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Original Article

Computed Tomography in Diagnosis of Lesions of Pulmonary Tuberculosis

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ABSTRACT

Pulmonary tuberculosis (MTB) is dangerous bacterial infection primarily affecting lungs and is capable of infecting everyone exposed to *Mycobacterium tuberculosis*. AFB and CXR are useful preliminary investigative tools, but CT scan are invaluable diagnostic tool for establishing a diagnosis and monitoring disease activity. **Objectives:** To diagnose the lesions of PTB and assess the CT scan findings in AFB-positive patients. **Methods:** The AFB-positive patients were examined using CT scan to reveal their mediastinal and pulmonary pathological conditions and activities and disease propagation using imaging technology of CT scan. In cases of PTB with lymphadenopathy, 50cc of non-ionic contrast was administered intravenously to examine the low attenuation area. **Results:** The findings of CT scan regarding micronodules, nodular masses and other foci and lymphadenopathy were scrutinized, and major diagnostic CT scan findings were Centrilobular nodules (97.40%), Parenchymal nodules (84.43%), Paratracheal and mediastinal lymphadenopathy (74.85%), air space consolidation and paucity (62.07%), Pulmonary calcification (31.73%), Pleural effusion (29.34%) and Bronchiectasis (12.77%). **Conclusions:** CT scan is the most sensitive and accurate tool for diagnosis confirmation and disease activity evaluation. In addition, it details the abnormalities and prognosis of organ deformity in PTB patients.

INTRODUCTION

Tuberculosis is a prevalent health public concern with significant casualties and morbidity rates. Active TB risk is influenced by immunological state, immunosuppressive medication, malnutrition, malignancy, extreme age, end-stage renal disease, diabetes mellitus and HIV infection [1]. Societal factors like poor life quality, unhygiene, overcrowding, malnutrition, lack of literacy, big families, early marriage and lack of wakefulness contribute to prevalence of tuberculosis [2]. Pulmonary tuberculosis (PTB) is caused by exposure to *Mycobacterium bacilli* for the first time. Its primary location in lungs reflect the area of highest ventilation; of which common sites are central or inferior lobe, or frontal part of greater lobe, with mediastinal lymphadenopathy. Such lesions manifest a calcified nodule (Ghon lesion) and heal spontaneously. As the lesions advance, pleural effusion, acute cavitation, tuberculous empyema and mediastinal lymphadenopathy develop too [3, 4]. Early diagnosis is vital for efficient treatment of PTB. But imaging is one of the most important diagnostic tests for it. Computed tomography (CT) is more sensitive than chest X-Ray at detecting microscopic solid TB processes of AFB-positive PTB in comparison to AFB-negative patients [5-7]. CT scan is the preferred approach for detecting early bronchogenic spread in secondary TB and is extra sensitive than CXR for disease activity assessment. The usual CT findings during actively propagating disease were deformed nodules, consolidation, tree-in-bud pattern, cavitation and ground glass opacities [3, 8]. Chest radiography persisted being the most important imaging tool for diagnosing PTB but

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plain CXR had 34% accuracy in diagnosing PTB and 59% of patients with post-primary PTB. While CT scan has been reported to be more sensitive than CXR in detecting minor exudative lesions, mild or concealed parenchymal deformities and disease activity. It is more sensitive in detecting miliary nodules, correlating underlying pathomorphological processes, and sequential morphological and structural deformities [9, 10]. Therefore, this study was performed to diagnose the lesions of PTB and assess CT scan findings in patients diagnosed with PTB.

METHODS

Current study was cross-sectional research conducted in the Pulmonology Centers of Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan from September 2021 to November 2022. The study comprised 501 patients, of all peripheral areas of the district of different age and sex groups, who were found positive for PTB through AFB techniques and chest X-Ray radiographs, during the study period. The sample size was calculated using the following equation:

