RESEARCH ARTICLE: CHEST RADIOGRAPHIC FINDINGS AND CLINICAL CORRELATES IN NEWLY DIAGNOSED PULMONARY TUBERCULOSIS PATIENTS AT PHAM NGOC THACH HOSPITAL

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ABSTRACT

Background: Pulmonary tuberculosis (PTB) remains a leading cause of morbidity and mortality globally, particularly in low and middle income countries. Despite the widespread use of chest X-ray (CXR), comprehensive data on clinical and radiographic features in newly diagnosed PTB patients remain limited. **Objective:** To describe the clinical profile, comorbidities, bacteriological status and radiographic features in newly diagnosed microbiologically confirmed PTB patients at Pham Ngoc Thach Hospital. **Subjects and Methods:** This retrospective study was conducted from January to December 2024 including 152 patients aged ≥18 years with newly diagnosed PTB confirmed by sputum smear, GeneXpert or culture. Clinical characteristics, comorbidities, nutritional status and CXR findings were collected and analyzed. Associations between CXR features and metabolic or nutritional status were assessed using the Chi-square test. **Results:** The study population was predominantly male (75%), with most patients aged between 45–65 years (70.4%) and 40.1% classified as underweight. Comorbidities were common, particularly hypertension (34.9%) and diabetes mellitus (DM), which was present in 33.6% of cases. Fever (65.8%) and dry cough (48.7%) were the most frequent symptoms. Radiographic findings included consolidation (73%), fibrosis (65.6%) and cavitary lesions (32.2%). DM was significantly associated with consolidation, cavitation, fibrosis, and pneumothorax ($p < 0.05$), while BMI classification showed no significant correlation with most CXR abnormalities, except for nodular calcification ($p = 0.01$).

Keywords: *Pulmonary tuberculosis; Chest radiograph; Diabetes mellitus; Body mass index*

I. INTRODUCTION

Tuberculosis (TB) remains a significant public health concern worldwide, particularly in low and middle income countries such as Vietnam. According to the World Health Organization (WHO), TB is among the top 10 causes of death globally, with pulmonary tuberculosis (PTB) being the most common and transmissible form [1].

Chest radiography plays a supportive role in the diagnosis of PTB. Its primary value lies in initial evaluation, treatment monitoring, and public health management of tuberculosis. Chest X-ray (CXR) findings in PTB such as consolidation, cavitation, and bilateral lesions are widely used to support clinical diagnosis, particularly in settings with limited access to bacteriological confirmation [2].

However, radiographic features of PTB are known to vary considerably based on host factors such as immune status, age, and comorbid conditions like diabetes mellitus (DM) or malnutrition [3]. In undernourished

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individuals with low body mass index (BMI), atypical or subtle radiographic changes may occur and the likelihood of cavitary lesions may be reduced due to impaired immune responses [4]. Conversely, patients with DM may present with more extensive or multilobar involvement on imaging [5]. These variations highlight the importance of understanding the interplay between clinical and radiological features in the diagnostic workup of PTB.

TB continues to be a public health priority, with a significant number of cases diagnosed annually. Pham Ngoc Thach Hospital in Ho Chi Minh City serves as a central referral center for TB diagnosis and treatment in southern Vietnam. While chest radiography is routinely performed for all suspected TB cases, comprehensive data on radiographic patterns and their clinical correlations especially in relation to comorbidities such as malnutrition and DM remain limited. Therefore, this study aimed to characterize the chest radiographic features in newly diagnosed PTB patients at Pham Ngoc Thach Hospital and to evaluate their associations with key clinical and comorbid conditions, particularly malnutrition and DM.

II. MATERIAL AND METHODS

2.1 Study design

This was a retrospective study involving adult patients newly diagnosed with PTB who were admitted to the A5 Department of Pham Ngoc Thach Hospital, Ho Chi Minh City. Medical records were reviewed for patients diagnosed from January 2024 to December 2024. A total of 152 patients were selected based on predefined inclusion and exclusion criteria.

Inclusion criteria

-Age ≥ 18 years;

-Diagnosis of PTB with microbiological confirmation, based on the national TB diagnostic algorithm issued by the Vietnamese Ministry of Health (including at least one positive result from sputum smear microscopy, GeneXpert MTB/RIF, or mycobacterial culture).

Exclusion criteria

-Pregnant women;

-Patients with poor-quality CXR images that were not interpretable

2.2 Data collection:

Data were collected using a standardized form from medical records and standard CXR. The variables included demographic data, clinical symptoms, medical history (e.g., DM, HIV infection), bacteriological findings.

2.3 Radiographic Evaluation

CXR radiographs were reviewed independently by two experienced radiologists blinded to clinical and laboratory data. Lesion patterns on posteroanterior chest radiographs were described according to the recommendations of the Fleischner Society [6] and the classification proposed by Rolando Reyna [7].

