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## **Chest X-Ray Finding Comparison in Sputum Positive and Sputum Negative Acid Fast Bacilli of Patients with Pulmonary Tuberculosis**

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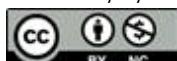
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**Summary**

*Tuberculosis (TB) is an endemic infectious disease in Iraq. In some cases, it can "mask" as other, less serious diseases. To identify tuberculosis, the patient must undergo a series of investigations. Chest X-ray remain for years is helpful to detect structural changes in the lungs indicating tuberculosis. Analysis and culture of sputum is further an excellent test with an accuracy up to 100%. This study aimed to compare the chest X-ray findings in smear positive pulmonary tuberculosis cases with these findings in smear negative culture positive pulmonary tuberculosis. Therefore we conducted a cross-sectional-analytical study, the period from 1st of July 2017 to 23th of June 2018, included suspected TB cases chest X-ray examination and early morning sputum samples for AFB in two separated occasion and sputum culture for mycobacterium tuberculosis were performed. Findings of the study showed that the most frequent radiographic finding seen in sputum positive AFB was reticulonodular infiltration with a frequency of (42.3%) followed by cavity and calcification, each contributed for (36.5%) and apical involvement and hilar lymphadenopathy in 32.7% and 30.8% respectively. Regarding sputum negative AFB patients reticulonodular reported in 48.1%, calcification, patchy infiltration, apical infiltration and pleural effusion reported in 22.2%, 18.5%, 18.5% and 18.5% respectively. While only reticulonodular infiltration is occurred more frequent in sputum negative AFB with no statistically significant difference, ( $P$ . value>0.05). In conclusion, the most frequent radiographic finding seen in sputum positive AFB was reticulonodular infiltration followed by cavity, calcification, apical involvement and hilar lymphadenopathy. The most frequent radiographic finding seen in sputum negative AFB patients were the reticulonodular, calcification, patchy infiltration, apical infiltration and pleural effusion.*

**Keywords:** Pulmonary tuberculosis, pathogenesis, epidemiology, diagnosis, chest x ray, acid fast bacilli

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## **1 | INTRODUCTION**

Tuberculosis is a chronic lung infection that is caused by mycobacterium germs. This disease caused more than 30% of all deaths in the 19th and 20th centuries and has currently infected one-third of all people worldwide. It causes nine million new cases and two million deaths annually (1-3). The prevalence of tuberculosis reduced to 5% annually until 1995 (4), but within the next five years, the prevalence increased to 15.8%. Currently, tuberculosis in association with acquired immunodeficiency syndrome (AIDS) is the most important public health problem in Asia, Africa and Latin America. Hence, it was called an emergency by WHO in 1993 (4, 5). The best and most definitive method in the diagnosis of pulmonary tuberculosis (PTB) is sputum smear and Ziehl-Neelsen staining with several consecutive tests (1-3). In the recent decades, due to the increase in diversity and number of diagnostic techniques, smear positive tuberculosis has raised (2, 3). Although smear negative tuberculosis has significantly reduced, still a considerable number of cases fall at this group. Since each smear negative patient can contaminate two people each year, rapid diagnosis of tuberculosis is as essentially important as the smear positive patient. In smear negative and even smear positive cases, radiographic changes are helpful in disease diagnosis. Although some chest X-ray findings, including nodular or patchy infiltration in the posterior parts of the superior lobes or anterior segments of the inferior lobes particularly in bilateral involvement and associated with cavity, are not specific for pulmonary tuberculosis, clinical manifestations and epidemiologic findings are very diagnostic (6,7). Generally, common radiologic findings in secondary PTB are demonstrated as follows: bronchiectasis, consolidation, patchy, cavitary, and miliary TB (8, 9).

## **2 | PATIENTS AND METHODS**

This was a cross-sectional-analytical study, conducted during the period from the 1st of July 2017 to 23th of June 2018. During this period, we studied suspected pulmonary tuberculosis patients starting by taking full history and examination of the patient concentrating on the respiratory system. Then, we sent every patient for standard postero-anterior chest x-ray (CXR) film, and also sent for early morning sputum samples for AFB in two separated occasion and sputum culture for mycobacterium tuberculosis. Based on

WHO criteria, positive smear PTB is defined with at least two positive sputum smears of acid-fast bacillus or one positive sputum smear associated either with one positive sputum culture or chest radiographic findings compatible with PTB. Negative smear PTB was confirmed when positive radiographic changes compatible for PTB have been detected and in spite of a 10-14 days wide spectrum antibiotic therapy, no change in the patient's general condition was noted from whom two negative serial sputum smears were taken with at least two weeks interval and in each session, three samples were examined and all samples were negative for acid fast bacillus. In addition, smear negative PTB is defined when a severely ill patient with radiographic changes in favour of PTB lesions (interstitial tissue involvement or miliary TB) shows two negative samples for acid fast bacillus.

