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Original Article

Radiological Profile of Post Pulmonary Tuberculosis Sequelae

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ABSTRACT

Background: Residual radiological lesions are common in cases following successful treatment of pulmonary tuberculosis. These radiological sequelae range from normal chest radiograph to destroyed lung. **Methods:** This hospital-based observational study included 242 cases of post-pulmonary tuberculosis sequelae, who were radiologically evaluated using chest X-rays and/or CT scans. Active pulmonary tuberculosis cases were excluded. **Results:** 242 cases with male:female ratio of 3.2:1 were included. Residual radiological lesions were observed in the majority of patients. Specifically, fibrotic changes were seen in 60.3% of cases, calcification in 47.9%, emphysema in 22.3%, and residual cavity in 20.7%. Bronchiectasis was observed in 19% of the cases, while other less common findings included destroyed lung (8.3%), kyphoscoliosis (6.6%), pneumothorax (5.8%), and pleural thickening (4.1%). Of the 146 cases with radiological abnormalities, 65.8% were confined to the upper lung zones. **Conclusion:** Post-tuberculosis radiological sequelae are prevalent in a substantial number of patients, with fibrotic changes and bronchiectasis being the predominant findings. These sequelae highlight the need for ongoing monitoring and management of patients even after successful tuberculosis treatment to address chronic respiratory complications.

Keywords*: Post-tuberculosis sequelae, radiological findings, fibrosis, bronchiectasis, chest X-ray, CT scan.*

INTRODUCTION

Tuberculosis (TB) is a chronic granulomatous infectious disease, caused by the Mycobacterium tuberculosis complex. Tuberculosis was the world's second leading cause of death from a single infectious agent in 2022 after COVID-19. India accounts for 27% of global tuberculosis cases, with 2.42 million cases in 2022. ,

Tubercle bacilli are transmitted from human to human mainly by the aerosol route by infected droplet nuclei. About 35% of close contacts of sputum smear–positive patients, will become infected by inhalation of droplet nuclei. Invading bacilli are engulfed by alveolar macrophages; spread to regional lymph nodes and disseminate haematogenously. Over the next few weeks, the cell-mediated immunity directs caseating granulomatous inflammatory response which may result in tissue destruction and lung cavitation. However, 40 to 97% of patients with pulmonary tuberculosis who have been successfully treated, develop chronic respiratory abnormalities. , , , , , As a result, it transitions from being a treatable infectious disease to a chronic morbidity, which is called Post Pulmonary TB sequelae (Post PTB Sequelae).

Post PTB sequelae can be categorised into sequelae affecting the Airways, Parenchyma, Pleura, Vessels, Mediastinum & Skeleton. Radiological evaluation is essential for diagnosing and managing these sequelae. Airways may exhibit Bronchiectasis, Tracheobronchial Stenosis, and Broncholithiasis. Parenchymal changes include Cavitation, Fibrotic

change, Calcifications, Destroyed lung, Aspergillus-related lung disease, and Scar carcinoma. Pleural manifestations involve Pleural Thickening, Pneumothorax, Pleural Calcifications, and Fibrothorax. Vascular sequelae consist of Rasmussen aneurysm, Pulmonary Vessel Vasculitis and Thrombosis. Mediastinal and Skeletal deformities can result in Anatomical distortions, Kyphoscoliosis, and Fibrosing Mediastinitis. These patterns are critical for understanding the long-term impacts of tuberculosis treatment on pulmonary health. In this article, we present a detailed radiological profile of post PTB sequelae.

MATERIALS AND METHODS

This was a hospital-based observational study undertaken on treated cases of pulmonary TB, attending OPD or admitted to the Department of Respiratory Medicine, in a tertiary care centre in Jaipur. The duration of the study was from September 2022 to March 2024. We included 242 cases with definite history of pulmonary tuberculosis and anti-tuberculosis treatment. Patients who were currently taking antitubercular treatment, or who had active Mycobacterium tuberculosis infection, were excluded. Sputum AFB smear was done in suspected active TB cases, sputum smear positive cases were excluded. Chest X-ray was performed in all the cases; CT chest was done in cases as per need. The chest radiology was evaluated for various types of pulmonary TB sequelae.