2.4 Data analysis

Data were analyzed using SPSS version 20.0. Descriptive statistics were used to summarize clinical, radiographic, and comorbidity-related features. Categorical variables were presented as frequencies and percentages, while continuous variables were reported as means ± standard deviations or medians with interquartile ranges. Associations between chest radiographic findings and nutritional status (based on BMI classification) as well as the presence of DM were assessed using the Chi-square test or

Fisher's exact test, as appropriate. A p-value < 0.05 was considered statistically significant.

2.5 Ethical considerations

This study was approved by the Institutional Review Boards of Tan Tao University and Pham Ngoc Thach Hospital. All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Patient confidentiality was strictly maintained throughout the study and all personal information was anonymized to ensure privacy and data protection.

III. RESULTS

1. Characteristic of the study population

Table 1: ***Baseline demographic, clinical profile of the study population (n = 152)***

Characteristic		Frequency (%)
Gender	Male	114 (75)
	Female	38 (25)
Age	18 - 45	19 (12.5)
	45 – 55	50 (32.9)
	55 – 65	57 (37.5)
	> 65	26 (17.1)
BMI	Underweight	61 (40.1)
	Normal	66 (43.4)
	Overweight	14 (9.2)
	Obesity	11 (7.3)
Comorbidites	Hypertension	53 (34.9)
	Diabetes mellitus	51 (33.60
	COPD	12 (7.9)
	Immunosupression	11 (7.2)
	Chronic kidney disease	9 (5.9)
	HIV/AIDs	6 (3.9)
	Cirrhosis	6 (3.9)
Clinical symptoms	Fever	100 (658)
	Dry cough	74 (48.7)
	Dyspnea	68 (44.7)
	Productive cough	59 (38.8)
	Chest pain	36 (23.7)
	Weight loss	29 (19.1)
	Hemoptysis	16 (10.5)
Sputum AFB smear grade	Negative	56 (36.8)
	Scanty	11 (7.2)
	AFB +	51 (33.6)
	AFB 2+	21 (13.8)
	AFB 3+	13 (8.6)

Comments:

Among the 152 patients included in the study, the majority were male (75%) with the predominant age groups being 55–65 years (37.5%) and 45–55 years (32.9%). Regarding nutritional status, 43.4% of participants had a normal BMI, while 40.1% were underweight. Hypertension and DM were the most common comorbidities, affecting 34.9% and 33.6% of

patients, respectively. The most frequently reported clinical symptoms were fever (65.8%) and dry cough (48.7%). In terms of sputum AFB smear results, negative smears were observed in 36.8% of patients, followed by AFB 1+ in 33.6%.

2. Distribution of chest radiograph findinds of the study of population

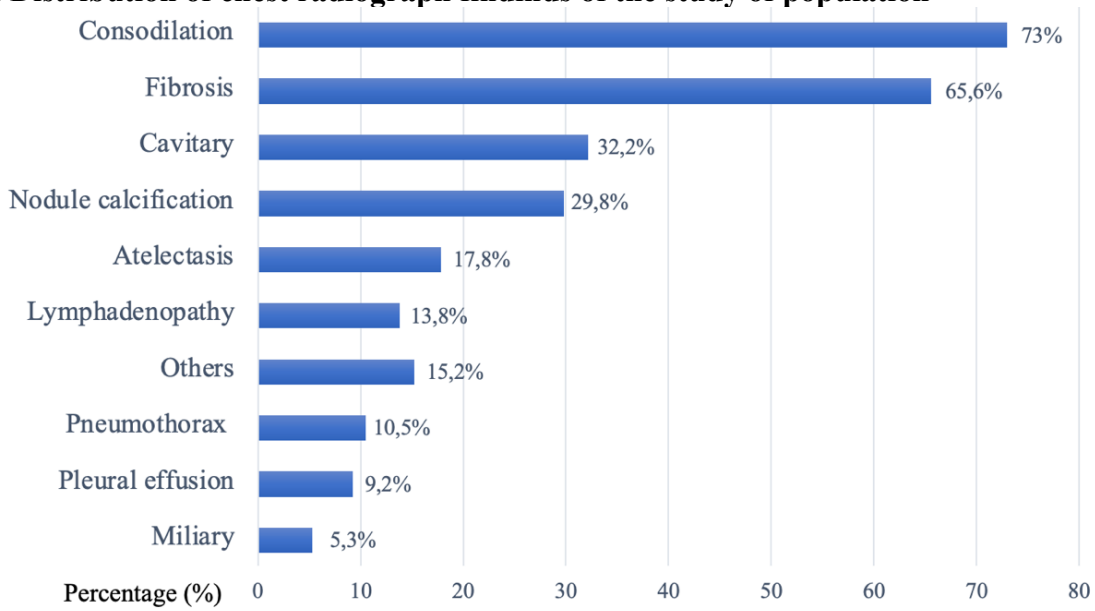

Figure 1: ***Distribution of chest radiograph findinds of the study of population***

Comments:

Among the 152 patients in the study, consolidation was the most frequently observed radiographic finding, present in 73% of cases. This was followed by fibrosis in 65.6%, and cavitary lesions in 32.2%. Miliary pattern was the least common, detected in only 5.3% of patients.

