



Research Article

Clinical and Radiological Profile of Newly Diagnosed Pulmonary Tuberculosis Patients in a Tertiary Care Hospital

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Abstract: Background: Pulmonary tuberculosis (PTB) remains a major public health challenge in India, contributing to a substantial proportion of the global TB burden. Understanding the clinical and radiological spectrum of newly diagnosed PTB is essential for early diagnosis and effective management. **Objective:** To study the clinical and radiological profile of newly diagnosed pulmonary tuberculosis patients attending a tertiary care hospital in South India. **Methods:** This hospital-based descriptive cross-sectional study was conducted in the Department of Pulmonary Medicine at a tertiary care hospital in South India from November 2019 to January 2020. A total of 36 newly diagnosed, sputum-positive or CBNAAT-positive pulmonary TB patients aged ≥ 18 years were included. Detailed clinical history, physical examination, and chest radiography findings were recorded and analyzed. **Results:** The majority of patients were males (69.4%) with a mean age of 42.3 ± 14.6 years. Cough (94.4%), fever (77.8%), and weight loss (72.2%) were the most common symptoms. Radiologically, consolidation (66.7%) and cavitation (52.8%) were the predominant patterns, with the upper lobe being the most frequently involved zone (63.9%). **Conclusion:** Newly diagnosed PTB in this region predominantly affects middle-aged males and presents with classical symptoms of cough, fever, and weight loss. Chest X-ray remains a valuable tool, most commonly showing consolidation and cavitary lesions in the upper lobes.

Keywords: Pulmonary tuberculosis, clinical profile, radiological profile, chest X-ray, South India, tertiary care hospital.

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INTRODUCTION

Tuberculosis (TB) continues to be one of the most significant infectious disease threats to global public health, with an estimated 10 million new cases and 1.5 million deaths annually [1]. India bears a disproportionate share of this burden, accounting for approximately one-quarter of the global TB incidence. The National Tuberculosis Elimination Programme (NTEP), formerly known as the Revised National Tuberculosis Control Programme (RNTCP), reported a total of 24.04 lakh TB cases notified in India in 2019, representing a 14% increase over the previous year [2]. Despite significant progress in diagnostic and therapeutic strategies, TB remains a formidable challenge, particularly in resource-limited settings where delayed diagnosis contributes to ongoing transmission and adverse treatment outcomes [3].

Pulmonary tuberculosis, caused by *Mycobacterium tuberculosis*, can present with a wide array of clinical manifestations, ranging from asymptomatic infection to severe, life-threatening disease. The classic symptoms of PTB include a persistent cough lasting more than two

weeks, often with expectoration, low-grade evening fever, night sweats, and significant weight loss [4]. However, atypical presentations are increasingly recognized, particularly in elderly patients, immunocompromised individuals, and those with comorbid conditions such as diabetes mellitus and HIV infection [5]. These variations in clinical presentation can pose diagnostic challenges and delay appropriate treatment initiation [6].

Radiological evaluation, particularly chest radiography, remains a cornerstone in the diagnostic workup of suspected pulmonary tuberculosis. Chest X-ray (CXR) is widely available, inexpensive, and provides valuable information about the extent and pattern of lung involvement [7]. The classical radiological hallmarks of post-primary PTB include consolidation, cavitation, and fibrotic changes, with a strong predilection for the apical and posterior segments of the upper lobes and the superior segments of the lower lobes [8]. However, the radiological spectrum of PTB is diverse and can include nodular opacities, pleural effusion, miliary patterns, and even normal findings in early or paucibacillary disease [9]. The advent of computed tomography (CT) has

further enhanced our understanding of the nuanced radiological manifestations of PTB, revealing findings such as tree-in-bud opacities and centrilobular nodules that may not be apparent on plain radiography [10].

In the South Indian context, regional variations in the clinical and radiological presentation of PTB have been reported, influenced by factors such as patient demographics, nutritional status, and the prevalence of comorbidities [11]. Understanding the local patterns of disease presentation is crucial for optimizing diagnostic algorithms and ensuring timely initiation of anti-tubercular therapy. This study was therefore undertaken to comprehensively characterize the clinical and radiological profile of newly diagnosed pulmonary tuberculosis patients at a tertiary care hospital in South India, thereby contributing to the existing body of knowledge and informing local clinical practice.