RESULTS

A total of 242 cases of post pulmonary TB sequelae were included in the study. 125 cases (51.7%) were over 60 years old, followed by 97 cases (40.08%) aged 40-60 years, and 20 cases (8.26%) under 40 years. Out of 242 cases, 184 (76.03%) cases were male and 58 (23.97%) were female. 193 (79.8%) cases were from urban areas, and 49 (20.2%) were from rural areas. Out of 242 cases, 67 (27.7%) were engaged in farming, 61 (25.2%) were dependents, and 56 (23.1%) were unskilled labourers. Business/merchandising accounted for 27 (11.2%) cases, skill-based work for 25 (10.3%) cases, and academics/paraprofessionals for 6 (2.5%) cases. 126 (52.1%) cases were smokers, with 104 males and 22 females. Additionally, 48 (19.8%) cases had a history of biomass fuel exposure, with 15 males and 33 females.

Table 1 shows Epidemiology & Treatment History among Study Population. 192 (79.3%) had a history of complete anti-tubercular treatment, while 50 (20.7%) had history of incomplete treatment.

Table 1: Epidemiology & Treatment History

		N	%
Age	<40	20	8.3%
	40-60	97	40.1%
	>60	125	51.7%
Sex	Male	184	76.0%
	Female	58	23.9%
Domicile	Urban	193	79.8%
	Rural	49	20.2%
Smoking, Biomass Exposure	Smoking	126	52.1%
	Biomass Exposure	48	19.8%
ATT History	Completed Single time	170	70.2%
	Completed Multiple times	22	9.1%
	Inadequate ATT	50	20.7%

Various Radiological Sequelae of Pulmonary TB in Study Population were as following (Fig. 1): Fibrosis was observed in 146 cases (60.3%) (Fig. 2), calcification in 116 cases (47.9%), and emphysema in 54 cases (22.3%). Residual cavity was present in 50 cases (20.7%), while bronchiectasis was noted in 46 cases (19%). Atelectasis was present in 22 cases (9.1%). Other abnormalities included destroyed lung in 20 cases (8.3%)(Fig.3), kyphoscoliosis in 16 cases (6.6%), pneumothorax in 14 cases (5.8%), and pleural thickening in 10 cases (4.1%).

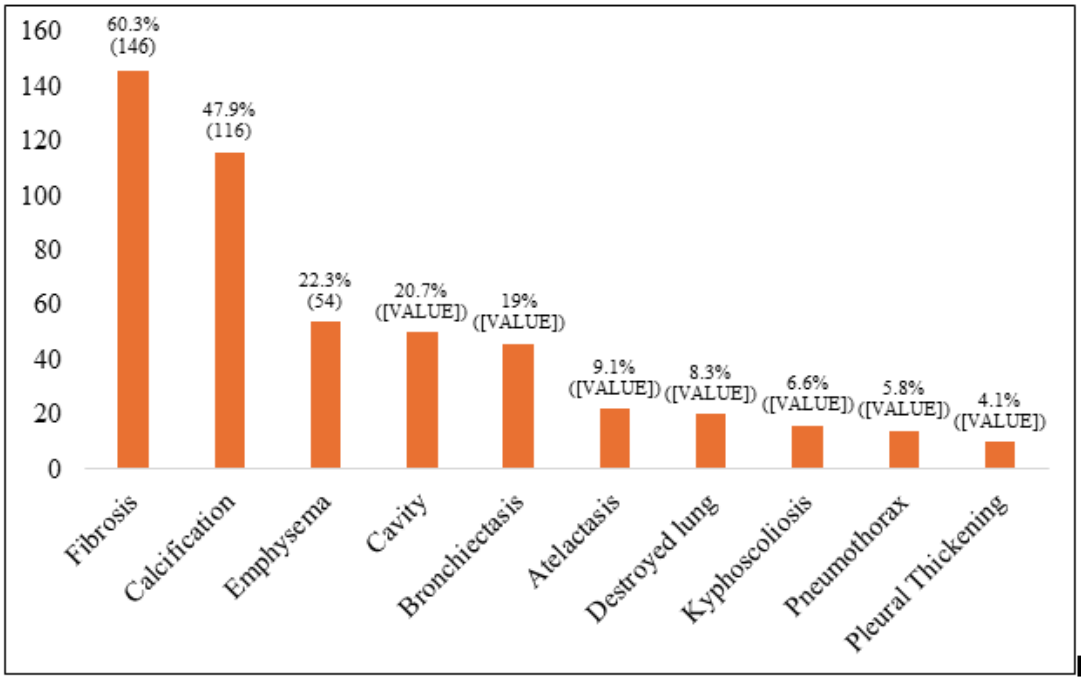

Fig. 1: Radiological Sequelae of Pulmonary TB in Study Population

Fig. 2: Chest X-ray showing Fibro-Calcification in a case of post pulmonary TB.

Fig. 3: Chest X-ray of a case of post pulmonary TB suggestive of Left-sided destroyed lung.