$$n = Z^2 x P(1-P)/ d^2$$

where, Z = 1.96 (constant), P = expected prevalence and d= absolute precision of 5% or 0.05. Only AFB-positive (on sputum or endobronchial washings smear or culture), and fresh cases of PTB were included. AFB-positive PTB cases in any retreatment group, and patients with Chronic Obstructive Airways Disease (COPD) and pneumoconiosis were excluded. All recruited patients were advised to abstain from oral consumption for at least two hours before operation. CT scan of the chest of all study patients was performed using a Toshiba Asteion Multi 4 Slice scanner in the recommended protocol. Both mediastinal (window width 250-400 Hounsfield units; window length -10 to 50 and lung (window width 1000; window length 700 HU) windows were used to image the scans. In cases of PTB with lymphadenopathy, 50cc of intravenous non-ionic contrast was administered manually as a bolus dose to examine low attenuation area [9]. The findings of CT scan regarding micronodules, nodular masses and other foci and lymphadenopathy, *etc* were examined properly and structurally analyzed. The research was granted ethical approval by Institutional Panel of Review Committee and the informed patients' consent and agreement were ensured. All the ethical norms especially patient confidentiality were in strict compliance with ethical codes. Data were processed using SPSS version-24.0 and demographic as well as descriptive data were statistically analyzed. Descriptive analysis was conducted. Quantitative variables were described in percentages and frequencies and the CT scan findings of PTB patient's variables were also presented.

RESULTS

The research was conducted in District Dera Ismail Khan, Khyber Pakhtunkhwa from September 2021 to November 2022, comprising 501 patients who were found positive for PTB through AFB techniques and CXR. The demographic features of the study population revealed that most of patients belonged to age group of over 50 years (51.49%), followed by 30-50 years of age (37.62%) and less than 30 10.77%. Most of them were females (55.48%), while 44.51% were males. A significantly high proportion of the study population ($p<0.05$) was uneducated (66.26%) and 33.73% were educated (169/501). Most of the PTB patients ($p<0.05$) belonged to the urban areas (68.27%) followed by the rural population (31.73%) (Table 1).

Table 1: Demographic features of AFB-positive individuals

Demographic feature	Frequency (%)
Age (Years)	
<30	54(10.77)
30-50	189(37.72)
>50	258(51.49)
Sex	
Male	223(44.51)
Female	278(55.48)
Education	
Educated	169(33.73)
Uneducated	332(66.26)
Locale	
Rural	159(31.73)
Urban	342(68.27)

Figure 1 showed the clinical sign of pulmonary Tuberculosis in participants with AFB-positive.

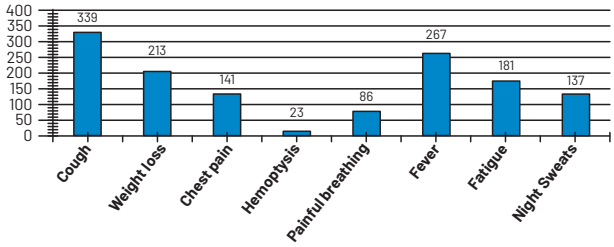

Figure 1: Clinical signs of PTB of the study patients

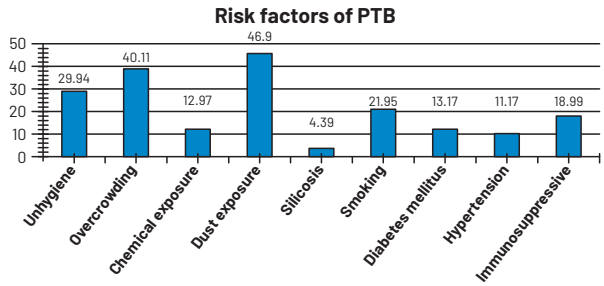

Figure 2: Frequency of risk factors associated with PTB in the study population

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The clinical features of the affected patients were also critically analyzed, and it was found that the major clinical signs were coughing (67.66%), followed by fever and pyrexia (53.29%), severe reduction of patients' weight (42.51%), fatigue (36.12%), chest pain (28.14%), night sweats (27.34%), painful breathing (17.16%) and hemoptysis (4.59%) (Figure 1). Figure 2 depicted the frequency (%) of risk factors associated with PTB in the study population and it was discovered that chief risk factors were dust exposure (46.90%), overcrowding (40.11%), unhygienic conditions (29.94%), smoking (21.95%), immunosuppressive disorders (18.99%), diabetes mellitus (13.17%), exposure to chemicals (12.97%), hypertension (11.17%), and silicosis (4.39%), *etc.* The AFB-positive patients were subjected to CT scan analysis, and it was found that the major diagnostic CT-scan findings of PTB patients were Centrilobular nodules (97.40%), Parenchymal nodules (84.43%), Paratracheal and mediastinal lymphadenopathy (74.85%), Air space consolidation and paucity (62.07%), Pulmonary calcification (31.73%), Pleural effusion (29.34%) and Bronchiectasis(12.77%)(Table 2).