We collected data from 53 patients with a positive smear pulmonary tuberculosis based on WHO criteria. Likewise we collect 27 smear negative, culture positive patients in our study in whom similar demographic characteristics with positive smear patients were considered. All of the patients underwent chest radiographies that were then interpreted by both expert radiologist and pulmonologist independently. Moreover, all patients' sputa were examined by an expert laboratory technician at the reference laboratory of the respiratory disease center.

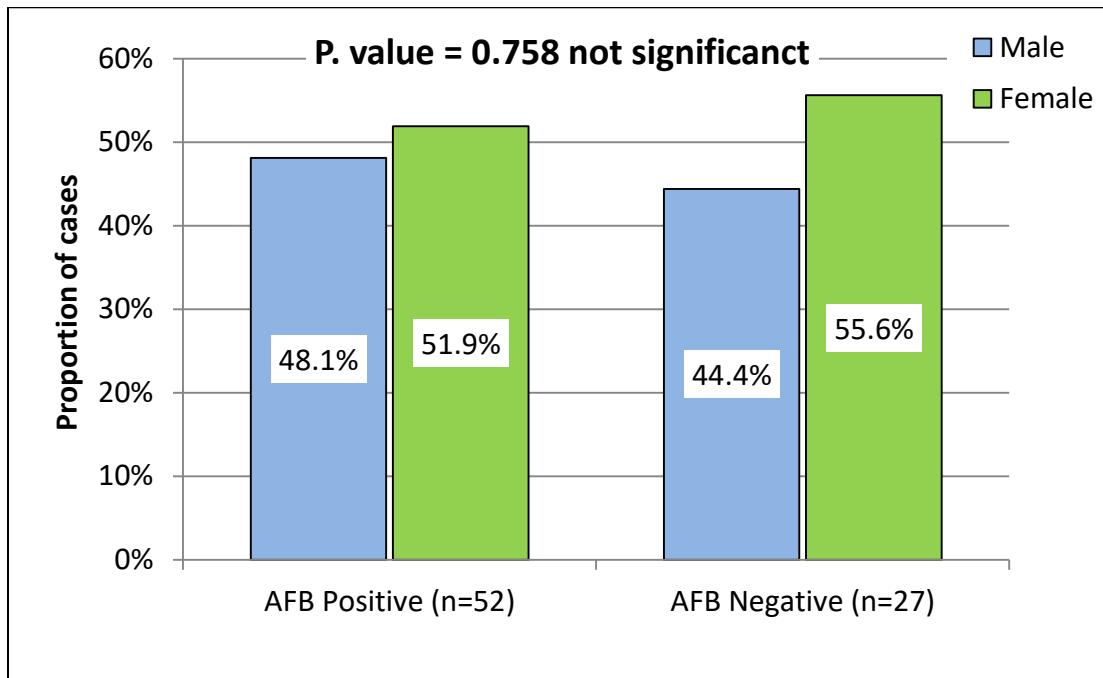
*Statistical Analysis:*

Statistical package of social sciences (SPSS) version 25 used in all statistical procedures and data analysis. Continuous variables presented as mean with standard deviation while discrete variables presented as frequencies and percentages. Student's t test for two independent samples used to assess the significance of difference in means, while Chi square test used to assess the significance of association between discrete variables, Fisher's exact test used as an alternative when chi square test was inapplicable. Level of significance, P. value, was two tailed of 0.05 or less to be considered significant.

