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A Comprehensive Analysis of Clinical and Radiological Manifestations of Pulmonary Tuberculosis in Diabetic Patients

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ABSTRACT

Tuberculosis (TB), an infectious disease, stands as a prominent contributor to global mortality and morbidity. Individuals with diabetes mellitus (DM) face a threefold increased likelihood of developing active tuberculosis (TB) compared to their non-diabetic counterparts. This study was done to ascertain the clinical and radiological manifestations of pulmonary tuberculosis in individuals diagnosed with diabetes mellitus. A study involving 136 subjects with both DM and pulmonary TB was undertaken. The diagnostic process included a thorough history assessment, clinical examination, sputum analysis for acid-fast bacilli and chest radiography. The clinical profiles, relevant tests and radiological findings were compiled and subjected to analysis. The study sample comprised of majority of males. Prevalent symptoms included cough, fever, and anorexia. Additional symptoms encompassed weight loss, hemoptysis, dyspnea, chest discomfort, and night sweats. A history of tuberculosis was reported in 24.26% of patients, 13.24% had associated hypertension, and 8.82% had concomitant ischemic heart disease. Among patients, 57.35% were smokers and 8.82% had a familial history of tuberculosis. Right-sided lung lesions were more prevalent in patients aged over 45, while left-sided lesions were found in similar number of cases in under or over 45. Bilateral lesions were more common in over 45 patients. Lower lung field lesions were more prevalent in patients. Chest X-ray findings included cavities, fibrous cavities, and infiltrative lesions. Tuberculous individuals with diabetes tend to have multiple cavities and involvement of multiple lobes. Those over 65 show a higher impact on the lower lung field. Notably, diabetes doesn't influence the presenting characteristics of pulmonary TB.

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Key Words

Pulmonary tuberculosis, diabetes mellitus, tuberculosis, hyperglycaemia

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INTRODUCTION

Tuberculosis (TB), an infectious malady, stands out as a prominent global contributor to both mortality and morbidity. Individuals diagnosed with diabetes mellitus (DM) exhibit a threefold higher susceptibility to developing active tuberculosis (TB) compared to their non-diabetic counterparts. The global impact of TB is substantial, with an estimated one-third of the world's population harboring the infection, leading to 8.8 million new cases and 1.45 million annual fatalities. According to World Health Organization (WHO) statistics, the prevalence is on the rise, with an annual incidence of 300 per 100,000 individuals in several Asian nations[1-7].

India the second most populous nation globally, bears a significant burden, contributing a quarter of the world's annual TB incidence cases. In 2012, India recorded an estimated 2.3 million TB cases out of 8.6 million worldwide, with a diabetes prevalence of 7.1% in the adult population. India accounts for 26% of the global TB cases annually, presenting the highest TB burden. In 2012, India's tuberculosis incidence and prevalence rates were estimated at 176 per 100,000 persons and 230 per 100,000 population, respectively, with a recorded death rate of 22 per 100,000 people [8,9].

The global impact of diabetes is anticipated to affect 366 million individuals by 2030, with low-to-middle-income nations experiencing the most significant surge. Diabetes diagnosis requires a fasting blood sugar level exceeding 126 mg dL^{-1} and a 2-hour post-glucose load surpassing 200 mg dL^{-1}. The weakened immune system in diabetic patients, stemming from chronic disease, places them at an elevated risk of latent infection, thereby contributing to the primary cause of tuberculosis in this population. Noteworthy factors, such as compromised cellular immunity, dysfunction of alveolar macrophages, low levels of interferon gamma, microangiopathy of the lungs, and micronutrient deficiency, collectively play a pivotal role in the occurrence of tuberculosis in individuals with diabetes[10-12]. This study was conducted to elucidate the clinical and radiological manifestations of pulmonary tuberculosis in individuals diagnosed with diabetes mellitus.

MATERIAL AND METHODS

This investigation was conducted within the departments of medicine and radiodiagnosis. A cohort of 100 individuals presenting with both DM and pulmonary TB was subjected to a thorough examination. The diagnostic process involved a comprehensive history assessment, clinical examination, sputum analysis for acid-fast bacilli and chest radiography to identify pulmonary TB. The diagnostic criteria outlined by the national diabetes data group and the WHO were adhered to for diabetes diagnosis. The study included adult patients with both DM and pulmonary TB, excluding diabetic individuals with extrapulmonary TB. Extensive evaluations, along with essential laboratory and radiographic tests, were conducted. The study encompassed the assessment of age and sex distribution, presentation symptoms, past tuberculosis history, duration of DM, smoking history, incidence of clubbing, hemoglobin levels, erythrocyte sedimentation rate (ESR), total leukocyte count (TLC), blood sugar levels (BSL), sputum acid-fast bacilli (AFB) results, and radiological patterns. The collected clinical profiles, relevant tests and radiological data underwent comprehensive collation and analysis.

In terms of statistical investigation, descriptive statistics including mean and standard deviation (SD) were employed. The Student's Unpaired t-test was utilized to compare mean values of continuous parameters. The Mann-Whitney test, Chi-square test, and Independent t-test were applied where appropriate to assess the significance of categorical data in the study. A $p>0.05$ was considered statistically significant.

