

A. Jamzad MD¹
M. Shahnazi MD²
A. Khatami MD³
Gh. Azimi MD⁴
Gh. Khanbabaee MD⁵
L. Salimi MD⁶
M. Mehrafarin MD⁶

1. Assistant Professor, Department of Radiology, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

2. Assistant Professor, Department of Radiology, Loghman-e Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

3. Assistant Professor, Department of Radiology, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

4. Assistant Professor, Department of Pulmonology, Mostafa Khomeini Hospital, Shahed University of Medical Sciences, Tehran, Iran.

5. Assistant Professor, Department of Pediatric Pulmonology, Mofid Children's Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

6. Department of Radiology, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Corresponding Author:

Alireza Khatami

Address: Department of Radiology, Mofid Children's Hospital, Shariati Ave., Tehran, Iran.

Tel: +9821-2225-1737

Fax: +9821-2222-0254

Email: alireza_khatami31@yahoo.com

Received May 24, 2009;

Accepted after revision November 1, 2009.

Iran J Radiol 2009;6(3):131-136

Radiographic Findings of Pulmonary Tuberculosis in Tehran in Comparison with Other Institutional Studies

Background/Objective: Tuberculosis (TB) is one of the most common worldwide infections, especially in developing countries. Early diagnosis is very important for prevention of the chronic form of the disease and sequel formation. Chest x-ray (CXR) is an easy, feasible, non-expensive and quick tool for the diagnosis of pulmonary tuberculosis.

Patients and Methods: We retrospectively evaluated 200 chest x-rays of secondary pulmonary TB cases in university-affiliated hospitals. These cases were all proved by a positive sputum smear or culture for mycobacterium tuberculosis.

Results: In this study, we correlated CXR findings of 100 male and 100 female patients. The peak age of involvement in both groups was 61-80 years. None of the chest x-rays were normal. The main radiographic findings were consolidation-infiltration, fibrosis, pleural effusion, cavitation, pleural thickening and bronchiectasis. Mediastinal lymphadenopathy was detected in 9% of the cases. Pulmonary infiltration with consolidation was the most common finding (55%). Miliary shadowing, atelectasis and pneumomediastinum were the least common presentations. Lymphadenopathy was more common in 40 to 60-year-old women. Right lung involvement was more common than the left side and the upper zones were involved in most cases. The most common underlying diseases were hypertension and diabetes mellitus. Infiltration in diabetic patients and fibrotic appearances in hypertensive patients were common findings.

Conclusion: There was no significant difference between our data and the other studies carried out in Iran. The patients were younger in the studies from other countries. However, cavitory lesions were more common in other studies than this study, which seems to be due to the higher prevalence of underlying diseases such as HIV or diabetes.

Keywords: Pulmonary Tuberculosis, Radiography, Infection, Diagnosis

Introduction

Mycobacterium tuberculosis is a common worldwide infection,¹ especially in developing countries and the lung is the primary focus of involvement.² Pulmonary tuberculosis has a wide range of radiographic appearances³ which may be normal⁴ or may have mediastinal or hilar lymphadenopathy,⁵ consolidation, miliary appearance, cavitation, pneumothorax, pleural effusion and thickening, bronchiectasis and finally pulmonary fibrosis.²

The radiographic appearance of TB depends on the patient's age, the underlying disease and the socioeconomic status.⁵

Early diagnosis of the disease is important in preventing undesirable complications. Chest x-ray (CXR) is one of the most popular and non-expensive imaging tools for the diagnosis of pulmonary TB.⁶ Mediastinal and hilar lymphadenopathy could be seen more commonly in children with primary TB, more than 50% are seen in the right hila-mediastinal region;^{1,6,7} however, in post primary pulmonary TB, lymphadenopathy is less common than primary pul-

monary TB.⁶ Tuberculous pleurisy is more common in primary than post-primary disease. It is a common presenting manifestation in young adults. Miliary disease is also more common in primary than post primary disease; however, its frequency is increasing in elderly patients with post-primary TB.⁶

In this study, we are going to assess the plain chest x-ray findings of a group of tuberculosis patients in Tehran.