Fig. 4 shows the Distribution of Radiological Sequelae of Pulmonary TB by Different Lung Zones. Of these, 65.8% were confined to the upper lung zone. There were no cases isolated to the middle zone, and only 1.4% were restricted to the lower zone. Cases involving both the upper and middle zones constituted 13.7%, while those affecting the middle and lower zones made up 1.4%. Fibrosis spanning all three lung zones was observed in 17.8% of the cases.

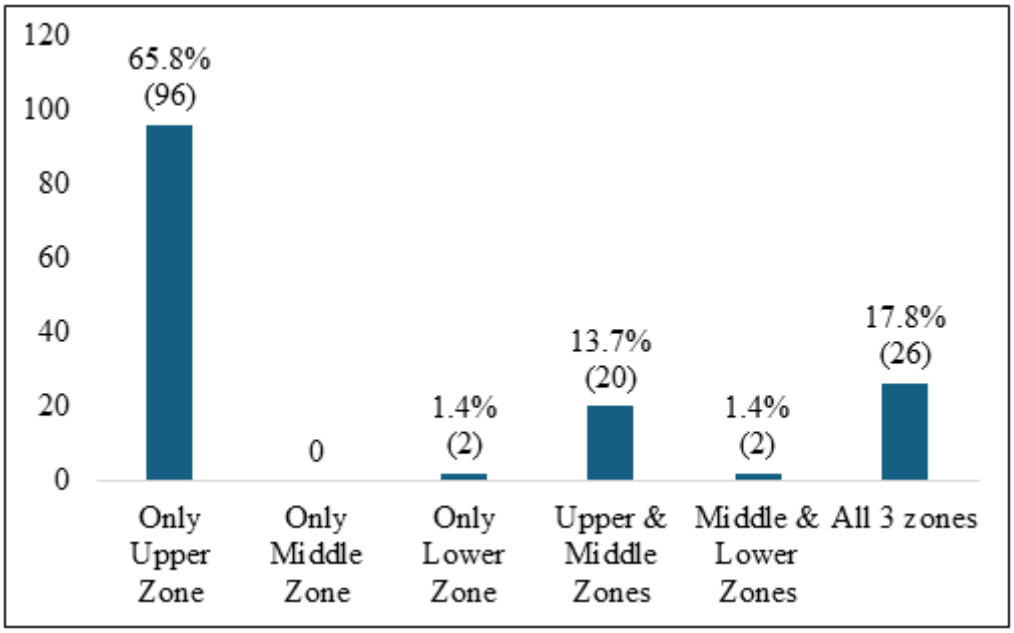

Fig. 4 Distribution of Radiological Sequelae of Pulmonary TB by Different Lung Zones

complete treatment (192 cases), fibrosis was observed in 56.3% (108 cases), calcification in 45.8% (88 cases), cavity in 19.8% (38 cases), bronchiectasis in 16.7% (32 cases), and kyphoscoliosis in 6.8% (13 cases). For patients with incomplete treatment (50 cases), fibrosis was present in 76% (38 cases), calcification in 56% (28 cases), cavity in 24%

(12 cases), bronchiectasis in 28% (14 cases), and kyphoscoliosis in 8% (4 cases). Fig. 5 shows the Comparison of Post PTB Sequelae cases with Status of Anti Tuberculosis Treatment History. Among those with