Table 2: CT scan findings of PTB patients for diagnostic purposes

Lesion	No. of patients exhibited	Patients not exhibited
Paratracheal and mediastinal lymphadenopathy	375	126
Air space consolidation	311	190
Parenchymal nodules	423	78
Pulmonary calcification	159	342
Bronchiectasis	64	437
Pleural effusion	147	354
Centrilobular nodules	488	13

DISCUSSION

In this study, factors that influenced severe lesions were scrutinized from perspectives of medical history and laboratory examination, on the basis of categorization values from mild to moderate of PTB individuals employing CT scan, in which the independent risk factors distressing stern lesions were effectively screened out and combined score was developed, provided that a reasonable, hasty and relatively expedient modus operandi for predicting the severity of lesions. Our findings revealed that major diagnostic CT-scan findings of PTB patients were centrilobular nodules, parenchymal nodules, paratracheal and mediastinal lymphadenopathy, air space consolidation and paucity, pulmonary calcification, pleural effusion and bronchiectasis. Our findings were consistent with the study revealing that substantial intrapulmonary lesions accounted for 61.56% of PTB cases [11], and were comparable to the findings of a research that 72.22% (206/285) of patients exhibited severe lung lesions via CT scanning and were predominantly cavity-type lesions, while 56.31% had predominantly thick-walled cavity lesions [12]. Other studies like Murthy *et al.*, and Carlesi *et al.*, reported that sputum-positive PTB bear a strong correlation with cavities, while the thick wall contained fiber tissue, caseous necrotic substance, inflammatory granulation tissue and wall thickness was certainly interrelated with sputum bacterial stack [13-15]. It was reported that CT was far more sensitive than CXR in detecting both localized and disseminated PTB infections and mediastinal lymphadenopathy [16]. It differentiated between active and inactive ailments. 80 and 89% of patients with active and inactive PTB were distinguished by chest CT [17, 18]. Another similar nature retrospective research analyzed that PTB was detected in 49.7%. males and 42%, were females. PTB was characterized by chronic productive cough, weight loss, squatness of breath, chest ache, fever and hemoptysis among other signs. The classic clinical manifestations of PTB were persistent cough, anorexia, sputum production, fever, night sweats, hemoptysis and weight loss 3. Such manifestations were also seen in our research. Our study was in close liaison with the findings that lung consolidations were observed in 70% of cases of PTB cases, while cavities were radiological signature of TB reactivation in 20-40% of cases. Miliary TB is also present in 2-6% of cases of primary TB [19]. Bronchiectasis developed in 30-60% of patients with active and 71-85% in inactive PTB in HRCT [20]. In Nachiappan *et al.*, study pneumothorax was seen in 5% of post-primary cases, which is a little higher than our 4.5% estimate [21]. Destruction of bone or costal cartilage and rim enlargement of accompanying soft tissue masses indicate chest wall involvement. TB spondylitis typically affects the lower thoracic and upper lumbar regions of the spine, manifesting as end plate erosions, sclerosis, and limited disc space with paravertebral abscesses.

CONCLUSIONS

Pulmonary tuberculosis is highly contagious, which negatively impacted the quality of life and health of individuals of underdeveloped nations such as Pakistan. Despite major advancements in detection and treatment, tuberculosis vestige one of the leading infectious sources of illness and mortality globally. AFB and CXR are useful first investigative tools, but CT-scan is an invaluable diagnostic tool for establishing a diagnosis and monitoring disease activity. In clinically suspected situations where CXR findings are ambiguous, CT scan is strongly suggested for diagnosis confirmation and disease activity evaluation. In addition, it details the abnormalities and prognosis of organ deformity PTB.

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Conflicts of Interest

The authors declare no conflict of interest.

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