.9% of patients. Haramati LB et al have detected cavitation among the immunocompetent patients to be 52% compare to 18% in HIV positive patients.¹⁶ This was also observed by Leung AN et al who found cavitation in 19% HIV positive patients and in 55% HIV negative patients. Compare to this, we found cavitation in only 25% of the patients, which is significantly lower. One reason for this may be because we did not take the immune status of the patients into consideration. However, we observed that elder population had significantly more frequent cavitation than younger population, which was statistically significant ($p = 0.02$).

With regards age, in addition to cavitation, fungal balls were found mostly in elder population (2 vs 16, $p =$

Table 3: Radiological pattern correlations at different age groups

Presentation	Young age-n (18-40 years)	Old age-n (41-92 years)	Total	P-value
Pleural effusion	36	28	64	0.07
Apical consolidation	26	36	62	0.71
Hilar lymph node	14	32	46	0.10
Cavitation	8	28	36	0.02
Middle zone consolidation	12	18	30	0.70
Apical fibrosis	8	16	24	0.40
Fungus ball	2	16	18	0.03
Lower zone consolidation	4	8	12	0.57
Miliary shadow	6	4	10	0.47

Table: 4 Radiological pattern correlation with smear status

Presentation	Smear status		Total	P-Value
	Positive	negative		
Pleural effusion	12	52	64	0.00
Apical consolidation	48	14	62	0.001
Hilar lymph node	40	6	46	0.00
Cavitation	22	14	36	0.590
Middle zone consolidation	26	4	30	0.006
Apical fibrosis	18	6	24	0.141
Fungus ball	14	4	18	0.156
Lower zone consolidation	12	0	12	0.022
Miliary shadow	8	2	10	0.260

0.03). Fungal balls are aspergillomas caused by infection of aspergillus fumigatus. With regards smear status, apical, middle and lower zone consolidation, cavitation and hilar lymphadenopathy was found more common among the sputum smear positive patients. A possible reason for this is the fact that patients who are smear positive usually have higher disease burden.

In our study, many patients had more than one type of radiographic finding. Indeed patients with pulmonary tuberculosis, as observed in the general population, presents a higher probability of having multiple radiological alteration, rather than only one type of radiographic finding.¹⁸

Conclusion

Chest X-ray is a rapid imaging modality, and is therefore helpful in early diagnosis of pulmonary tuberculosis. The wide range of radiographic manifestations seen in our study indicates that the understanding of these manifestations is essential for early diagnosis, treatment and follow-up of the disease in our population, considering that the prevalence of the disease in our population is high. Our study concluded that pleural effusion and consolidation are the most common radiological finding in pulmonary TB patients.

References

1. Glaziou P, Sismanidis C, Floyd K, Raviglione M. Global Epidemiology of Tuberculosis. *Cold Spring Harbor Perspectives in Medicine*. 2014;5(2):a017798-a017798.
2. Tuberculosis (TB) [Internet]. Who.int. 2019 [cited 15 May 2019]. Available from: <https://www.who.int/news-room/fact-sheets/detail/tuberculosis>

3. Churchyard G, Kim P, Shah N, Rustomjee R, Gandhi N, Mathema B et al. What We Know About Tuberculosis Transmission: An Overview. *The Journal of Infectious Diseases*. 2017;216(suppl_6):S629-S635.
4. Self-study modules on tuberculosis. Centers for Disease Control and Prevention website. <http://www.cdc.gov/tb/education/ssmodules/>. Updated May 11, 2016. Accessed June 14, 2016.
5. Donald PR, Marais BJ, Barry CE., 3rd Age and the epidemiology and pathogenesis of tuberculosis. *Lancet*. 2010;375:1852-4
6. Osler W. The principles and practice of medicine. Chapter 26. New York: D. Appleton and Company; 1892. Tuberculosis; pp. 184-255
7. North RJ, Jung YJ. Immunity to tuberculosis. *Annu Rev Immunol*. 2004;22:599-623.
8. Arango L, Brewin AW, Murray JF. The spectrum of tuberculosis as currently seen in a metropolitan hospital. *Am Rev Respir Dis* 1973;108(4):805-812.
9. Foulds J, O'Brien R. New tools for the diagnosis of tuberculosis: the perspective of developing countries. *Int J Tuberc Lung Dis*. 1998 Oct; 2(10):778-83.
10. Okur E, Yilmaz A, Saygi A, Selvi A, Sngn F, Oztrk E, Dabak G. Patterns of delays in diagnosis amongst patients with smear-positive pulmonary tuberculosis at a teaching hospital in Turkey. *Clin Microbiol Infect*. 2006 Jan; 12(1):90-2.
11. Im JG, Itoh H, Shim YS, Lee JH, Ahn J, Han MC, Noma S. Pulmonary tuberculosis: CT findings--early active disease and sequential change with antituberculous therapy. *Radiology*. 1993 Mar; 186(3):653-60.

12. Jeong YJ, Lee KS. Pulmonary tuberculosis: Up-to-date imaging and management. *AJR Am J Roentgenol.* 2008;191:834–44.
13. Cegielski JP, Chin DP, Espinal MA, et al. The global tuberculosis situation: progress and problems in the 20th century, prospects for the 21st century. *Infect Dis Clin North Am* 2002; 16:1–58
14. World Health Organization. Fact sheet no. 104 Tuberculosis. www.who.int/mediacentre/factsheets/fs104. WHO Website. Revised March 2007. Accessed May 21, 2008.
15. Woodring JH, Vandiviere HM, Fried AM, Dillon ML, Williams TD, Melvin IG. Update: the radiographic features of pulmonary tuberculosis. *AJR Am J Roentgenol.* 1986 Mar;146(3):497-506.
16. Haramati LB, Jenny-Avital ER, Alterman DD. Effect of HIV status on chest radiographic and CT findings in patients with tuberculosis. *Clin Radiol.* 1997;52(1):31–35.
17. Leung AN, Brauner MW, Gamsu G, Cabanne NM, Romdhane HB, Carette MF, et al. Pulmonary tuberculosis: Comparison of CT Findings in HIV-Seropositive and HIV-Seronegative Patients. *Radiology.* 1996;198:687–91.
18. Bombarda S, Figueiredo CM, Funari MBG, et al. Imagem em tuberculose pulmonar. *J Pneumol.* 2001;27:329–340. *ulosis and Lung Disease.* 2015; 19(6): 685-92.