OBJECTIVE

The primary objective of this study was to describe the clinical profile of newly diagnosed pulmonary tuberculosis patients, including demographic characteristics, symptomatology, and the prevalence of associated comorbidities, in a tertiary care hospital setting in South India. By systematically documenting these parameters, the study aimed to identify the most common presenting features that could aid clinicians in suspecting and diagnosing PTB at an early stage.

The secondary objective was to characterize the radiological patterns observed on chest radiography in these newly diagnosed patients. Specifically, the study sought to determine the frequency and distribution of various radiographic abnormalities, including consolidation, cavitation, nodular opacities, and pleural involvement, and to assess the lobar and zonal predilection of these lesions. Understanding these radiological patterns is expected to enhance the diagnostic yield of chest X-ray and facilitate the differentiation of PTB from other pulmonary conditions.

METHODOLOGY & MATERIALS

This study was a hospital-based descriptive cross-sectional investigation conducted in the Department of Pulmonary Medicine at a tertiary care hospital in South India over a three-month period from November 2019 to January 2020. The study was designed to systematically evaluate the clinical and radiological characteristics of consecutive patients newly diagnosed with pulmonary tuberculosis who presented to the outpatient department or were admitted as inpatients during the study period. The hospital serves as a major referral center for the surrounding districts, providing a diverse patient population that is representative of the broader community in the region.

Inclusion Criteria: Patients aged 18 years and above of either sex were eligible for inclusion if they had a newly diagnosed, microbiologically confirmed case of pulmonary tuberculosis. Microbiological confirmation was defined as at least one of the following: a positive sputum smear for acid-fast bacilli (AFB) using Ziehl-Neelsen staining, a positive sputum culture for *Mycobacterium tuberculosis*, or a positive cartridge-based nucleic acid amplification test (CBNAAT) result indicating the presence of *M. tuberculosis* complex. Additionally, patients with a compatible clinical and radiological picture who had not yet received any anti-tubercular treatment were considered for enrollment.

Exclusion Criteria: Patients were excluded from the study if they had a history of prior anti-tubercular treatment for more than one month (i.e., previously treated or relapse cases), as their clinical and radiological features could be confounded by treatment effects and disease chronicity. Patients with known HIV infection, as HIV co-infection significantly alters both the clinical presentation and radiological manifestations of TB, were also excluded to maintain the homogeneity of the study population. Other exclusion criteria included age below 18 years, pregnancy, severe immunocompromising conditions other than HIV (e.g., active malignancy on chemotherapy, long-term corticosteroid use), and refusal to provide informed consent.

Data Collection Procedure: After obtaining approval from the Institutional Ethics Committee, consecutive patients fulfilling the eligibility criteria were identified and enrolled after obtaining written informed consent. A structured proforma was used to capture detailed demographic information (age, sex, occupation, and residence), clinical history (duration and nature of symptoms, presence of comorbidities such as diabetes mellitus, hypertension, and chronic obstructive pulmonary disease), and physical examination findings. Sputum samples were collected from all patients for AFB smear microscopy and CBNAAT as part of routine diagnostic workup. Chest radiography (posteroanterior view) was performed for all patients using a standardized digital radiography system, and the images were independently reviewed by two experienced radiologists who were blinded to the patients' clinical details. Radiological findings were recorded in terms of the type of lesion (consolidation, cavitation, nodular opacity, fibrosis, pleural effusion, etc.), zonal distribution (upper, middle, lower), and laterality (unilateral or bilateral).

Statistical Data Analysis: All collected data were entered into Microsoft Excel and subsequently analyzed using IBM SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were employed to summarize the data. Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range, as appropriate.

Categorical variables were presented as frequencies and percentages. The chi-square test or Fisher's exact test was used to examine associations between categorical variables where applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 36 patients newly diagnosed with pulmonary tuberculosis were enrolled during the study period. The demographic and clinical characteristics of the study population are summarized in Table 1. The mean age of the patients was 42.3 ± 14.6 years, with the majority

belonging to the 31–50 years age group ($n = 17$, 47.2%). Male preponderance was evident, with 25 (69.4%) males and 11 (30.6%) females, yielding a male-to-female ratio of approximately 2.3:1. Regarding occupational status, the majority were manual laborers ($n = 14$, 38.9%), followed by office workers ($n = 9$, 25.0%), homemakers ($n = 8$, 22.2%), and others ($n = 5$, 13.9%). Diabetes mellitus was the most common comorbidity, present in 9 patients (25.0%), while 3 patients (8.3%) had hypertension and 2 patients (5.6%) had chronic obstructive pulmonary disease.