RESULTS

Males constituted 55.15% of the study cohort, with a male-to-female ratio of 1.23:1. The prevalence of pulmonary tuberculosis was notably higher among individuals aged 45 and above (Table 1). Prominent symptoms encompassed cough, fever and anorexia, while additional manifestations included weight loss, hemoptysis, dyspnea, chest discomfort and night sweats. A history of tuberculosis was disclosed by 24.26% of patients, 13.24% had concurrent hypertension and 8.82% presented with concomitant ischemic heart disease. Smoking was reported by 57.35% of patients, with 8.82% having a familial history of tuberculosis. Right-sided lung lesions were more frequent in patients over 45, whereas left-sided lesions occurred in a comparable number of cases under and over 45. Bilateral lesions were more prevalent in those aged over 45 and lower lung field lesions were predominant in patients (Table 2).

Chest X-ray findings indicated the presence of cavities, fibrous cavities and infiltrative lesions. Additionally, consolidation, pleural effusion, hydropneumothorax, parenchymal opacity and bronchiectasis were observed (Table 3).

DISCUSSIONS

A clinical and radiological evaluation was conducted on 136 patients diagnosed with pulmonary tuberculosis (TB) and diabetes. The observed high prevalence of TB in diabetic individuals, noted by both Western and Indian researchers, suggests a significant association between these two conditions[13]. In our study, males constituted 55% of participants, with a male-to-female ratio of 1.23:1. This aligns with

Table 1: Demographic variables of study population

Age group	No.	Percentage
<45 Years	54	39.71
>45 Years	82	60.29
Mean±SD (Years)	51.68±4.76	
Gender		
Male	75	55.15
Female	61	44.85

Table 2: Clinical presentation of study population

Clinical symptoms	No.	Percentage
Anorexia	105	77.21
Cough	102	75.00
Fever	88	64.71
Loss of weight	69	50.74
Night sweats	56	41.18
Dyspnea	29	21.32
Chest pain	29	21.32
Hemoptysis	18	13.24
Past history		
TB	33	24.26
Smoking	78	57.35
Hypertension	18	13.24
Ischemic heart disease	12	8.82
Family history of TB	12	8.82
Side of Lesion		
Left		
<45 Years	15	11.03
>45 Years	23	16.91
Right		
<45 Years	24	17.65
>45 Years	26	19.12
Bilateral		
<45 Years	15	11.03
>45 Years	33	24.26
Lower lung field tuberculosis		
Yes		
<45 Years	16	11.76
>45 Years	42	30.88
No		
<45 Years	38	27.94
>45 Years	40	29.41

Table 3: Investigational findings of study population

Sputum AFB positive	No.	Percentage
Yes		
<45 Years	27	19.85
>45 Years	17	12.50
No		
<45 Years	27	19.85
>45 Years	65	47.79
X-ray Chest Findings		
Cavity	40	29.41
Fibrous cavity	14	10.29
Pleural effusion	12	8.82
Fibrosis	11	8.09
Consolidation	10	7.35
Fibrous cavity + Infiltration	10	7.35
Infiltration	10	7.35
Bronchiectasis	5	3.68
Cavity + Infiltration	5	3.68
Hydropneumothorax	4	2.94
Parenchymal opacity	3	2.21
Parenchymal opacity + Infiltration	3	2.21
Fibrosis + Infiltration	3	2.21
Infiltration + Hydropneumothorax	3	2.21
Pleural effusion + Infiltration	3	2.21
Total	136	100.00

Desmukh *et al*.[13] research, where 72.4% of diabetes cases with pulmonary TB were male[14] and Patel findings, where 76% of cases were male[15]. Our investigation also concurs with the notion that males exhibit a higher incidence of TB than females, potentially linked to the higher prevalence of TB and diabetes in men or variances in healthcare-seeking behavior[13].

The prevalence of pulmonary tuberculosis was notably higher in individuals above the age of 45, consistent with Desmukh's research, which found that 82.6% of tuberculous diabetics were in this age group[14]. Plausible explanations include increased overall morbidity and a gradual loss of immunity with age. The most frequently reported symptoms were cough, fever and anorexia, consistent with Fleke research on Ethiopian diabetic patients with TB[16].

Regarding comorbidities, 24.26% of patients had a history of tuberculosis, 13.24% had associated hypertension and 8.82% had concomitant ischemic heart disease. Smoking was reported by 57.35% of patients, aligning with Lowe's findings of a high prevalence of smoking in TB patients[17]. Clubbing was observed in 14% of patients, indicating advanced tuberculosis, similar to Gordonleitch As observations[18].

Tripathy *et al*.[19] reported a time interval between diabetes diagnosis and the onset of pulmonary TB ranging from a few months to 15 years, with a mean interval of approximately 6 years. Similar findings were noted in Anand AL's investigation, where diabetes preceded TB in 70% of patients[20]. Longer diabetes duration is associated with an increased risk of infection.

Sachdeva *et al*.[21] research revealed a high frequency of pulmonary TB linked with severe hyperglycemia. Sputum acid-fast bacilli (AFB) positivity was higher in individuals over 45, possibly due to daily activities and increased immune response. Right-sided lung lesions were more prevalent in patients over 45, attributed to the larger lung mass on the right side. Bilateral distribution in diabetics may result from rapid bronchial spread. Cavities were a common radiological pattern, possibly related to widespread caseous necrosis. Fibrosis, bronchiectasis, hydropneumothorax, nonspecific parenchymal opacity and consolidation were also observed on radiology[22].

CONCLUSION

Tuberculous individuals with diabetes are predisposed to the likelihood of having multiple cavities and involvement of multiple lobes. Additionally, individuals aged over 65 exhibit a more prevalent impact on the lower lung field. Elevated hyperglycemia emerges as a discernible risk factor for diabetics in the development of pulmonary tuberculosis (TB). It is noteworthy that diabetes does not appear to exert any influence on the presenting characteristics of pulmonary TB.

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