Patients and Methods

In this study, we evaluated 200 cases of proved pulmonary tuberculosis aged 20-80 years old. The TB diagnosis was confirmed by sputum smear and culture of gastric washout. Age, sex, underlying disease and positive family history of TB were recorded. Patients were categorized into three groups according to age; 20-40 years, 41-60 years and 61-80 years. After categorization, the presenting radiographies of the patients were studied to find any abnormality in the x-rays. Each CXR was interpreted by one of the co-author radiologists. Radiographical findings of TB, such as consolidation-infiltration, cavitation, lymphadenopathy, pleural effusion and thickening, bronchiectasis, fibrosis, miliary pattern, calcified granuloma, pneumothorax and pneumomediastinum, emphysematous changes and atelectasis were included in a sheet and were marked by the radiologists if present in the CXR. Otherwise, we considered the CXR normal. After recording radiographical findings, lobar location and the side of involvement were notified. Finally, radiographic findings were compared according to age, sex and underlying diseases using chi square and Mann-Whitney U test by SPSS 11 for windows (SPSS Corp., Chicago, Illinois). P value<0.05 was considered statistically significant.

Results

The male/female ratio of the evaluated patients was 1/1. There were three age groups of 20-40 years, 41-60 years and 61-80 years (Fig. 1). The mean age was 57.85 years; 58 (58%) of the men and 55 (55%) of the women (overallly 56.5% in both genders) were located in the 61 to 80-year-old age group and the least number of both genders were in the 20-40-year-old

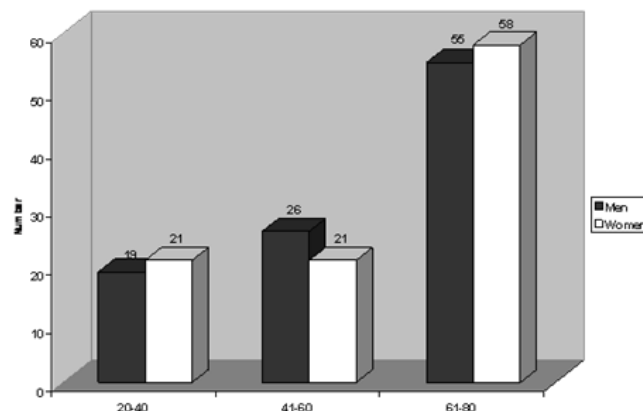


Fig. 1. Distribution of men and women in different age groups.

age group. All the cases had abnormal CXRs. Some of the radiographic patterns are depicted in the following page (Figs. 2-5).

The most common radiological finding in both genders was pulmonary consolidation-infiltration, which was seen in 110 (55%) of the cases; 74 cases had single lobe involvement (67.2%). If only one segment was involved, the distribution of infiltration was as follows; right upper lobe (RUL) in 24 (32.4%), left upper lobe (LUL) in 21 (28.4%), right lower lobe (RLL) in 10 (13.5%), right middle lobe (RML) in 8 (10.8%), left lower lobe (LLL) in 6 (8.1%) and lingual and mid zone of the left lung were involved in 5 (6.7%) of the cases. Therefore, upper lobe involvement was seen in 76 (69.1%) and lower lobe involvement in 18 (16.4%) of the patients. Right middle lobe involvement was seen in 16 (14.5%) of the cases. Bronchopneumonic and both lung involvement was seen in 24 (21.8%) and 12 (10.9%) of the cases, respectively.

Other radiographical findings were as follows; fibrosis in 68 (34%), pleural effusion in 66 (33%), cavity lesion in 46 (23%) of the cases; which appeared as thick-wall cavity with air-fluid level in 3 cases (1.5%) and one case (0.5%) appeared as bulla and the same percent appeared as fungus ball formation. Pleural thickening was seen in 45 (22.5%) cases; of which 6 cases of pleural thickening (13.3%) contained calcifications (3% of all cases). Bronchiectasis was detected in 44 (22%), lymphadenopathy in 18 (9%); of which nine (50%) revealed calcifications (4.5% of all cases). Miliary pattern was noticed in six (3%) of all cases.