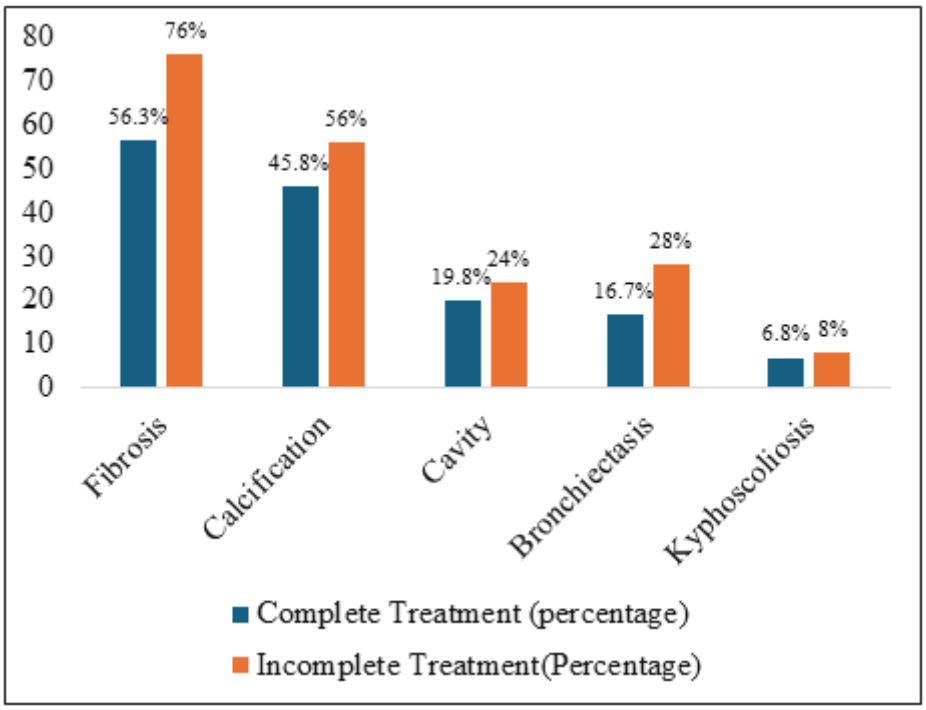

Fig. 5: Comparison of Post PTB Sequelae cases with Status of Anti Tuberculosis Treatment History

DISCUSSION

The dominant age group in our study being above 60 years might be attributed to the long-term effects of TB that became more apparent as patients aged. The majority of the study population was male (76.03%). Reason for the male predominance might include biological differences, higher exposure to TB risk factors among men like smoking and occupational hazards. In our study, 79.8% of the study population belonged to rural areas. This rural predominance may be attributed to the several factors, including underdeveloped healthcare facilities, delays in seeking medical consultation, and limited disease awareness. In our study, the majority of the study population were engaged in farming 67 (27.7%), followed by dependents 61 (25.2%) and unskilled labourers 56 (23.1%) cases.

52.1% (126) of study subjects were current smokers or ex-smokers, while 19.8% (48) cases reported biomass fuel exposure. The increased prevalence of smoking and biomass fuel exposure in post-PTB sequelae cases can be attributed to smoke impairing tracheobronchial clearance, allowing Mycobacterium tuberculosis to reach alveoli and weakening alveolar macrophages' immune response. ,

On radiological evaluation of study population, we observed that the most common sequelae were fibrosis, observed in 60.3% (n=146) of cases, followed by calcification in 47.9% (n=116), residual cavities in 20.7% (n=50), Bronchiectasis in 19% (n=46). In the study by Musafiri et al. (2015), fibrosis was present in 64.3% (130) cases, bronchiectasis in 57.4% (116), residual cavities in 41.1% (83). Both studies identified fibrosis as the most common sequela, likely due to the chronic inflammatory response and subsequent scarring following active infection. That study observed a higher incidence of bronchiectasis (57.4%) compared to our study (19%). Another study by Jamilah Meghji et al. (2020) identified bronchiectasis in 44.2% (170 out of 385) of their cases. The variation in bronchiectasis prevalence could be influenced by different diagnostic criteria or imaging modalities used.

In our study, 8.3% (n=20) of the cases had a destroyed lung. In a study by Jamilah Meghji et al., 9.4% (36 cases) exhibited destroyed lung.

We further correlated the sequelae in cases with complete versus inadequate treatment histories. In our study, Fibrosis occurred in 56.3% (108/192) of those with completed treatment and 76% (38/50) of those with inadequate treatment. Bronchiectasis was seen in 16.7% (32/192) of cases with completed treatment and 28% (14/50) of those with inadequate treatment. Inadequate tuberculosis treatment was associated with higher rates of radiological abnormalities, including

fibrosis, calcification, residual cavities, and bronchiectasis. Inadequate treatment can exacerbate the severity of tuberculosis infection, leading to a higher incidence of post-pulmonary TB sequelae.

In our study, radiological abnormalities predominantly affected the upper lung zones with 65.8% (96/146) of cases. Our study observed a higher percentage of radiological abnormality involving bilateral lungs (56.2% vs. 36.7%). This highlights the predominant involvement of the upper lung zones and bilateral lung fields in post-pulmonary tuberculosis sequelae.

CONCLUSION

This study provides a comprehensive evaluation of the radiological sequelae in patients treated for pulmonary tuberculosis at a tertiary care centre. The findings indicate that post-tuberculosis radiological abnormalities are highly prevalent. The study highlights that incomplete anti-tubercular treatment is associated with a higher incidence of severe radiological sequelae, emphasizing the critical importance of treatment adherence. These results emphasize the need for long-term monitoring and management of patients even after successful TB treatment to address chronic respiratory complications.

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