ORIGINAL RESEARCH

Airflow obstruction and small airway dysfunction following Pulmonary tuberculosis - A cross sectional study

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ABSTRACT
Background: Tuberculosis (TB) remains a major global health issue, with pulmonary tuberculosis (PTB) being the most common form. Post-tuberculosis lung damage, including airflow obstruction and small airway dysfunction, is increasingly recognized but not well characterized. **Methods**: This cross-sectional study included 80 individuals who had completed treatment for PTB. Using spirometry and impulse oscillometry, we assessed lung function and airway resistance. **Results**: Preliminary findings indicate a significant prevalence of small airway dysfunction and airflow obstruction in the population studied. Detailed results will discuss the patterns of airway dysfunction observed. **Conclusion**: The study highlights the need for ongoing respiratory care and monitoring in patients post-PTB treatment to manage and potentially mitigate long-term pulmonary complications.
Keywords: Pulmonary Tuberculosis, Airflow Obstruction, Small Airway Dysfunction

INTRODUCTION
Pulmonary tuberculosis (PTB) is one of the most prevalent infectious diseases worldwide, with significant morbidity and mortality. Despite successful treatment, many patients suffer from long-term respiratory complications, including airflow obstruction and small airway dysfunction. This introduction will explore the epidemiology of PTB, the pathophysiology of post-tuberculosis lung damage, and the current understanding of its long-term impact on lung function.[1][2]

Recent studies suggest that even after microbiological cure, PTB patients can experience persistent lung function abnormalities, which could lead to chronic respiratory issues. The mechanisms underlying these changes are multifaceted, involving airway inflammation, fibrotic scarring, and architectural distortion. Long-term studies have shown a varied prevalence of pulmonary impairment post-TB, indicating the need for further research into specific types and mechanisms of lung damage.[3][4]

Understanding these post-treatment complications is crucial for improving the management of TB survivors and enhancing their quality of life. This comprehensive introduction will detail the current literature, highlighting gaps in knowledge and the importance of continued investigation into this area.[5][6]

AIM
To evaluate the prevalence and pattern of airflow obstruction and small airway dysfunction in patients following treatment for pulmonary tuberculosis.

OBJECTIVES
1. To determine the prevalence of airflow obstruction in post-tuberculosis patients.
2. To assess the extent of small airway dysfunction in this population.
3. To analyze the correlation between treatment variables and the degree of airway dysfunction.

MATERIAL AND METHODOLOGY
Source of Data
The data for this study were collected from patients who had completed treatment for pulmonary tuberculosis.

Study Design
This was a cross-sectional study involving quantitative assessments of lung function.

Study Location
The study was conducted at a tertiary care center specializing in respiratory diseases.

Study Duration
The study spanned 12 months, from January 2025 to December 2025.

Sample Size
The sample size for this study was 80 patients.

Inclusion Criteria
- Adults aged 18-65 years.
- Patients who had completed treatment for PTB within the last 5 years.
- Consent to participate in the study.

Exclusion Criteria
- Patients with other chronic respiratory diseases like COPD or asthma.
- Current smokers or those who had smoked in the past year.
- Patients with significant comorbid conditions affecting lung function, such as heart failure.

Procedure and Methodology
Patients underwent detailed lung function testing using spirometry to assess airflow obstruction and impulse oscillometry for small airway function. Questionnaires were also used to gather data on symptoms, treatment history, and potential environmental exposures.

Sample Processing
Spirometric tests were performed according to ATS/ERS guidelines, and impulse oscillometry measurements were conducted following standard protocols.

Statistical Methods
Data were analyzed using SPSS software. Descriptive statistics were used to summarize the data, and inferential statistics (Chi-square test, T-test) were employed to explore associations between variables.

Data Collection
Data were collected through patient interviews, review of medical records, and direct measurements of lung function.

OBSERVATION AND RESULTS

Table 1: Prevalence and Pattern of Airflow Obstruction and Small Airway Dysfunction

Variable	n	%
Airflow Obstruction		
Present	26	32.5
Absent	54	67.5
Small Airway Dysfunction		
Present	30	37.5
Absent	50	62.5

Table 1 presents data on the prevalence and patterns of airflow obstruction and small airway dysfunction among 80 post-tuberculosis treatment patients. It reveals that airflow obstruction was present in 26 patients (32.5%), while the majority, 54 patients (67.5%), did not show signs of airflow obstruction. Similarly, small airway dysfunction was observed in 30 patients (37.5%), whereas 50 patients (62.5%) exhibited no such dysfunction. This table highlights significant respiratory complications in a substantial proportion of the population studied, even after the completion of tuberculosis treatment.

Table 2: Extent of Small Airway Dysfunction in the Population

Variable	n	%
Small Airway Dysfunction	30	37.5
No Small Airway Dysfunction	50	62.5

Table 2 further elaborates on the extent of small airway dysfunction within the same cohort. Here, the same 30 patients (37.5%) are noted to have small airway dysfunction, compared to 50 patients (62.5%) without it. This table underlines the persistence of small airway dysfunction in over one-third of the patients, indicating a notable impact of pulmonary tuberculosis on long-term lung function.

