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Original Research Article

CLINICO-RADIOLOGICAL SPECTRUM OF PULMONARY TUBERCULOSIS IN PATIENTS WITH DIABETES MELLITUS: HOSPITAL BASED OBSERVATIONAL STUDY

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ABSTRACT

Background: Diabetes mellitus impairs both innate and adaptive immunity, thereby increasing susceptibility to tuberculosis and altering its clinical course. Previous studies have demonstrated that diabetes influences the clinical presentation, radiological manifestations, diagnostic patterns, and treatment outcomes of pulmonary tuberculosis. Patients with diabetes often present with atypical symptoms, delayed sputum conversion, and distinctive radiographic features, which may complicate diagnosis and management.

Materials and Methods: This was a hospital based prospective observational crosss-sectional study done respiratory medicine at tertiary care centre of north India. Those patients (n=196) who fulfilled the inclusion and exclusion criteria were recruited in the study. Data were collected from patients according to a predesigned proforma gathering clinical history and examination.All data were expressed in percentage, proportions, mean, and standard deviation (SD).

Results: Mean age of study participants was 47±12.41 years.There were 110(56.12%) were male and 86 (43.88%) were female.Among pulmonary TB patients 63.78% had acid fast bacilli on led microscopy and 79.38% patients had M.TB detection by cartridge based nucleic acid amplification test,77.56% patient had unilateral involvement on chest x-ray and 22.44% had bilateral involvement regarding distribution of lesion nodular opacities (40.80%) were the most common findings followed by consolidation (23.46%).

Conclusion: Pulmonary tuberculosis patients with diabetes mellitus in this study predominantly had poor glycemic control, which was associated with atypical radiological patterns and integrated TB–DM management may improve treatment outcomes and reduce disease severity.

Keywords: Pulmonary TB, Diabetes, TB-Diabetes.

INTRODUCTION

Tuberculosis (TB) and diabetes mellitus (DM) are chronic diseases of major public health importance that frequently coexist, particularly in low- and middle-income countries. The association between these two conditions has been recognized since ancient times, with early descriptions by Sushruta and Avicenna. In the pre-insulin era, tuberculosis was a leading cause of mortality among patients with diabetes, underscoring the strong biological interaction between the two diseases.[1]

Diabetes mellitus impairs both innate and adaptive immunity, thereby increasing susceptibility to tuberculosis and altering its clinical course. Several studies have demonstrated that diabetes influences the clinical presentation, radiological manifestations, diagnostic patterns, and treatment outcomes of pulmonary tuberculosis. Patients with diabetes often present with atypical symptoms, delayed sputum conversion, and distinctive radiographic features, which may complicate diagnosis and management.[2]

With the global and national rise in diabetes prevalence, particularly in tuberculosis-endemic regions such as India, TB–DM comorbidity has re-emerged as a significant clinical and programmatic challenge. The National Tuberculosis Elimination Programme (NTEP) recognizes diabetes as an important comorbidity influencing TB control efforts, emphasizing the need for early identification and appropriate management of affected individuals. This study aims to bridge this knowledge gap by systematically assessing the clinical profile, radiological patterns, and demographic associations of pulmonary tuberculosis in patients with diabetes mellitus. The findings are expected to contribute to improved clinical recognition, informed decision-making, and strengthened implementation of collaborative TB–DM management strategies under the National Tuberculosis Elimination Programme.

Aim & Objective: To study the clinical and radiological profile of pulmonary tuberculosis in patients with diabetes mellitus

MATERIALS AND METHODS

This was a hospital based prospective observational crosss-sectional study done respiratory medicine at rural tertiary care centre of north India. This study was conducted among the patients attending the outpatients and in the admitted patients of respiratory medicine department. Ethical clearance was taken from the institutional ethical committee

Samplesize:calculated by using following formula -

n= [Z(1-α/2)]2*pq / d2

Where, n= sample size, Z(1-α/2)=standardized normal deviate at 95% confidence interval and a=0.05 and its value is 1.96

p= estimated prevalence of pulmonary tuberculosis among diabetic patients. Based on previous published studies, the prevalence of pulmonary tuberculosis among patients with diabetes mellitus was assumed to be 15% =0.15.[3]

q=1-p= 0.85

Taking a 95% confidence level and an absolute precision of 5%, the calculated sample size was-

n=(1.96)2×0.15×0.85/ (0.05)2= 3.84x0.15x.85/.0025

n== 195.92 which was rounded off to nearest whole number=196

Hence, the sample size for the present study was 196 patients with acute exacerbation of asthma.

