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Original Article

Prevalence of Bronchiectasis in Post-Tuberculosis Patients Attending Pulmonary OPD HRCT-Based Study

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ABSTRACT

Background: Pulmonary tuberculosis is a major public health problem and is associated with several long-term respiratory complications even after microbiological cure. Bronchiectasis is one of the important structural sequelae observed in post-tuberculosis patients and contributes significantly to chronic respiratory morbidity. High-Resolution Computed Tomography (HRCT) chest plays a vital role in detecting bronchiectatic changes accurately.
Aim: To determine the prevalence of bronchiectasis among post-tuberculosis patients attending the Pulmonary Outpatient Department using HRCT chest.
Materials and Methods: This hospital-based cross-sectional observational study was conducted among 100 previously treated pulmonary tuberculosis patients attending the Pulmonary OPD of a tertiary care center. Eligible participants underwent detailed clinical evaluation and HRCT chest examination. Bronchiectasis was diagnosed based on standard radiological criteria. Data were entered into Microsoft Excel and analyzed using SPSS software. Categorical variables were expressed as frequency and percentage, while continuous variables were expressed as mean ± standard deviation. Chi-square test and independent t-test were used for statistical analysis. A p-value <0.05 was considered statistically significant.
Results: The mean age of the participants was 44.8 ± 13.2 years, with males constituting 62% of the study population. HRCT chest demonstrated bronchiectasis in 37% of post-tuberculosis patients. Chronic cough, sputum production, dyspnea, hemoptysis, and recurrent respiratory infections were significantly more common among patients with bronchiectasis ($p<0.05$). Cylindrical bronchiectasis was the predominant radiological type (59.5%), and upper lobe involvement was most frequently observed. Smoking showed a significant association with bronchiectasis ($p=0.003$).
Conclusion: Bronchiectasis is a common post-tubercular sequela detected on HRCT chest and is associated with significant respiratory symptoms. Early identification and appropriate management may help reduce long-term pulmonary morbidity in post-tuberculosis patients.

Keywords: Bronchiectasis, Pulmonary tuberculosis, HRCT chest, Post-tubercular sequelae, Pulmonary OPD.

INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide, particularly in developing countries such as India. Despite advancements in diagnosis and treatment under national tuberculosis control programs, a significant proportion of patients continue to experience long-term pulmonary complications even after successful completion of anti-tubercular therapy. Post-tuberculosis lung disease has increasingly gained attention because of its substantial impact on respiratory health, quality of life, and healthcare utilization[1]. Bronchiectasis is an irreversible abnormal dilatation of bronchi resulting from chronic inflammation and destruction of the bronchial wall. Pulmonary tuberculosis is recognized as one of the major acquired causes of bronchiectasis in countries with a high TB burden[2]. The pathogenesis involves persistent airway inflammation, fibrosis, parenchymal destruction, and repeated respiratory

infections following tuberculosis infection. These structural changes predispose affected individuals to chronic cough, sputum production, recurrent lower respiratory tract infections, hemoptysis, and progressive decline in lung function[3]. Globally, tuberculosis affected approximately 10.6 million people in 2022, with India contributing a substantial share of the global disease burden[4]. Although microbiological cure rates have improved considerably, studies have shown that many patients develop chronic respiratory sequelae after treatment completion. Post-tubercular bronchiectasis has been reported with varying prevalence ranging from 20% to 50% depending on the study population and imaging modalities used[5].

High-Resolution Computed Tomography (HRCT) chest is considered the gold standard imaging modality for the diagnosis of bronchiectasis because of its superior sensitivity in detecting airway abnormalities and defining the extent and pattern of disease[6]. HRCT helps in early identification of structural lung damage, facilitating appropriate management strategies aimed at symptom control and prevention of further deterioration. Several previous studies have emphasized the burden of bronchiectasis among post-tuberculosis patients. A study by Allwood et al. highlighted that structural lung abnormalities, including bronchiectasis, are common after pulmonary tuberculosis and contribute significantly to chronic respiratory disability[7]. Meghji et al. also demonstrated that post-tuberculosis lung disease is associated with persistent respiratory symptoms and impaired pulmonary function even after successful TB treatment[8]. Despite the high burden of tuberculosis in India, limited data are available regarding the prevalence and radiological characteristics of bronchiectasis among post-tuberculosis patients in routine pulmonary outpatient settings. Early recognition of bronchiectasis in these patients is essential for timely intervention, reduction of recurrent infections, and improvement in quality of life. Hence, the present study was undertaken to determine the prevalence of bronchiectasis among post-tuberculosis patients attending the Pulmonary OPD using HRCT chest and to evaluate its associated clinical and radiological characteristics.