### 3 | RESULTS

In this study, 79 patients with proved pulmonary tuberculosis were included (52 patients with sputum positive acid fast bacilli and 27 patients were sputum negative acid fast bacilli). In sputum positive group, 25 patients (48.1%) were male and 27 patients (51.9%), were females while in sputum negative group 12 patients (44.4%) were males and 15 patients (55.6%) were females with no significant difference in gender distribution between both groups, (P. value > 0.05), (Figure 1)

Based on the results of our study the most frequent radiographic finding seen in sputum positive AFB was reticulonodular infiltration with a frequency of (42.3%) with the second most common radiographic manifestation were shared between both the cavity and calcification which are (36.5%) and the next common are the apical involvement and hilar lymphadenopathy which carry a frequency of (32.7%, 30.8% respectively). Other less common radiological manifestation are patchy involvement, pleural effusion, lung fibrosis, bronchiectasis and incomplete destruction which have frequency of (28.8%, 23.1%, 19.1%, 15.4% and 15.4% respectively). The other manifestations are less frequent with a frequency of less than 10%.Otherwise regarding sputum negative AFB patients the most frequent one is the reticulonodular finding with a frequency of 48.1%, the other next frequent are the calcification, patchy infiltration, apical infiltration and pleural effusion which carry frequency of (22.2%, 18.5%, 18.5% and 18.5% respectively).While only reticulonodular infiltration was more frequent in sputum negative AFB with a P value of 0.62 which is not statistically significant. AFB status was not significantly associated with any of apical infiltration, hilar adenopathy, widened Mediastinum and pleural effusion (P >0.05).. Cavitary Disease significantly associated with positive AFB status (P< 0.05), Tables 1, 2 & 3).



**Figure 1. Gender distribution of the studied group**

**Table 1. Distribution of sampled patients according to AFB status and to involvement observed on chest x-ray**

Finding	AFB Positive (n = 52)		AFB Negative (n = 27)		P. value
	No.	%	No.	%	
Apical Infiltration	17	32.7	5	18.5	0.183
Hilar Adenopathy	16	30.8	3	11.1	0.052
Widened Mediastinum	5	9.6	1	3.7	0.347
Pleural Effusion	12	23.1	5	18.5	0.640

**Table 2. Distribution of sampled patients according to AFB status and lung lesions observed on chest x-ray**

Finding	AFB Positive (n = 52)		AFB Negative (n = 27)		P. value
	No.	%	No.	%	
Cavity	19	36.5	4	14.8	0.044
Calcification	19	36.5	6	22.2	0.194
Patchy Infiltration	15	28.8	5	18.5	0.317
Reticulonodular Infiltration	22	42.3	13	48.1	0.620
Miliary Shadow	1	1.9	1	3.7	1.000

**Table 3. Distribution of sampled patients according to AFB status and chronic lung tissue damage observed on chest x-ray**

Finding	AFB Positive (n = 52)		AFB Negative (n = 27)		P. value
	No.	%	No.	%	
Bronchiectasis	8	15.4	2	7.4	0.312
Lung Fibrosis	10	19.2	3	11.1	0.356
Incomplete Lung Destruction	8	15.4	2	7.4	0.312
Complete Lung Destruction	3	5.8	1	3.7	0.691

## 4 | DISCUSSION

In our descriptive study, the patients who had been confirmed having pulmonary tuberculosis were compared in the term of radiologic features and laboratory findings and here our findings are compared with other studies literature. In this study, we take both smears positive and smear negative patients and evaluated for common radiological features that show typical pulmonary changes such as cavity and apical involvement were more common, most likely due to the higher range of patient's age in our cases compared to other studies. The results of our