Table 1 demonstrates these findings according to gender.



Fig. 2. A 26-year-old mother of a neonate with miliary tuberculosis. CXR reveals RUL consolidation with air-bronchogram and some volume loss. Left hilar lymphadenopathy is seen.



Fig. 3. A 62-year-old man with chronic productive cough. CXR reveals bronchiectasis in RUL and right paracardiac infiltration.



Fig. 4. A 34-year-old woman with longstanding cough. CXR reveals LUL calcification with volume loss.



Fig. 5. A 49-year-old man with cough and fever. CXR reveals bronchopneumonic infiltration with right side pleural effusion. Left costophrenic angle is blunted.

Right lung involvement was seen in 54% and left lung involvement was noticed in 46% of the cases; however, these differences were not significant ($p=0.056$). Pleural effusion was slightly more common on the right side.

Lymphadenopathy was seen on the left side in 10 cases (5%) which was slightly more compared to 8 cases (4%) on the right side; however, this difference was not significant ($p=0.33$). Some rare radiographical findings were calcified granuloma in 18 (9%), emphysematous changes in 15 (7.5%), pneumothorax in eight (4%), atelectasis in six (3%) and pneumomediastinum which was seen in three (1.5%) cases.

The most common recognized underlying diseases

in our patients were smoking and opium addiction in 38 (18%), hypertension in 26 (13%), diabetes mellitus in 20 (10%), ischemic heart disease and cardiac failure in 16 (8%), asthma in seven (3.5%) and finally AIDS and renal transplantation, each seen in two of the patients (1%).

We found that consolidation, fibrotic appearance, pleural effusion and thickening were the most common presentations in patients with smoking and opium abuse, nonetheless, diabetic cases revealed consolidation, fibrosis, bronchiectasis, pleural effusion and lymphadenopathies; however, these differences were not significant ($p=0.24$). Hypertensive cases showed fibrotic changes. In two AIDS cases,

Table 1. Radiographic Findings According to Gender

Radiological Findings	Men (percent)	Women (percent)	Overall
Consolidation-infiltration	50(50%)	60(60%)	110(55%)
Pleural effusion	39(39%)	27(27%)	66(33%)
Cavitation	22(22%)	24(24%)	46(23%)
Fibrosis	38(38%)	30(30%)	68(34%)
Pleural thickening	23(23%)	22(22%)	45(22.5%)
Lymphadenopathy	3(3%)	15(15%)	18(9%)
Miliary pattern	4(4%)	2(2%)	6(3%)
Bronchiectasis	23(23%)	21(21%)	44(22%)
Calcified granuloma	10(10%)	8(8%)	18(9%)
Emphysematous changes	8(8%)	7(7%)	15(7.5%)
Pneumothorax	5(5%)	3(3%)	8(4%)
Pneumomediastinum	2(2%)	4(4%)	6(3%)
Atelectasis	1(1%)	2(2%)	3(1.5%)

pleural thickening, effusion, consolidation, bronchiectasis and cavitation were detected. (Figs. 2-5).

Discussion

The peak age of symptomatic pulmonary TB was 61-80 years, which may be due to the poor general condition in this age group. The mean age in our study was 56.4 years, which was reported between 29-56 years in other articles.⁸⁻¹³ In Iranian studies, the mean ages were near to our study,^{8,9} while in South American and African studies, the mean ages were younger than this study.^{10,11,13}

According to this data, consolidation-infiltration (alveolar and interstitial shadowing) was the most common appearance (55%), especially in the upper lobes; on the other hand, pneumothorax, miliary shadowing, atelectasis and pneumomediastinum were the least common appearances. Consolidation, the most common finding in other studies, has been reported between 42%-89%^{7-9,11,12,14-21} compared to 55% of our cases. In 20-40-year-old men, pleural effusion was the most common and in the 41-80-year-old group, consolidation-infiltration were the most common findings. However, in some studies, normal CXR was reported in 1%-15%^{9,15,20,22-27} but we had no normal CXRs.