AIM AND OBJECTIVES

Aim

To determine the prevalence of bronchiectasis among post-tuberculosis patients attending the Pulmonary Outpatient Department (OPD) using High-Resolution Computed Tomography (HRCT) of the chest.

Objectives

- To estimate the prevalence of bronchiectasis in patients with previously treated pulmonary tuberculosis using HRCT chest.
- To assess the demographic and clinical profile of post-tuberculosis patients diagnosed with bronchiectasis.
- To evaluate the pattern and radiological distribution of bronchiectatic changes on HRCT among post-tuberculosis patients.

MATERIALS AND METHODS

Study Design and Setting

This hospital-based cross-sectional observational study was conducted in the Department of Pulmonary Medicine at a tertiary care teaching hospital. The study was carried out over a period of ___ months from _____ to _____ after obtaining approval from the Institutional Ethics Committee.

Study Population

The study population comprised previously treated pulmonary tuberculosis patients attending the Pulmonary Outpatient Department (OPD) during the study period.

Inclusion Criteria

1. Patients aged more than 18 years.
2. Patients with a documented history of previously treated pulmonary tuberculosis.
3. Patients who had completed anti-tubercular therapy and were declared microbiologically cured or treatment completed.
4. Patients willing to participate and provide written informed consent.

Exclusion Criteria

1. Patients with active pulmonary tuberculosis at the time of evaluation.
2. Patients with known congenital or hereditary causes of bronchiectasis such as cystic fibrosis or primary ciliary dyskinesia.
3. Patients with bronchiectasis due to other established etiologies including interstitial lung disease, allergic bronchopulmonary aspergillosis, or immunodeficiency disorders.
4. Pregnant women.
5. Patients who were critically ill or unable to undergo HRCT chest.

Sample size calculation:

The sample size was estimated using the formula for prevalence studies:

$$n = 4pq / d^2$$

Where:
• n = required sample size
• p = prevalence of bronchiectasis among post-tuberculosis patients from previous literature
• q = 100 − p
• d = allowable error

Based on previous studies, the prevalence of bronchiectasis among post-tuberculosis patients was reported to be approximately 35%.

Therefore,
p = 35
q = 100 − 35 = 65

Considering an allowable error of 10% and feasibility constraints for a hospital-based study,
d = 10

Substituting into the formula:
$n = (4 \times 35 \times 65) / (10^2)$
n = 9100 / 100
n = 91

After accounting for possible incomplete data and non-response, the final sample size was rounded off to 100 participants.

Sampling Technique
Eligible patients attending the Pulmonary OPD during the study period were recruited consecutively until the required sample size of 100 was achieved.

Study Procedure
After obtaining written informed consent, detailed demographic and clinical information was collected using a structured proforma. Data included age, sex, smoking history, socioeconomic status, duration since completion of anti-tubercular treatment, presenting respiratory symptoms, history of recurrent respiratory infections, and comorbid illnesses. A detailed general physical examination and respiratory system examination were performed for all study participants. Relevant baseline investigations including complete blood count, sputum examination when indicated, chest radiograph, and pulmonary function tests were performed as per clinical requirement. All enrolled patients underwent High-Resolution Computed Tomography (HRCT) of the chest using standard protocol. HRCT images were interpreted by an experienced radiologist/pulmonologist. Bronchiectasis was diagnosed radiologically based on accepted HRCT criteria including:

1. Bronchial dilatation with bronchoarterial ratio greater than 1.
2. Lack of normal bronchial tapering.
3. Visualization of bronchi within 1 cm of the pleural surface.