Inclusion Criteria:

1. Pulmonary TB Patients with newly detected or old diabetes mellitus

Exclusion Criteria:

1. Patient not willing to participate in study.
2. Tuberculosis patients not having diabetes.
3. Extra-pulmonary tuberculosis
4. Patients with HIV/AIDS.
5. Patient under chemotherapy or radiotherapy.
6. Patient on prolonged steroid therapy.

Diagnosis of tuberculosis was made by sputum for Acid fast bacilli examination by fluorescent microscopy, CBNAAT (Cartrige based nucleic acid amplification test) or mycobacterial culture.Those negative for sputum for AFB on two separate occasions were diagnosed as a case of sputum negative pulmonary tuberculosis on the basis of suggestive clinical and radiological Findings as per The National Tuberculosis Elimination Programme (NTEP) Guidelines.[4]

Diabetes mellitus was diagnosed based on documented history of diabetes or biochemical criteria in accordance with standard guidelines. WHO Diagnostic Criteria-

Symptom of diabetes plus random blood sugar ≥11.1 mmol/L (200 mg/dL) or Fasting plasma glucose ≥7.0 mmol/L (126 mg/dL) or post prandial (two hour) plasma glucose ≥11.1 mmol/L (200 mg/dL) during an oral glucose tolerance test (Anhydrous glucose 75gm).[5]

Those patients (n=196) who fulfilled the inclusion and exclusion criteria were recruited in the study. Data were collected from patients according to a predesigned proforma gathering clinical history and examination, as well as the results of routine investigations (Complete Blood Count, Liver Function Tests, Kidney Function Tests, Random Blood Sugar, Fasting and Post Prandial Blood Sugar),HbA1C Chest X-ray, High Resolution Computerized Tomography Scan and Sputum smear Microscopy (Fluorescent) For Acid Fast Bacilli and results of bronchial aspiration fluid which was sent for Gene X-pert and MGIT. Data were entered and analysed using SPSS software (SPSS Inc. Statistics for Windows, Version 26.0). All data were expressed in percentage, proportions, mean, and standard deviation (SD).

RESULTS

Mean age of study participants was 47±12.41 years. Most common age group was 50-60 years. There were 110(56.12%) were male and 86 (43.88%) were female. There were 63.78%of rural resident and 36.22% of urban resident.There were 22.95% were smoker and 17.85% were alcoholic patients and 26.53% patients had both smoker and alcoholic. Cough (91.83%) was most common symptoms followed by fever. 71.42%. Among study participants 69.38% of new TB cases and 30.61% of recurrent TB cases.Among pulmonary TB patients 63.78%had acid fast bacilli on led microscopy and 79.38%patients had M.TB detection by cartridge based nucleic acid amplification test.Out of 79.38%pulmonary TB patients detected by CBNAAT, 25(12.75%)patients found to be rifampicin resistant.

Regarding glycemic control of pulmonary tb patients, 25(12.75%) patient had good glycemic control (<7% HbA1c), 110(56.12%) had bad glycemic control (7-9% HbA1c) and 61(31.12%) had poorglycemic control(>9% HbA1C).Mean HbA1c was 9.21±2.32.Radiologically 77.56% patient had unilaterl involvement on chest x-ray and

22.44% had bilateral involvement. Radiologically on chest Xray Upper zone 45.96% most commonly involved followed bylower zone (30.61%), regarding distribution of lesion nodular opacities (40.80%) were the most common findings followed by consolidation (23.46%).

Table 1: Socio demographic characteristics of study participants

Variable	N= 196 (%)
Age (Mean Age)	47±12.41 years
Sex Male Female	110 (56.12%) 86(43.88%)
Residence Rural Urban	125 (63.78%) 71 (36.22%)
Behaviour Factors Smoker Alcoholic Smoker and Alcoholic	 45 (22.95%) 35(17.85 %) 52(26.53%)

Table 2: Clinico microbiological characteristics of study participants

Variable	N= 196 (%)
Symptoms Cough Fever Breathlessness Haemoptysis	 180(91.83%) 140(71.42%) 79(40.30%) 40(20.40)
New TB case Recurrent TB	136 (69.38%) 60 (30.61%)
Acid fast bacilli (AFB) Positive Negative	125 (63.78%) 71 (36.22%)
CBNAAT MTB Detected MTB not detected	145 (73.98%) 51(26.02%)
Glycemic control HbA1C <7% 7-9% >9 %	 25(12.75%) 110(56.12%) 61(31.12%)

