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Correlation of Hrct Thorax Findings with Dyspnea and Spirometry in Post-Tubercular Lung Sequelae

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ABSTRACT

Background: Post-tubercular lung disease (PTLD) is characterised by persistent structural and functional pulmonary abnormalities despite microbiological cure of tuberculosis. Residual lung damage, such as fibrosis, bronchiectasis, cavitation, and pleural thickening, may lead to chronic respiratory symptoms and impaired pulmonary function. High-Resolution Computed Tomography (HRCT) of the thorax and spirometry are important tools for evaluating these sequelae.
Aim: To study the correlation between HRCT thorax findings, dyspnea, and spirometric parameters in patients with post-tubercular lung sequelae.
Materials and Methods: This cross-sectional observational study was conducted in the Department of Respiratory Medicine at Postgraduate Institute of Medical Education and Research and Capital Hospital from January 2025 to June 2025. A total of 85 patients with post-tubercular lung disease were included. Detailed clinical history and dyspnea assessment using Modified Medical Research Council (mMRC) grading were performed. HRCT thorax was evaluated for fibrosis, cavitation, bronchiectasis, nodules, and aspergilloma. Total Lung Score (TLS) and Total Morphological Score (TMS) were calculated. Pulmonary function tests including FEV1, FVC, FEV1/FVC, FEF25–75%, and TLC were recorded.
Results: Out of 85 patients, 63 were males, and 22 were females. Dyspnea (mMRC grade 2–4) was present in 13 patients. Fibrosis was the most common HRCT finding. Restrictive ventilatory defect was the predominant spirometric abnormality (40%), followed by mixed pattern (29.2%) and obstructive pattern (2.4%). Patients with dyspnea had significantly higher median TMS (11.5) and TLS (10) compared to non-dyspneic patients. Severe spirometric impairment (FEV1 <60%) was associated with higher fibrosis, cavitation, TMS, and TLS scores.
Conclusion; Post-tubercular lung sequelae are associated with significant structural and functional pulmonary impairment. HRCT severity scores showed strong correlation with dyspnea and spirometric abnormalities. HRCT thorax and pulmonary function tests are valuable tools for assessment and follow-up of patients with post-tubercular lung disease.

Keywords: *Post-tubercular lung disease, HRCT thorax, pulmonary tuberculosis sequelae, spirometry, dyspnea, pulmonary function test, fibrosis, bronchiectasis.*

INTRODUCTION

Tuberculosis (TB) continues to be a major global health problem despite significant advances in diagnosis and treatment. According to the World Health Organization, millions of people are affected by pulmonary tuberculosis every year, especially in developing countries such as India.[1] Although microbiological cure can be achieved with effective anti-

tubercular therapy, many patients continue to experience chronic respiratory symptoms and functional impairment even after completion of treatment.[2]

Post-tubercular lung disease (PTLD) refers to persistent structural and functional abnormalities of the lungs following successful treatment of pulmonary tuberculosis.[3] Increasing evidence suggests that clinical cure does not necessarily indicate restoration of normal lung health. Residual pulmonary damage caused by tuberculosis can significantly affect long-term respiratory function and quality of life.[4]

The common sequelae of pulmonary tuberculosis include fibrosis, cavitation, bronchiectasis, pleural thickening, nodules, volume loss, and parenchymal destruction.[5] These structural abnormalities may lead to airflow limitation, restrictive ventilatory defects, impaired gas exchange, chronic cough, and dyspnea.[6] Fibrotic healing and distortion of the lung architecture contribute to decreased lung compliance and reduced pulmonary reserve.[7]

High-Resolution Computed Tomography (HRCT) thorax is considered a sensitive imaging modality for assessing post-tubercular lung damage. HRCT provides detailed visualization of parenchymal abnormalities, airway involvement, cavitary lesions, and bronchiectatic changes that may not be adequately identified on conventional chest radiography.[8] Quantitative HRCT scoring systems such as Total Lung Score (TLS) and Total Morphological Score (TMS) help assess the severity and extent of pulmonary involvement.[9]

Pulmonary function tests (PFTs), particularly spirometry, are useful tools for evaluating functional impairment in post-TB patients. Various spirometric patterns including obstructive, restrictive, and mixed ventilatory defects have been described in patients with post-tubercular lung disease.[10] Restrictive ventilatory defect is often associated with extensive fibrosis and volume loss, whereas bronchiectasis and cavitary lesions may contribute to airflow obstruction.[11]

Dyspnea remains one of the most common symptoms in patients with post-tubercular lung sequelae and significantly impacts daily activities and quality of life.[12] Correlating HRCT findings with spirometric abnormalities and dyspnea severity may provide valuable insight into the relationship between structural lung damage and functional impairment. Therefore, the present study was undertaken to evaluate the correlation between HRCT thorax findings, dyspnea, and spirometric parameters in patients with post-tubercular lung sequelae.