3. Association between chest radiographic features and clinical factors

Table 2: ***Association between chest radiographic findings and diabetic status (n = 152)***

Findings on chest radiograph	TB – DM	Non TB – DM	P value
Consolidation, n (%)	68 (61,3)	43 (38,7)	0,033 *
Cavitary, n (%)	32 (65,3)	17 (34,7)	0,001 *
Lymphadenopathy, n (%)	5 (23,8)	16 (76,2)	0,456
Miliary, n (%)	3 (37,5)	5 (62,5)	0,9
Nodule calcification, n (%)	18 (40)	27 (60)	0,347
Fibrosis, n (%)	39 (39,4)	60 (60,6)	0,047*
Atelectasis, n (%)	5 (18,5)	22 (81,5)	0,076
Pleural effusion, n (%)	2 (14,3)	12 (85,7)	0,142
Pneumothorax, n (%)	1 (6,3)	15 (93,8)	0,012 *

*: statistically significant

Comments:

Among patients with DM, consolidation (61.3%) and cavitary lesions (65.3%) were the most common chest radiographic findings, both showing statistically significant associations ($p = 0.033$ and $p = 0.001$, respectively). Other findings such as fibrosis ($p = 0.047$) and pneumothorax ($p = 0.012$) also demonstrated statistically significant differences between the

two groups. In contrast, no significant association was found between DM and other radiographic findings including lymphadenopathy, miliary pattern, calcification, atelectasis, or pleural effusion.

Table 3: ***Association between chest radiographic findings and BMI classificcation (n = 152)***

Findings on chest radiograph	Classification of BMI				P value
	Underweight	Normal	Overweight	Obesity	
Consolidation, n (%)	46 (41,4)	48 (43,2)	11 (9,9)	6 (5,4)	0,512
Cavitary, n (%)	22 (44,9)	21 (42,9)	4 (8,2)	2 (4,1)	0,683
Lymphadenopathy, n (%)	8 (38,1)	10 (47,6)	2 (9,5)	1 (4,8)	0,954
Miliary, n (%)	5 (62,5)	3 (37,5)	0 (0)	0 (0)	0,474
Nodule calcification, n (%)	11 (24,4)	21 (46,7)	6 (13,3)	7 (15,6)	0,01*
Fibrosis, n (%)	38 (38,4)	42 (42,4)	10 (10,1)	9 (9,1)	0,599
Atelectasis, n (%)	11 (40,7)	13 (48,1)	1 (3,7)	2 (7,4)	0,74
Pleural effusion, n (%)	5 (35,7)	7 (50)	1 (7,1)	1 (7,1)	0,96
Pneumothorax, n (%)	8 (50)	7 (43,8)	0 (0)	1 (6,3)	0,551

*: statistically significant

Comments:

There was no significant association between most chest radiographic findings and BMI classification. However, nodule calcification was significantly more frequent in patients with normal BMI (46.7%) compared to other BMI categories (p = 0.01). Other findings such as consolidation, cavitary lesions, fibrosis, and pleural abnormalities showed no statistically significant differences among BMI groups.

IV. DICUSSION

1. Characteristic of the study population

In our study, the majority of newly diagnosed PTB patients with bacteriological confirmation were in the age groups of 45–55 and 55–65 years, accounting for 32.9% and 37.5% respectively. This finding is consistent with the study by Kumbar et al.conducted in India in 2021, in which 54.9% of PTB patients were over 50 years old [8]. Males accounted for 75% of the participants, which is consistent with the findings reported by Murthy et al., where the proportion of male patients was 72.5%. 40.1% of patients with PTB were underweight (BMI < 18.5 kg/m²), indicating a high prevalence of poor nutritional status. This proportion is slightly lower but comparable to the findings reported by Murthy et al., who observed 58.2% of underweight patients [9]. These findings highlight the predominance of middle-aged and undernourished male patients among newly diagnosed bacteriologically confirmed pulmonary tuberculosis cases.

Hypertension and DM were the most common comorbidities, accounting for 34.9% and 33.6%, respectively. The prevalence of DM in our study was higher compared to the findings of Soedarsono et al. (2023) in Indonesia, where the prevalence of DM among drug-resistant and drug-sensitive TB patients was 21.9% and 23.4%, respectively [10]. These results highlight the substantial burden of DM among patients with PTB and underscore the necessity of incorporating routine screening and

comprehensive management of DM into TB control programs.