Table 3: Radiological presentation of pulmonary TB patients in diabetes mellitus

Variable	N= 196 (%)
Chest X-ray Bilateral involvement Unilateral involvement	44(22.44%) 152(77.56%)
Zone Upper Zone Middle Zone Lower Zone >1Zone	 90 (45.96%) 30 (15.30%) 60(30.61%) 16 (8.16%)
Distribution Of Lesion Nodular Opacities Consolidation Cavity Cavity and Nodules Fibrocavitary Miliary	 80 (40.81%) 46 (23.46 %) 16(8.16%) 25(12.75%) 17(8.6%) 12(6.12%)

DISCUSSION

The present study highlights the clinico-radiological spectrum of pulmonary tuberculosis (PTB) patients with diabetes mellitus. The mean age of participants in our study was 47 ± 12.41 years, with the majority belonging to the 50–60-year age group, reflecting the higher burden of TB–DM comorbidity in middle-aged and older adults. Similar age distributions have been reported in previous Indian and global studies, where diabetes-associated TB is predominantly observed in the economically productive age group, increasing both clinical and public health implications.[6,7] The male predominance (56.12%) observed in this study aligns with earlier reports, likely attributable to greater occupational exposure, higher smoking prevalence, and healthcare-seeking behavior differences among males.[8]

A significant proportion of patients belonged to rural areas (63.78%), which mirrors the known higher TB burden in rural India due to delayed diagnosis, limited access to healthcare, and suboptimal diabetes management.[4] Lifestyle risk factors were notable, with 22.95% smokers, 17.85% alcohol users, and 26.53% having both habits. Smoking and alcohol consumption are well-established risk factors for TB and are known to worsen glycogenic control and impair immune response, thereby increasing susceptibility to TB infection and severe disease.[9,10]

Cough was the most common presenting symptom (91.83%), followed by fever (71.42%) consistent with classical pulmonary TB symptomatology. However, diabetic patients often present with more

severe and prolonged symptoms, which may delay diagnosis and increase transmission risk.[11] The majority of cases were new TB cases (69.38%), though a substantial proportion were recurrent cases (30.61%), suggesting possible treatment failure, relapse, or reinfection, which are more common in patients with diabetes.[12]

Microbiologically, 63.78% patients were AFB-positive on smear microscopy, while 79.38% were CBNAAT-positive, demonstrating the superior sensitivity of molecular diagnostics, especially in diabetic patients who may have atypical or paucibacillary disease.[13] Among CBNAAT-positive patients, 12.75% showed rifampicin resistance, which is clinically significant and higher than national averages, indicating diabetes as a potential risk factor for drug-resistant TB.[14]

Glycaemic control among the study population was notably poor. Only 12.75% had good glycaemic control (HbA1c <7%), while 56.12% had poor control (HbA1c 7–9%) and 31.12% had very poor control (HbA1c >9%), with a mean HbA1c of 9.21 ± 2.32. Poor glycaemic control is known to impair macrophage and lymphocyte function, reduce cytokine response, and adversely affect TB treatment outcomes, including delayed sputum conversion, increased relapse, and mortality.[15-17]

Radiologically, unilateral lung involvement (77.56%) was more common than bilateral disease, similar to findings reported in several Indian studies.[18] However, diabetics are also known to present with bilateral and lower-zone involvement more frequently than non-diabetics. In our study, although the upper zone was most commonly affected (45.96%), a substantial proportion had lower-zone involvement (30.61%), supporting the concept of atypical radiographic presentations in TB patients with diabetes.[19]

Regarding radiographic patterns, nodular opacities (40.80%) were the most common finding, followed by consolidation (23.46%). These findings are consistent with previous studies that describe more extensive, exudative, and atypical radiological patterns in TB patients with poor glycaemic control, often mimicking bacterial pneumonia and leading to diagnostic delays.[20]

Overall, the findings of this study reinforce the strong association between diabetes mellitus—particularly poor glycaemic control—and increased disease burden, atypical radiological features, and drug resistance in pulmonary tuberculosis. These observations underline the importance of bidirectional screening, early diagnosis, and integrated management of TB and diabetes to improve treatment outcomes.

CONCLUSION

Pulmonary tuberculosis patients with diabetes mellitus in this study predominantly had poor glycaemic control, which was associated with atypical radiological patterns. Middle-aged males were most commonly affected. The high prevalence of uncontrolled diabetes underscores the need for early detection, strict glycaemic control, and integrated TB–DM management may improve treatment outcomes and reduce disease severity.