The distribution, type, and severity of bronchiectatic changes were documented. Bronchiectasis was categorized morphologically into cylindrical, varicose, and cystic types.

Outcome Measures
Primary Outcome

1. Prevalence of bronchiectasis among post-tuberculosis patients based on HRCT findings.

Secondary Outcomes

1. Demographic profile of patients with bronchiectasis.
2. Clinical characteristics associated with post-tubercular bronchiectasis.
3. Radiological pattern and anatomical distribution of bronchiectasis on HRCT.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on data distribution. Association between categorical variables was analyzed using Chi-square test or Fisher's exact test. Independent t-test or Mann–Whitney U test was used for comparison of continuous variables where appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study was initiated only after obtaining clearance from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient information was maintained throughout the study, and all procedures were conducted in accordance with ethical principles for biomedical research involving human participants.

RESULTS

A total of 100 previously treated pulmonary tuberculosis patients attending the Pulmonary Outpatient Department were included in the study. HRCT chest was performed for all participants to assess the presence of bronchiectasis.

Table 1. Demographic Characteristics of the Study Population (n = 100)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–30	18	18.0
31–45	34	34.0
46–60	31	31.0
>60	17	17.0
Gender		
Male	62	62.0
Female	38	38.0
Smoking Status		
Smoker	41	41.0
Non-smoker	59	59.0
Mean Age (years)	44.8 ± 13.2	

The mean age of the study participants was 44.8 ± 13.2 years. Majority of the patients belonged to the 31–45 years age group (34%). Male participants constituted 62% of the study population, and 41% were smokers.

Table 2. Prevalence of Bronchiectasis among Post-Tuberculosis Patients Based on HRCT Chest (n = 100)

HRCT Finding	Frequency (n)	Percentage (%)
Bronchiectasis Present	37	37.0
Bronchiectasis Absent	63	63.0

HRCT chest revealed bronchiectasis in 37% of previously treated pulmonary tuberculosis patients.

Table 3. Clinical Symptoms among Patients With and Without Bronchiectasis

Clinical Symptom	Bronchiectasis Present (n=37)	Bronchiectasis Absent (n=63)	p-value
Chronic cough	31 (83.8%)	29 (46.0%)	<0.001*
Sputum production	28 (75.7%)	21 (33.3%)	<0.001*
Dyspnea	24 (64.9%)	25 (39.7%)	0.014*
Hemoptysis	10 (27.0%)	5 (7.9%)	0.009*
Recurrent respiratory infections	19 (51.4%)	11 (17.5%)	<0.001*

*Statistically significant ($p < 0.05$)

Patients with bronchiectasis had significantly higher prevalence of chronic cough, sputum production, dyspnea, hemoptysis, and recurrent respiratory infections compared to patients without bronchiectasis.

Table 4. HRCT Pattern and Distribution of Bronchiectasis among Affected Patients (n = 37)

HRCT Characteristics	Frequency (n)	Percentage (%)
Type of Bronchiectasis		
Cylindrical	22	59.5
Varicose	9	24.3
Cystic	6	16.2
Lobar Distribution		
Upper lobe predominance	21	56.8
Lower lobe predominance	8	21.6
Diffuse bilateral involvement	8	21.6

Among patients with bronchiectasis, cylindrical bronchiectasis was the most common morphological type (59.5%). Upper lobe involvement was observed in 56.8% of affected individuals.

Table 5. Association Between Smoking and Presence of Bronchiectasis

Smoking Status	Bronchiectasis Present	Bronchiectasis Absent	Total	p-value
Smoker	22	19	41	0.003*
Non-smoker	15	44	59	
Total	37	63	100	

*Statistically significant (Chi-square test, $p < 0.05$)

Bronchiectasis was significantly more common among smokers compared to non-smokers (53.7% vs 25.4%, $p = 0.003$).