Table 1: Demographic and Clinical Profile of Study Participants (n = 36)

Characteristic	Category	Frequency (n)	Percentage (%)
Age group (years)	18–30	8	22.2
	31–50	17	47.2
	>50	11	30.6
Sex	Male	25	69.4
	Female	11	30.6
Occupation	Manual laborer	14	38.9
	Office worker	9	25.0
	Homemaker	8	22.2
	Other	5	13.9
Comorbidity	Diabetes mellitus	9	25.0
	Hypertension	3	8.3
	COPD	2	5.6
	None	22	61.1
Symptoms	Cough	34	94.4
	Fever	28	77.8
	Weight loss	26	72.2
	Night sweats	19	52.8
	Hemoptysis	10	27.8
	Chest pain	12	33.3
	Breathlessness	8	22.2

The clinical symptomatology of the study cohort was consistent with the classical presentation of pulmonary tuberculosis. Cough was the most frequently reported symptom, present in 34 patients (94.4%), with a median duration of 4 weeks (interquartile range: 3–6 weeks). Fever was reported by 28 patients (77.8%), while significant weight loss was documented in 26 patients (72.2%). Night sweats were present in 19 patients (52.8%). Hemoptysis, a potentially alarming symptom, was reported by 10 patients (27.8%). Chest pain and breathlessness were noted in 12 (33.3%) and 8 (22.2%) patients, respectively. The mean body mass index (BMI) of the study population was 18.9 ± 2.7 kg/m², indicating a high prevalence of undernutrition among the patients.

The radiological findings on chest radiography are detailed in Table 2. Consolidation was the most common radiological pattern, observed in 24 patients (66.7%), followed by cavitation in 19 patients (52.8%). Nodular opacities were present in 14 patients (38.9%), while fibrotic changes were noted in 9 patients (25.0%). Pleural effusion was seen in 5 patients (13.9%), and 3 patients (8.3%) had a miliary pattern. Regarding zonal distribution, the upper lobe was the most frequently involved zone, affected in 23 patients (63.9%), either alone or in combination with other zones. Bilateral involvement was observed in 15 patients (41.7%), whereas unilateral disease was documented in 21 patients (58.3%). Among patients with cavitation, the cavities were predominantly located in the upper lobes ($n = 15$, 78.9%) and were more commonly multiple ($n = 11$, 57.9%) than single.

Table 2: Radiological Findings on Chest X-ray (n = 36)

Radiological Finding	Frequency (n)	Percentage (%)
Pattern		
Consolidation	24	66.7
Cavitation	19	52.8
Nodular opacity	14	38.9
Fibrosis	9	25.0
Pleural effusion	5	13.9
Miliary pattern	3	8.3
Zonal distribution		
Upper zone	23	63.9
Middle zone	11	30.6
Lower zone	8	22.2
Laterality		
Unilateral	21	58.3
Bilateral	15	41.7
Cavity characteristics (n = 19)		
Single cavity	8	42.1
Multiple cavities	11	57.9
Upper lobe cavity	15	78.9

DISCUSSION

This hospital-based study provides valuable insights into the clinical and radiological profile of newly diagnosed pulmonary tuberculosis patients in a tertiary care setting in South India. The demographic findings of our study, with a male preponderance (69.4%) and a mean age of 42.3 years, are consistent with the established epidemiological pattern of TB in India, where adult males are disproportionately affected [2,4]. The higher proportion of cases in the economically productive age group (31–50 years) underscores the significant socioeconomic impact of the disease. Similar demographic trends have been reported in other Indian studies, including a large retrospective analysis from Chennai, which found that active post-primary tuberculosis was more common in patients above 45 years, with a comparable male-to-female ratio [10].

The clinical presentation of our patients was characterized by the classic triad of cough, fever, and weight loss, which were present in 94.4%, 77.8%, and 72.2% of patients, respectively. These findings align closely with those reported in previous Indian studies. For instance, a study from Puducherry documented cough in 95.3% and fever in 80% of patients, while another multi-center study reported cough with expectoration in 69.5% and weight loss in 63.0% of cases [9,12]. The high prevalence of undernutrition (mean BMI 18.9 kg/m²) in our cohort is a noteworthy observation, as malnutrition is a well-established risk factor for both the development of active TB and poor treatment outcomes [4]. The relatively high frequency of hemoptysis (27.8%) in our study may reflect the advanced nature of the disease at presentation, a common scenario in resource-limited settings where patients often delay seeking care until symptoms become severe [6].