study show that there is no significant difference in mean age between the two study groups: (44.7±17.3) in sputum smear positive while (47.1±17.5) in sputum smear-negative ( $P > 0.05$ ). Also, there was no significant association between AFB status and each of age group and sex ( $P > 0.05$ ). Disease duration significantly associated with AFB status that "AFB positive" patients are more likely to present at month one (53.8%) compared to "AFB negative" patients (25.9%) ( $P < 0.05$ ). In our study, reticulonodular Infiltration and Calcification were the most frequent radiological findings in both groups while Apical Infiltration, Hilar adenopathy, and cavity lesions were much more frequent in sputum positive patients than in those with sputum negative smear. Only Reticulonodular Infiltration (48.1%) and Miliary Shadow (3.7%) were more frequent in smear negative patients than in smear-positive patients (42.3%) and (1.9%) respectively. However, both were statistically insignificant ( $p$ -value  $>0.05$ ). All other radiological findings were more frequent in smear-positive patients than in smear negative patients (36.5% V 14.8%), Calcification (36.5% V 22.2%), Apical Infiltration (32.7% V 18.5%), Hilar Adenopathy (30.8% V 11.1%), Patchy Infiltration (28.8% V 18.5%), Pleural Effusion (23.1% V 18.5%), Lung Fibrosis (19.2% V 11.1%), both Bronchiectasis and Incomplete Lung Destruction (15.4% V 7.4%), Widened Mediastinum (9.6% V 3.7%) Complete Lung Destruction (5.8% V 3.7%) respectively. Despite this, only cavity lesions had statistically significant difference between both groups ( $p$ -value  $<0.05$ ). By taking more attention to these differences by physicians would give a good predictor and may hasten the diagnosis of the disease. Moreover, by keeping in mind the fact that the common radiologic findings which can be seen in pulmonary tuberculosis can also be seen in another disease as we mentioned like pulmonary malignancy, pulmonary abscess, and chronic pulmonary diseases, so the best approach is to always exclude these diseases in the differential diagnosis before any step toward confirming diagnosis or any medical intervention. In one study performed by van Cleef et al. smear positive and smear negative patients with tuberculosis were followed up for 1 year and the chest radiographic changes raised from 1% to 10% in the smear negative cases. There is generalized reticulonodular infiltration (55%); cavity (30%) and pleural effusion (15%) were more frequent in smear negative than smear-positive cases ( $P < 0.001$ ). Whilst, patchy infiltration (45%), calcification (45%), Adenopathy (30%), and bronchiectasis (22%) were more frequent in smear positives compared to the smear negative

group ( $P = 0.001$ ) (10). In the study conducted by Rathman et al., of the 1389 cases which are suspicious for tuberculosis, 34% were smear positive and 66% were smear negative. Radiographic changes were assessed in the two groups. The cavity was noted in smear positive cases more than smear negative ones (40% vs. 25%), ( $P < 0.001$ ). Likewise, calcification was significantly more common in smear positives than smear negatives ( $P < 0.001$ ) (11). So the results of this study were similar to that of our study. In another study carried out by Miller et al. pulmonary findings compatible with smear positive were patchy infiltration, cavitation, and calcification (12). While in the study conducted by Gartner et al. pulmonary lesions compatible with smear-negative PTB, hilar or mediastinal adenopathy, diffuse reticulonodular infiltration, and pleural effusion were more common (13). In a very important study performed by Jones et al. in jail, he found that 20% of the patients who have smear-negative pulmonary tuberculosis might have been missed when the physicians neglect the radiographic changes that could be seen (14). Also, in another study of 518 pulmonary tuberculosis patients, 14.8% of patients with smear negative had typical pulmonary findings that compatible with pulmonary tuberculosis (15). Based on our study regarding the findings and results, the clinical manifestations and sputum examination for AFB smear in the light of radiographic manifestations are very useful tools in the diagnosis of pulmonary tuberculosis especially when combined together and so a remarkable help for the early diagnosis and treatment of pulmonary tuberculosis patients.

## 5 | CONCLUSIONS

Patients with sputum positive pulmonary tuberculosis tends to present earlier than those with sputum negative disease. So, in sputum positive group 53.8% is seen within the first month compared to "AFB negative" patients (25.9%). ( $P < 0.05$ ). The most frequent radiographic finding seen in sputum positive AFB was reticulonodular infiltration (42.3%) , the cavity and calcification (36.5%) , the apical involvement and hilar lymphadenopathy (32.7%, 30.8% respectively). The most frequent radiographic finding seen in sputum negative AFB patients were the reticulonodular(48.1%) , the calcification, patchy infiltration, apical infiltration and pleural effusion (22.2%, 18.5%, 18.5% and 18.5% respectively). Cavitation seen on chest X ray is

associated with sputum positive disease with P value of 0.044 which is statistically significant. We recommend that the finding of a cavity in plain CXR of patient with suggestive history of chest infection raise the suspicion of pulmonary TB and necessitate complete work up of pulmonary TB. Finding of calcification and reticulonodular opacity can occur frequently and can support pulmonary TB diagnosis .So in the setting of such radiological findings with the presence of suggestive history, we recommend that pulmonary TB should be considered even when the direct smear for AFB is negative. We insist on the well-known recommendation that the diagnosis of pulmonary TB depend on a combination of detailed and precise history, good clinical judgment, radiological findings and sputum staining and negative sputum smear for AFB may not exclude the existence of the disease.

#### **Ethical Issue:**

All ethical issues were approved by the author, in accordance with Ethical Principles of Declaration of Helsinki of the world Medical Association, 2013, for research involving human subjects

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