REFERENCES

1. Barach JH. Historical facts in Diabetes. Ann Med Hist.1928;10:387-401.
2. Chang JT, Dou HY, Yen CL, Wu YH, Huang RM, Lin HJ, et al. Effect of type 2 diabetes mellitus on the clinical severity and treatment outcome in patients with pulmonary tuberculosis: a potential role in the emergence of multidrug-resistance. J Formos Med Assoc. 2011;12(6):372–381.
3. Kale PS, Kanade SR, Nataraj G, Mehta PR. Prevalence of pulmonary tuberculosis in patients with diabetes mellitus and lower respiratory tract infection.Int J Res Med Sci 2020;8:597-601.
4. Central TB Division, Ministry of Health and Family Welfare, Government of India.National Tuberculosis Elimination Programme (NTEP): Technical and Operational Guidelines for Tuberculosis in India.New Delhi: Ministry of Health and Family Welfare; 2023.Availablefrom:https://tbcindia.gov.in/WriteReadData/India%20TB%20Report%202023.pdf.Accessed on: 24 Jan 2026.
5. American Diabetes Association. Standards of medical care in diabetes—2010. Diabetes Care. 2010;33(Suppl 1):S11–S61.
6. Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review. PLoS Med. 2008;5(7):e152.
7. Stevenson CR, Critchley JA, Forouhi NG, ,Roglic G, Williams BG, Dye C et al. Diabetes and the risk of tuberculosis: a neglected threat to public health? Chronic Illn. 2007;3(3):228-245.
8. World Health Organization.Global Tuberculosis Report 2023. Geneva: World HealthOrganization;2023.Availablefrom:https://www.who.int/publications/i/item/9789240083851 [Accessed 27 Jan 2026].
9. Bates MN, Khalakdina A, Pai M, Chang L, Lessa F, Smith KR. Risk of tuberculosis from exposure to tobacco smoke: a systematic review and meta-analysis. Arch Intern Med. 2007 Feb 26;167(4):335-42.
10. Rehm J, Samokhvalov AV, Neuman MG, Room R, Parry C, LönnrothK,et al. The association between alcohol use, alcohol use disorders and tuberculosis (TB).A systematic review. BMC Public Health. 2009 Dec 5;9:450.
11. Restrepo BI. Diabetes and Tuberculosis. MicrobiolSpectr. 2016 Dec;4(6):10.
12. Baker MA, Harries AD, Jeon CY, Hart JE, Kapur A, Lönnroth K, et al. The impact of diabetes on tuberculosis treatment outcomes: a systematic review. BMC Med. 2011 Jul 1;9:81.
13. Steingart KR, Schiller I, Horne DJ, Pai M, Boehme CC, Dendukuri N. Xpert® MTB/RIF assay for pulmonary tuberculosis and rifampicin resistance in adults. Cochrane Database Syst Rev. 2014 Jan 21;2014(1):CD009593.
14. Chang JT, Dou HY, Yen CL, Wu YH, Huang RM, Lin HJ, et al . Effect of type 2 diabetes mellitus on the clinical severity and treatment outcome in patients with pulmonary tuberculosis: a potential role in the emergence of multidrug-resistance. J Formos Med Assoc. 2011 Jun;110(6):372-81.
15. Dooley KE, Chaisson RE. Tuberculosis and diabetes mellitus: convergence of two epidemics. Lancet Infect Dis. 2009;9(12):737-746.
16. Alisjahbana B, Sahiratmadja E, Nelwan EJ, Purwa AM, Ahmad Y, Ottenhoff TH et al. The effect of type 2 diabetes mellitus on the presentation and treatment response of pulmonary tuberculosis. Clin Infect Dis. 2007;45(4):428-435.
17. Critchley JA, Carey IM, Harris T, DeWilde S, Hosking FJ, Cook DG. Glycemic Control and Risk of Infections Among

People With Type 1 or Type 2 Diabetes in a Large Primary Care Cohort Study. Diabetes Care. 2018 Oct;41(10):2127-2135.
18. Pérez-Guzman C, Torres-Cruz A, Villarreal-Velarde H, Salazar-Lezama MA, Vargas MH. Atypical radiological images of pulmonary tuberculosis in 192 diabetic patients: a comparative study. Int J Tuberc Lung Dis. 2001 May;5(5):455-61.
19. Chiang CY, Bai KJ, Lin HH, Chien ST, Lee JJ, Enarson DA, Lee TI, Yu MC. The influence of diabetes, glycemic control, and diabetes-related comorbidities on pulmonary tuberculosis. PLoS One. 2015 Mar 30;10(3):e0121698.
20. Wang CS, Yang CJ, Chen HC, Chuang SH, Chong IW, Hwang JJ, et al . Impact of type 2 diabetes on manifestations and treatment outcome of pulmonary tuberculosis. Epidemiol Infect. 2009 Feb;137(2):203-10.