MATERIAL AND METHODS

Study Design and Setting

This cross-sectional observational study was conducted in the Department of Respiratory Medicine at Postgraduate Institute of Medical Education and Research and Capital Hospital over a period of 6 months from January 2025 to June 2025.

Study Population

The study population consisted of 85 patients diagnosed with post-tubercular lung disease attending the outpatient and inpatient departments of Respiratory Medicine during the study period.

Inclusion Criteria

- Adult patients aged more than 18 years.
- Patients previously treated and cured of pulmonary tuberculosis.
- Patients willing to participate and providing informed consent.

Exclusion Criteria

- Patients with active pulmonary tuberculosis confirmed by sputum AFB positivity, CBNAAT positivity, or radiological evidence suggestive of active disease.
- Patients who received inadequate anti-tubercular treatment regimen or dosage.
- Pregnant women.
- HIV-positive patients.
- Patients unwilling to provide consent.
- Patients with pre-existing obstructive airway diseases such as chronic obstructive pulmonary disease (COPD) or bronchial asthma.
- Patients with restrictive lung diseases such as interstitial lung disease (ILD).
- Patients younger than 18 years.

Data Collection
A detailed clinical history was obtained from all enrolled patients with particular emphasis on respiratory symptoms, especially dyspnea. Dyspnea severity was assessed using the Modified Medical Research Council (mMRC) dyspnea grading scale.

Radiological Assessment
All patients underwent chest radiography (posteroanterior view) and High-Resolution Computed Tomography (HRCT) of the thorax.

The lungs were divided into six zones:
- Right upper, middle, and lower zones
- Left upper, middle, and lower zones

Each lung zone was evaluated for the extent of parenchymal involvement and scored as follows:
- <25% involvement = 1
- 25–50% involvement = 2
- 50–75% involvement = 3
- 75% involvement = 4

The following radiological abnormalities were assessed:
- Fibrosis
- Cavitation
- Bronchiectasis
- Nodules
- Aspergilloma

Total Lung Score (TLS)
TLS was calculated as the sum of the extent of parenchymal involvement in all six lung zones.

Total Morphological Score (TMS)
TMS was calculated as the cumulative score of all morphological abnormalities including fibrosis, cavitation, bronchiectasis, nodules, and aspergilloma according to the extent of involvement in each lung zone.

Microbiological Evaluation
Sputum examination for Acid-Fast Bacilli (AFB) and Cartridge-Based Nucleic Acid Amplification Test (CBNAAT) was performed in all patients to exclude active tuberculosis.

Pulmonary Function Testing
Spirometry was performed in all patients according to standard guidelines. The following parameters were recorded:
- Forced Expiratory Volume in 1 second (FEV1)
- Forced Vital Capacity (FVC)
- FEV1/FVC ratio
- Forced Expiratory Flow 25–75% (FEF25–75%)
- Total Lung Capacity (TLC)

Patients were categorized according to FEV1 values into:
- Normal ventilation: FEV1 >80%
- Mild to moderate defect: FEV1 60–79%
- Severe defect: FEV1 <60%

Spirometric patterns were classified as obstructive, restrictive, or mixed ventilatory defects.

Statistical Analysis
Clinical, radiological, and spirometric data were analyzed to evaluate the correlation between HRCT thorax findings, dyspnea severity, and pulmonary function parameters in patients with post-tubercular lung sequelae. Median scores of Total Morphological Score (TMS), Total Lung Score (TLS), and individual CT abnormalities were compared with dyspnea grades and spirometric severity categories.

RESULTS AND OBSERVATIONS

Demographic Profile of Study Population

A total of 85 patients with post-tubercular lung sequelae were included in the study. Among them, 63 were males and 22 were females, indicating male predominance in the study population.

Table 1: Gender Distribution of Study Population

Gender	Number of Patients	Percentage (%)
Male	63	74.1
Female	22	25.9
Total	85	100

Dyspnea Distribution Among Study Population

Dyspnea was assessed using the Modified Medical Research Council (mMRC) grading system. Out of 85 patients, 13 patients had significant dyspnea (mMRC Grade 2–4), while the remaining patients had mild or no dyspnea (mMRC Grade 0–1).

Table 2: Distribution of Dyspnea Among Male and Female Patients

Gender	Total Patients	Dyspneic Patients (mMRC 2–4)	Non-Dyspneic Patients (mMRC 0–1)
Male	63	10	53
Female	22	3	19
Total	85	13	72

HRCT Thorax Findings in Relation to Dyspnea

Median HRCT morphological scores were significantly higher in patients with dyspnea compared to non-dyspneic patients. Fibrosis was the most common radiological abnormality observed.