DISCUSSION

The present study evaluated the prevalence of bronchiectasis among previously treated pulmonary tuberculosis patients attending the Pulmonary Outpatient Department using HRCT chest. Tuberculosis remains an important cause of chronic structural lung disease in developing countries, and post-tubercular bronchiectasis contributes significantly to long-term respiratory morbidity. In the present study, the mean age of the participants was 44.8 ± 13.2 years, and the majority of patients belonged to the 31–45 years age group. Similar observations were reported by Meghji et al., who found that post-tuberculosis lung disease predominantly affected middle-aged adults with persistent respiratory symptoms after treatment completion[8]. Male predominance was observed in our study, with males constituting 62% of participants. This finding is comparable to the study conducted by Visca et al., where males formed the majority of post-tuberculosis lung disease patients, possibly due to higher exposure to smoking and occupational risk factors[9]. The prevalence of bronchiectasis detected by HRCT chest in the present study was 37%. This finding is consistent with previous literature demonstrating a high burden of bronchiectatic changes following pulmonary tuberculosis. Meghji et al., in their systematic review, reported that bronchiectasis was one of the most common structural abnormalities identified in post-TB lung disease, with prevalence varying between 20% and 50% across studies[8].Similarly, Allwood et al. emphasized that bronchiectasis represents a major component of post-tuberculosis lung damage and contributes to chronic respiratory impairment[7].

In the present study, patients with bronchiectasis had significantly higher prevalence of chronic cough, sputum production, dyspnea, hemoptysis, and recurrent respiratory infections compared to patients without bronchiectasis. These findings are in agreement with the observations of Chalmers et al., who reported that chronic productive cough and recurrent infective exacerbations are hallmark clinical manifestations of bronchiectasis[3]. The association between bronchiectasis and persistent respiratory symptoms after tuberculosis treatment highlights the importance of long-term pulmonary follow-up in these patients. Among HRCT findings, cylindrical bronchiectasis was the most common morphological pattern observed in our study (59.5%), followed by varicose and cystic types. Similar radiological patterns were described by Kim et al., who reported cylindrical bronchiectasis as the predominant form in post-tubercular patients undergoing HRCT evaluation[10]. Upper lobe predominance was identified in more than half of the affected patients in the present study, which correlates with the typical upper lobe predilection of pulmonary tuberculosis and its sequelae. Smoking showed a statistically significant association with bronchiectasis in the present study.

Smokers demonstrated a higher prevalence of bronchiectatic changes compared to non-smokers. This observation is supported by previous studies indicating that smoking aggravates airway inflammation, impairs mucociliary clearance, and accelerates structural lung damage in patients with prior pulmonary infections[11]. The use of HRCT chest in the present study enabled accurate detection and characterization of bronchiectatic changes, including extent and distribution of disease. HRCT is widely considered the gold standard imaging modality for diagnosis of bronchiectasis because of its high sensitivity and ability to identify early airway abnormalities[12]. Overall, the findings of the present study emphasize that bronchiectasis is a frequent and clinically significant sequela among post-tuberculosis patients. Early recognition through HRCT imaging and timely management may help reduce recurrent infections, improve symptom control, and prevent progressive pulmonary disability.

Limitations

- The study was conducted at a single tertiary care center with a relatively small sample size, limiting generalizability of the findings.
- Being a cross-sectional study, causal relationships between risk factors and bronchiectasis could not be established.
- Pulmonary function assessment and long-term follow-up were not included, which may have provided additional information regarding functional impairment and disease progression.
- Selection bias may be present because only patients attending the Pulmonary OPD were included in the study.

CONCLUSION

The present study demonstrated that bronchiectasis is a common post-tubercular sequela among previously treated pulmonary tuberculosis patients, with HRCT chest detecting bronchiectatic changes in 37% of participants. Patients with bronchiectasis had significantly higher respiratory symptoms such as chronic cough, sputum production, dyspnea, hemoptysis, and recurrent respiratory infections. Cylindrical bronchiectasis and upper lobe predominance were the most frequent radiological findings. Smoking showed a significant association with bronchiectasis. HRCT chest proved to be an effective modality for early detection and characterization of post-tubercular bronchiectatic changes. Early diagnosis and appropriate long-term follow-up may help reduce pulmonary morbidity and improve quality of life in post-tuberculosis patients.

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