Miliary TB was the least common presentation seen in 3% of the cases, which was observed more commonly in the 20-40-year-old age group. Other researchers reported miliary shadowing in 0.75%-20%.^{8,9,12,14-16,18,20-22} According to Thorson's study,²⁸

miliary TB was seen more frequently in men (11% involvement in men compared to 3% involvement in women). Lymphadenopathy was seen in 9%, more commonly in the 41-60 years age group and significantly commoner in women than men ($p=0.0052$). However, no significant difference in side or gender was detected. In literatures, lymphadenopathy was noted in 1%-34% of the cases.^{7-9,12-15,17,20,21,28,29} A study carried out by Thorson et al.²⁸ in Scandinavia revealed lymphadenopathy in 65% of the cases compared to 53.3% involvement in an Iranian study carried out on HIV/TB cases by Bakhshayesh Karam et al.³⁰ A Nigerian study performed by Ahidjo et al.³¹ reported that male and left side involvement were commoner compared to Thorson et al.'s study, which revealed lymphadenopathy was slightly commoner in women (M/F= 65/61).²⁸ Obviously, the prevalence of mediastinal lymphadenopathy is very high in primary TB and in children and more common on the right side.^{7,32}

Pleural effusion is not common in children^{7,17} but it is relatively common in adults (40%).¹⁷ In this study, pleural effusion was seen in 33% of the cases and was more common in men than women, which is similar to Thorson's study (M/F=17/3),²⁸ especially in the 20-40-year-old age group which is similar to fibrosis and bronchiectasis. However, consolidation-infiltration and cavitary lesions were seen more frequently in the 20-40-year-old women compared with the men in the same age group, but these differences were not significant ($p>0.3$). In this study, similar to other studies, upper lobe infiltration was observed more fre-

quently than lower lobe infiltration,^{8,9,15,16} and right lung involvement was more common. Fibrosis was the most common appearance in hypertensive cases and consolidation- infiltration was the most common presentation in diabetic and smoking cases. In this study, 23% of the cases had cavitary lesions. Choyke³³ and Gomes¹⁰ reported cavitary lesions in 7.7% and 36% of the cases, respectively and in studies carried out in other parts of Iran, it was detected between 21%-53% of the cases.^{8,9,12,16,20} Ahidjo¹³ in Nigeria reported cavitary lesions in 50% of the cases which could reach up to 80% in HIV cases with multidrug resistant mycobacterium tuberculosis.¹⁹ Weber et al.³⁴ found cavitary lesions in 56% of the 324 cases aged ten to eighteen-years in his study. This finding together with Wang et al.'s³⁵ finding supported this idea that cavitary lesions are more common in younger cases. In our study, lower lobe involvement was seen in 31.2% of the cases. We found no relation between gender or underlying diseases like diabetes mellitus and lower lobe involvement. Mousavi,⁹ Van den Brande,¹⁸ Ayatollahy³⁶ and Mathur³⁷ reported lower zone involvement in 0.63%-24.3%, which was more common in diabetic³⁶ and female cases.^{36,37} In HIV cases, also, lower lobe infiltration was common and was observed in 50%-85% of the patients.^{38,39} Wang et al.³⁵ also noted that elderly patients had more involvement in lower lobes than younger cases and in the 60-year-old patients, pleural effusion was more frequent and cavitary lesions were less frequent. The prevalence of bronchopneumonic appearance was 10.5% in our study, which was half of Hadlock's study (19%).⁴⁰

In conclusion, there was no significant difference between this study and other researches achieved in Iran. Socioeconomic and underlying diseases like HIV could be considered as the main reason for the differences detected between this research and other studies. The patients were younger in other countries and cavitary lesions were more common in other studies, which seems to be due to the higher level of underlying diseases such as HIV or diabetes.

References

1. Andreu J, Cáceres J, Pallisa E, Martinez-Rodriguez M. Radiological manifestations of pulmonary tuberculosis. *Eur J Radiol* 2004 Aug;51(2):139-49.