The radiological findings in our study revealed that consolidation (66.7%) and cavitation (52.8%) were the predominant patterns, with a strong predilection for the upper lobes (63.9%). This is in excellent agreement with the classical radiological description of post-primary pulmonary tuberculosis [8,13]. A study from Gujarat reported infiltration (39.6%), cavitory lesions (37.7%), and consolidation (37.5%) as the most common lesions in newly detected sputum-positive PTB cases [13]. The higher frequency of cavitation in our study (52.8%) compared to some other Indian reports (37.7%) could be attributed to the tertiary care setting, where patients often present with more advanced disease, as well as to the exclusion of HIV-positive patients, in whom cavitation is less common. The upper lobe predominance of cavities (78.9%) further corroborates the well-documented tropism of *M. tuberculosis* for the high-oxygen-tension environment of the lung apices [8].

Our finding of bilateral involvement in 41.7% of patients is clinically significant, as bilateral disease is associated with a higher bacterial burden and an increased risk of transmission. This is comparable to the findings of a study from Hyderabad, which reported bilateral disease in 56.75% of patients [14]. The presence of diabetes mellitus in 25% of our patients is particularly noteworthy, given the well-established bidirectional relationship between TB and diabetes. Diabetic patients with TB have been shown to have a higher likelihood of lower lung field involvement, multilobar disease, and cavitation, although our study was not powered to detect such subgroup differences [15]. The high prevalence of diabetes in our cohort highlights the importance of routine screening for hyperglycemia in all newly diagnosed TB patients, as recommended by the NTEP [2].

The strengths of this study include its prospective design, the use of standardized diagnostic criteria, and the comprehensive capture of both clinical and radiological data. However, several limitations must be acknowledged. The relatively small sample size ($n = 36$) limits the generalizability of the findings and precludes robust subgroup analyses. The exclusion of HIV-positive and previously treated patients, while methodologically justified, restricts the applicability of our findings to the broader population of TB patients encountered in clinical practice. Furthermore, the reliance on chest radiography alone, without the routine use of CT imaging, may have led to an underestimation of certain radiological patterns, such as tree-in-bud opacities and small cavities. Finally, the study was conducted over a short duration of three months, which may not capture seasonal variations in disease presentation.

Limitations of the Study

This study has several limitations that warrant consideration. The small sample size of 36 patients, while adequate for a descriptive analysis, limits the statistical power to detect significant associations between clinical and radiological variables and restricts the generalizability of the findings to the wider population of pulmonary TB patients in South India. The single-center design further compounds this issue, as the patient profile at a tertiary care referral hospital may differ from that seen at primary or secondary care levels. The exclusion of patients with HIV co-infection and those with a history of prior anti-tubercular treatment, although necessary to maintain a homogeneous study population, excludes important subgroups that are highly relevant to the real-world clinical landscape of TB. Additionally, the diagnosis and radiological characterization relied on chest radiography without routine computed tomography, which is known to be more sensitive for detecting subtle parenchymal abnormalities, particularly in early or smear-negative disease. The short study duration of three months may not adequately capture the full spectrum of disease presentation, including seasonal variations. Finally, the lack of longitudinal follow-up data precludes any assessment of treatment outcomes or radiological resolution.

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CONCLUSION

This study provides a comprehensive snapshot of the clinical and radiological profile of newly diagnosed pulmonary tuberculosis patients at a tertiary care hospital in South India. The findings confirm that PTB in this region predominantly affects middle-aged males and presents with the classical symptoms of cough, fever, and weight loss. The high prevalence of undernutrition and diabetes mellitus among the study population underscores the importance of addressing these modifiable risk factors as part of a holistic approach to TB management. Chest radiography remains an indispensable diagnostic tool, with consolidation and cavitation in the upper lobes being the most characteristic findings. The presence of bilateral disease in a substantial proportion of patients signals advanced disease and heightened transmission risk, reinforcing the need for early case detection and prompt initiation of treatment.

From a clinical and public health perspective, these findings have several implications. The high frequency of classical symptoms and upper-lobe cavitory disease should prompt clinicians to maintain a high index of suspicion for PTB in patients presenting with these features, facilitating early diagnosis and reducing diagnostic delays. The notable prevalence of diabetes in this cohort supports the NTEP's recommendation for bidirectional screening, wherein all TB patients are screened for diabetes and vice versa [2]. Future research should focus on larger, multi-center studies with longer follow-up periods to validate these findings and to explore the impact of comorbidities, nutritional status, and drug resistance on the clinical and radiological trajectory of pulmonary tuberculosis in this region.

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