Table 3: Comparison of CT Findings Between Dyspneic and Non-Dyspneic Patients

CT Finding	Overall Median Score	Dyspnea (mMRC 2–4)	Non-Dyspnea (mMRC 0–1)
Fibrosis Score	4	5	3
Cavitation Score	2	3	0
Bronchiectasis Score	1	2	0
Nodule Score	0	0	0
Aspergilloma Score	0	0	0
TMS (Total Morphology Score)	9	11.5	6
TLS (Total Lung Score)	9	10	6

Table 4: Distribution of Spirometric Patterns

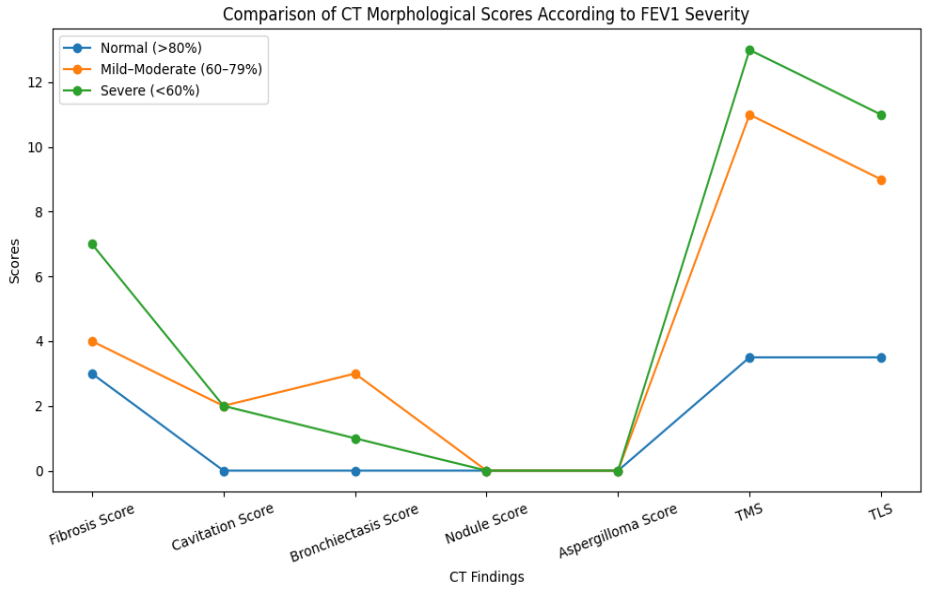
Spirometric Pattern	Percentage (%)
Restrictive Pattern	40
Mixed Pattern	29.2
Obstructive Pattern	2.4
Normal Spirometry	28.2

HRCT Morphological Scores According to Severity of Spirometric Impairment

Patients were categorized based on FEV1 values into normal ventilation (>80%), mild to moderate defect (60–79%), and severe defect (<60%). Patients with severe spirometric impairment showed significantly higher fibrosis, cavitation, TMS, and TLS scores.

Table 5: Comparison of CT Morphological Scores According to FEV1 Severity

CT Finding	Normal (>80%)	Mild–Moderate (60–79%)	Severe (<60%)
Fibrosis Score	3	4	7
Cavitation Score	0	2	2
Bronchiectasis Score	0	3	1
Nodule Score	0	0	0
Aspergilloma Score	0	0	0
TMS (Total Morphology Score)	3.5	11	13
TLS (Total Lung Score)	3.5	9	11



DISCUSSION

The present cross-sectional observational study evaluated the correlation between HRCT thorax findings, dyspnea, and spirometric abnormalities in patients with post-tubercular lung sequelae. A total of 85 patients were included in the study, among whom males constituted the majority of the study population. Similar male predominance has been reported in previous studies, possibly due to higher exposure to smoking, occupational hazards, and increased prevalence of pulmonary tuberculosis among males.[5,9]

In the present study, fibrosis was the most common HRCT abnormality observed among post-TB patients. Fibrotic changes were more frequently observed in older patients and were associated with greater functional impairment. Similar findings were reported by Panda et al., who demonstrated fibrosis as the predominant radiological abnormality in post-tubercular sequelae.[9] Fibrosis results from fibro-cicatricial healing following pulmonary tuberculosis and contributes to distortion of lung architecture, reduced lung compliance, and impaired gas exchange.[7]

Cavitary lesions were more common among male patients and were significantly associated with dyspnea and severe spirometric impairment. Cavities can lead to regional ventilation-perfusion mismatch and increased dead space ventilation, thereby contributing to chronic respiratory symptoms.[11] Bronchiectasis was also commonly observed and was associated with obstructive airway changes. Chronic airway inflammation and destruction following tuberculosis predispose patients to bronchial dilatation and airflow limitation.[6]