2. Sutton D. Text book of radiology and imaging. 7th ed. Churchill Livingstone; 2003. p. 140-5.
3. Hlawatsch A, Kauczor HU, Thelen M. Pulmonary TB, The current radiologic diagnosis of an old disease. *Radiologe* 2000 Jun; 40(6):507-17.
4. Wilcke JTR, Askgaard DS, Nybo Jensen B, Døssing M. Radiographic spectrum of adult pulmonary TB in a developed country. *Respir Med* 1998;22(3):493-7.
5. Weber HC, Beyers N, Gie RP, Schaaf HS, Fish T, Donald PR. The clinical and radiological feature of TB in adolescents. *Ann Trop Pediatr* 2000;Mar;20(1):5-10.
6. McAdams HP, Erasmus J, Winter JA. Radiologic manifestations of pulmonary tuberculosis. *Radiol Clin North Am* 1995 Jul;33(4):655-78.
7. Khatami A, Sabouri S, Ghoroubi J, Rassouli N, Abdollah Gorji F. Radiological findings of pulmonary tuberculosis in infants and young children. *Iran J Radiol* 2008;5(4):231-4.
8. Tavanaei Sani A, Rezaei Talab F, Farrokh D, Kalali AM. A comparison between radiologic manifestation in adults with smear positive and smear negative pulmonary tuberculosis. *Med J Mashhad Uni Med Sci* 2008;50(98):405-10.
9. Mousavi SJ, Talebi Taher M, Alavi MR. Survey on the frequency of abnormal chest X-ray findings in patients with pulmonary tuberculosis admitted to Rasoul-e-Akram and Firoozgar hospitals, 2001-02. *J Iran Uni Med Sci* 2005;12(45):37-42.
10. Gomes M, Saad Junior R, Stirbulov R. Pulmonary tuberculosis: Relationship between sputum bacilloscopy and radiological lesions. *Rev Inst Med Trop Sao Paulo* 2003 Sep-Oct;45(5):275-81.
11. Rathman G, Sillah J, Hill PC, Murray JF, Adegbola R, Corrah T, Lienhardt C, McAdam KP. Clinical and radiological presentation of 340 adults with smear-positive tuberculosis in the Gambia. *Int J Tuberc Lung Dis* 2003;7(10):942-7.
12. Hatami H, Haddadi P. Radiographic evidences of smear positive TB in patients admitted in Sina Hospital of Kermanshah, 1992-2001. *Behbood* 1384;27(9):33-43.
13. Ahidjo A, Hammangabdo A, Anka MK. The chest radiographic appearance and frequency distribution of cavities in pulmonary tuberculosis among adults in northeastern, Nigeria. *Afr J Med Med Sci* 2005 Sep;34(3):281-4.
14. Abediny M, Sajady M, Sajady A. Radiological findings of pulmonary tuberculosis in Bandar Abbas. *Med J Hormozgan Uni* 2001;5(1):12-16.
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. Farahmand H, Pourgholami M, Nasaji M. Chest X-Ray findings of sputum positive tuberculosis patients in Rafsanjan city. *Sci J Hamadan Uni Med Sci Health Serv* 2004;10(4):51-4.
17. Daley CL, Gotway MB, Jasmer RM. Radiographic manifestation of tuberculosis. A primer for clinicians. San Francisco: Francis J Curry National Tuberculosis Center; 2003. p. 12-31.
18. Van den Brande P, Dockx S, Valck B, Demedts M. Pulmonary tuberculosis in the adult in a low prevalence area: is the radiological presentation changing? *Int J Tuberc Lung Dis* 1998;2(11):904-8.
19. Zahirifard S, Amiri MV, Bakhshayesh Karam M, Mirsaedi SM, Ehsanpour A, Masjedi MR. The radiological spectrum of pulmonary multidrug-resistant tuberculosis in HIV-negative patients. *Iran J Radiol* 2003 Dec:161-6.
20. Taramian, S, Molaei Langroodi R. Radiographic findings in active pulmonary TB. *J Guilan Uni Med Sci* 2001;10(378-38):58-62.
21. Hadadi A, Rasoulinezhad M, Davoudi S, Nikdel M, Rasteh M. Clinical characteristic of pulmonary tuberculosis in patients with HIV/AIDS: a case-control study. *Teh Uni Med J* 2006 Aug;64(5):87-95.
22. Aurangzeb S, Badshah M, Khan RS. Chest radiographic findings in neurotuberculosis without pulmonary signs and symptoms. *J Coll Physicians Surg Pak* 2008 Jan;18(1):27-30.