Fever was the most common constitutional symptom in our study, observed in 65.8% of patients. In addition, respiratory symptoms such as dry cough (48.7%), dyspnea (44.7%), and productive cough (38.8%) were also frequently reported. Compared to the study by Kumbar et al., the prevalence of cough and sputum production in our study was noticeably lower (94.1% and 83.8%, respectively), and fever was also less common than the 78.9% reported in their study. This difference may be due to our inclusion of Xpert-positive but AFB-negative patients, whereas Kumbar's study only included AFB-positive cases, who typically present with more prominent symptoms [8].

Among the studied population, 36.8% of patients had negative sputum AFB smear results, while 63.2% were smear-positive. These findings are comparable to those reported by Bhargava et al., with 34% smear-negative and 66% smear-positive cases [11]. This emphasizes the critical need for utilizing both smear microscopy and molecular diagnostic tools to ensure accurate detection of bacteriologically confirmed tuberculosis cases.

2. Distribution of chest radiograph findinds of the study of population

Our study showed that the most frequently observed radiographic abnormalities on CXR were consolidation (73%), fibrosis (65.6%), and cavitary lesions (32.2%). In comparison, Oriekot et al. reported a consolidation rate of 77% and a cavitary lesion rate of 39.4% in their study conducted in Uganda [12]. Similarly, Kumbar et al. in India also found that consolidation, fibrosis, and nodular lesions were predominant, particularly in patients with comorbidities such as DM or HIV infection [8].

The high prevalence of consolidation, fibrosis, and cavitary lesions in our study can be explained by a combination of pathophysiological mechanisms and epidemiological characteristics of the study population. All included patients were newly diagnosed PTB cases with microbiological confirmation, indicating active disease with a high bacillary burden. Consolidation represents acute inflammation and alveolar filling due to ongoing infection, while cavitary lesions result from caseating necrosis and tissue destruction in the context of a strong immune response. Fibrosis may reflect early healing or residual changes from subclinical lesions preceding diagnosis [13] [14].

3. Association between chest radiographic features and clinical factors

3.1 Association between chest radiographic findings and DM

Our findings support growing evidence that DM influences the radiographic presentation of PTB patients. In our study, consolidation and cavitary lesions were significantly more common in PTB patients with DM.

These results are consistent with previous studies. Patel et al. reported that 80% of consolidation and cavitary lesions occurred in TB patients with DM, compared to only 59% in those without DM with more frequent involvement of the lower lobes and diffuse patterns [15]. Similarly, Huang et al. noted that poor glycemic control (HbA1c $\geq$ 8%) was associated with more severe radiographic findings, including cavitary and atypical lesions [5]. Our findings emphasize the importance of recognizing DM as a factor influencing TB radiological presentation. Radiographic patterns such as consolidation and cavitation, especially when extensive or

atypical, should raise suspicion for underlying metabolic comorbidities like DM.

3.2 Association between chest radiographic findings and Body mass index BMI classificcation

In our study, we found no significant association between most chest radiographic abnormalities including consolidation, cavitation, fibrosis, and pleural effusion and BMI classification. Previous studies have demonstrated that nutritional status is associated with the extent and severity of pulmonary lesions in tuberculosis patients. A study by Hoyt et al. (2019) in India found that patients with severe malnutrition (BMI <16 kg/m²) had significantly more extensive lung involvement and a 4.6-fold increased odds of cavitation compared to those with normal BMI [4].

Our findings reinforce the complexity of TB pathophysiology and highlight the need for further studies exploring the role of nutritional status, not only BMI but also specific markers of malnutrition or metabolic syndrome in shaping radiological manifestations. Understanding these associations may provide additional insights into disease progression and guide tailored clinical assessments.

V. CONCLUSION

This study provides a comprehensive characterization of newly diagnosed, microbiologically confirmed PTB patients in Vietnam, highlighting the predominance of middle-aged undernourished males with a high prevalence of comorbidities such as DM and hypertension. Consolidation, fibrosis, and cavitary lesions were the most common radiographic abnormalities. Notably, DM was significantly associated with more severe radiographic findings, whereas BMI classification showed limited correlation except for nodular calcification. These findings underscore the importance of integrating comorbidity screening particularly for DM and nutritional assessment into TB management and control strategies to improve diagnostic accuracy and patient outcomes.

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CONFLICT OF INTEREST

The authors declare that they have no commercial, financial, or personal relationships that could be construed as a potential conflict of interest in relation to this study. This research was conducted independently, without any sponsorship or external funding that could have influenced the findings, interpretation, or presentation of the data.

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