The present study demonstrated that patients with dyspnea had significantly higher Total Morphological Score (TMS) and Total Lung Score (TLS) compared to non-dyspneic patients. Median fibrosis, cavitation, and bronchiectasis scores were also higher among dyspneic individuals. These findings suggest a strong radio-clinical correlation between structural lung damage and symptom severity. Similar observations were made by Panda et al., who reported a significant association between HRCT severity and dyspnea in post-tubercular lung disease.[9]

Spirometric abnormalities were observed in the majority of patients in the present study. Restrictive ventilatory defect was the predominant spirometric pattern followed by mixed ventilatory defect. These findings are consistent with studies conducted by Sailaja and Rao[5] and Santra et al.[7], who also observed restrictive impairment as a common abnormality in post-TB patients. Extensive fibrosis, pleural thickening, and lung volume loss are likely responsible for the restrictive pattern observed in these patients.

Patients with severe spirometric impairment (FEV1 <60%) showed significantly higher fibrosis scores, cavitation scores, TMS, and TLS compared to patients with normal spirometry. This indicates that increasing structural damage on HRCT correlates with worsening pulmonary function. Similar findings have been documented in earlier studies evaluating post-tubercular lung disease.[8,9]

The present study highlights the importance of HRCT thorax and spirometry in the assessment of post-tubercular lung sequelae. Early identification of structural and functional impairment may help in the timely initiation of pulmonary rehabilitation, respiratory physiotherapy, smoking cessation counselling, and long-term follow-up care. Integration of post-TB care into national tuberculosis control programmes may help reduce chronic respiratory morbidity and improve quality of life in these patients.

CONCLUSION

Post-tubercular lung sequelae remain an important cause of chronic respiratory morbidity even after microbiological cure of tuberculosis. Fibrosis was the most common HRCT abnormality observed in the present study, with a restrictive ventilatory defect being the predominant spirometric pattern. Higher HRCT severity scores, including Total Morphological Score (TMS) and Total Lung Score (TLS), showed significant correlation with dyspnea severity and spirometric impairment. These findings suggest that HRCT thorax and pulmonary function tests are valuable tools for assessing the extent of structural and functional lung damage in post-tubercular patients. Early identification and regular follow-up of such patients may help in timely intervention and improved long-term respiratory outcomes.

REFERENCES

1. World Health Organization. Global Tuberculosis Report 2024. Geneva: World Health Organization; 2024.
2. Allwood BW, van der Zalm MM, Amaral AFS, et al. Post-tuberculosis lung health: perspectives from the First International Symposium. Int J Tuberc Lung Dis. 2020;24(8):820-828.
3. Meghji J, Simpson H, Squire SB, Mortimer K. A systematic review of the prevalence and pattern of imaging defined post-TB lung disease. PLoS One. 2016;11(8):e0161176.
4. Byrne AL, Marais BJ, Mitnick CD, et al. Tuberculosis and chronic respiratory disease: a systematic review. Int J Infect Dis. 2015;32:138-146.
5. Sailaja K, Rao HN. Study of pulmonary function impairment by spirometry in post pulmonary tuberculosis. J Evol Med Dent Sci. 2015;4(42):7365-7371.
6. Patil S, Patil R, Jadhav A. Pulmonary function assessment in post-tuberculosis cases by spirometry: obstructive pattern is predominant and needs cautious evaluation in all treated cases irrespective of symptoms. Int J Mycobacteriol. 2018;7(2):128-132.
7. Santra A, Dutta P, Manjhi R, Pothal S. Clinico-radiologic and spirometric profile of an Indian population with post-tuberculous obstructive airway disease. J Clin Diagn Res. 2017;11(3):OC35-OC38.
8. Hnizdo E, Singh T, Churchyard G. Chronic pulmonary function impairment caused by initial and recurrent pulmonary tuberculosis following treatment. Thorax. 2000;55(1):32-38.
9. Panda A, Bhalla AS, Sharma R, et al. Correlation of chest computed tomography findings with dyspnea and lung functions in post tubercular sequelae. Lung India. 2016;33(6):592-599.
10. Amaral AFS, Coton S, Kato B, et al. Tuberculosis associates with both airflow obstruction and low lung function: BOLD results. Eur Respir J. 2015;46(4):1104-1112.
11. Pasipanodya JG, Miller TL, Vecino M, et al. Pulmonary impairment after tuberculosis and its contribution to TB burden. BMC Public Health. 2010;10:259.
12. Chakaya J, Kirenga B, Getahun H. Long term complications after completion of pulmonary tuberculosis treatment: a quest for a public health approach. J Clin Tuberc Other Mycobact Dis. 2016;3:10-12.