23. Leung AN. Pulmonary tuberculosis: the essentials. *Radiology* 1999;210:307-22.
24. Navarro V, Guix J. Pulmonary TB with normal chest radiography and infection by HIV. *Enferm Infec Microbiol Clin* 1991 Jan;9(1):26-9.
25. Taniguchi H, Suzuki K, Fujisaka A, Abo H, Miwa T, Miyasawa H et al. X ray negative endobronchial tuberculosis with persistent irritating cough that resulted in unpredicted mass infection. *Nihon Kokyuki Gakkai Zasshi* 2003 Aug;41(8):541-5.
26. Greenberg SD, Frager D, Suster B, walker S, Stavropoulos C, Roth-pearl A. Active pulmonary tuberculosis in patients with AIDS: spectrum of radiographic findings (including a normal appearance). *Radiology* 1994 Oct;193(1):115-9.
27. Marciniuk DD, McNab BD, Martin WT, Hoepfner VH. Detection of Pulmonary tuberculosis in patients with a normal chest radiograph. *Chest* 1999 Feb;115(2):445-2.
28. Thorson A, Long NH, Larsson LO. Chest X-ray findings in relation to gender and symptoms: a study of patients with smear positive tuberculosis in Vietnam. *Scand J Infect Dis* 2007;39(1):33-7.
29. Woodring JH, Vandiviere HM, Fried AM. Update: the radiographic features of pulmonary tuberculosis. *AJR Am J Roentgenol* 1986;146:497.
30. Bakhshayesh Karam M, Zahiri Fard S, Tabarsi P, Mir Saeidi SM, Valielahi Pour Amiri M, Masjedi MR, Velayati AA. Radiographic manifestation in TB/HIV patients. *Tanaffos* 2004;3(9):33-9.
31. Ahidjo A, Anka MK, Yusuph H. Radiographic evaluation of lymphadenopathy in pulmonary tuberculosis in Northeastern, Nigeria. *Niger J Med* 2006 Jan-Mar;15(1):68-71.
32. Milkovic D, Richter D, Zoricic-Letoja I, Raos M, Koncul I. Chest radiography findings in primary tuberculosis in children. *Coll Antropol* 2005 Jun;29(1):271-6.
33. Choyke PL, Sostman HD, Curtis AM, Ravin CE, Chen JT, Godwin JD et al., Adult-onset tuberculosis. *Radiology* 1983;48:357.
34. Weber HC, Beyers N, Gie RP, Schaaf HS, Fish T, Donald PR. The clinical and radiological features of tuberculosis in adolescents. *Ann Trop Paediatr* 2000 Mar;20(1):5-10.
35. Wang CS, Chen HC, Yang CJ, Wang WY, Chong IW, Hwang JJ et al. The impact of age on the demographic, clinical, radiographic characteristics and treatment outcomes of pulmonary tuberculosis patients in Taiwan. *Infection* 2008 Aug;36(4):335-40.
36. Ayatollahi J. The chest X-ray findings of tuberculosis patients. *J Rafsanjan Uni Med Sci Health Serv* 2006;5(3):187-92.
37. Mathur KC, Tanwar KL, Razdan JN. Lower lung field tuberculosis. *Indian J Chest Dis* 1974;16(1):31-41.
38. Post FA, Wood R, Pillay GP. Pulmonary tuberculosis in HIV infection: radiographic appearance is related to CD4+ T- lymphocyte count. *Tuber Lung Dis* 1995 Dec 76(6):518-21.
39. Purohit SD, Gupta RC, Bhatara VK. Pulmonary tuberculosis and human immunodeficiency virus infection in Ajmer. *Lung India* 1996;14(3):113-20.
40. Hadlock FP, Park SK, Awe RJ. Unusual radiographic findings in adult pulmonary tuberculosis. *AJR Am J Roentgenol* 1980;134(5):1015-8.