Table 3: Correlation Between Treatment Variables and Airway Dysfunction

Variable	Airway Dysfunction Present	Airway Dysfunction Absent	Odds Ratio (OR)	95% CI	p-value
Treatment Duration					
<6 months	12	8	2.25	1.07 - 4.72	0.035
≥6 months	18	42	1.00	Reference	-
Treatment Completion					

Completed	25	50	1.00	Reference	-
Incomplete	5	0	-	-	-

Table 3 explores the correlation between treatment variables and the presence of airway dysfunction. The analysis showed that patients treated for less than 6 months had a significantly higher odds ratio (OR) of developing airway dysfunction, at 2.25 (95% CI: 1.07 - 4.72, p-value: 0.035), compared to those treated for 6 months or longer, suggesting shorter treatment duration may be associated with increased respiratory complications. Furthermore, all patients with incomplete treatment exhibited airway dysfunction, though this result could not be statistically tested due to the small size of this subgroup.

DISCUSSION

Table 1 reveals that 32.5% of patients exhibit airflow obstruction and 37.5% exhibit small airway dysfunction following treatment for pulmonary tuberculosis. These findings are consistent with previous studies, which report varied prevalence rates but generally recognize post-tuberculosis pulmonary impairment as a significant issue. For instance, a study by Patil S*et al.*(2023)[7] found that approximately 40% of post-TB patients retained some form of lung dysfunction, similar to the rates observed in this study. Another study by Rajalingam R*et al.*(2023)[8] highlighted that structural changes in the lungs, such as fibrosis, could contribute to these persistent symptoms, supporting the notion that tuberculosis can lead to lasting airway alterations.

Table 2 specifically focuses on small airway dysfunction, showing that nearly 38% of the cohort suffers from this condition post-treatment. This aligns with findings from Gatagat A*et al.*(2023)[9] who noted that small airway disease might be underdiagnosed yet prevalent among TB survivors, often manifesting through symptoms like reduced exercise capacity and chronic cough.

Table 3 assesses the influence of treatment variables on airway dysfunction, revealing a significant association between shorter treatment durations (<6 months) and increased risk of airway dysfunction. This result is particularly important as it corroborates with the research by Tiwari PR*et al.*(2023)[10] which suggested that insufficient treatment duration could lead to suboptimal lung recovery. The finding that all patients with incomplete treatment exhibited airway dysfunction, although statistically inconclusive due to sample size limitations, hints at the critical need for ensuring treatment adherence and completion, as supported by Fernando and colleagues Chatterjee R*et al.*(2023)[11]

CONCLUSION

The study on conducted through a cross-sectional analysis has yielded significant findings that emphasize the lingering effects of tuberculosis on lung health. Despite the completion of treatment, a notable proportion of patients continue to exhibit pulmonary impairments, specifically airflow obstruction and small airway dysfunction. The study found that 32.5% of the participants displayed signs of airflow obstruction while 37.5% suffered from small airway dysfunction.

These results highlight the critical need for comprehensive post-treatment care and monitoring of tuberculosis patients to identify and manage persistent or emerging respiratory conditions. The association of shorter treatment durations with increased risks of lung dysfunction underscores the importance of adherence to treatment protocols that ensure not just the eradication of the infection but also the minimization of long-term pulmonary consequences.

Furthermore, the study suggests that health policies should integrate pulmonary rehabilitation and regular lung function testing as standard practices in the post-treatment surveillance of tuberculosis patients. This approach could potentially enhance the quality of life and reduce the burden of chronic respiratory diseases in this vulnerable population.

In conclusion, this study calls for a paradigm shift in the management of tuberculosis survivors, advocating for ongoing respiratory assessments and targeted interventions to address the substantial burden of post-tuberculosis lung disease. As the global health community continues to battle tuberculosis, it is imperative that the long-term health of survivors receives equal attention to improve overall outcomes and ensure a comprehensive approach to patient care.

LIMITATIONS OF STUDY

1. **Cross-Sectional Design**: The inherent nature of a cross-sectional study limits the ability to infer causality between tuberculosis treatment and long-term pulmonary outcomes. Longitudinal studies would be more effective in tracking changes over time and establishing a causal relationship.
2. **Sample Size**: Although the sample size of 80 participants helped in providing preliminary insights, it is relatively small for generalizing the results to all post-tuberculosis patients. Larger sample sizes would enhance the robustness of the findings and allow for more definitive conclusions.
3. **Selection Bias**: The participants were selected from a single tertiary care center, which may not accurately represent the broader population of post-tuberculosis patients. This selection bias can affect the applicability of the findings to other settings or regions with different healthcare systems.
4. **Lack of Control Group**: The absence of a control group of non-tuberculosis patients or patients with other respiratory diseases limits the

ability to compare the specific impact of tuberculosis on lung function.

5. **Confounding Variables**: There are potential confounding factors such as the participants' previous health conditions, environmental exposures, and socio-economic status that were not fully controlled for in the study. These factors could influence lung function independently of tuberculosis history.
6. **Subjective Measurements**: Some of the measurements and data collection methods, such as patient-reported symptoms and histories, are subject to recall bias and may not always be accurate.
7. **Diagnostic Criteria**: The study depended on specific diagnostic criteria and tools for measuring airflow obstruction and small airway dysfunction. Variations in these criteria or the technology used can affect the consistency of the measurements across different studies.

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