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CHAPTER 26

Tuberculosis and Other Infections in Uncontrolled Diabetes Mellitus

BL Bhardwaj, Rajbir Singh, Prabhpreet Kaur, Kanchan Bhardwaj, RS Bhatia

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INTRODUCTION

Persistent hyperglycemia is a risk factor for precipitation as well as activation of infection, including tuberculosis (TB), especially in the elderly/malnourished/immunosuppressed persons, mostly inflicting eyes, skin, buccal cavity, chest, genitourinary system, gastrointestinal system, etc. Hyperglycemia or uncontrolled diabetes mellitus also predisposes to TB and is also considered a risk factor for its activation. The centuries-old association has seen diabetes mellitus in <10% of cases of TB hospital admissions, which has increased to 10% in TB patients over the age of 40 years who have diabetes mellitus at present in India.

Radiological diagnosis of TB among diabetic patients in Korea varied from 9.6 to 12.8%, whereas the 2002 Imphal study revealed the prevalence of pulmonary TB in 100 diabetic patients as 27% radiologic diagnosis and 60% sputum positivity. The risk of TB in diabetes mellitus increases 3.4 times, directly related to uncontrolled hyperglycemia of a longer duration. Relative risk is higher among younger age groups, i.e., 9.88% (30–39 years), 4.72% (40–49 years), and 1.76–2.3% (above 49 years). TB among male diabetics is 2.2 times more than female diabetics. Both bronchial and pleuropulmonary involvements are known to occur. Multiple lobe involvement can occur; lower lung fields are commonly affected in diabetes mellitus. The duration of diabetes mellitus has no correlation with the occurrence of TB, but the risk of developing multidrug-resistant (MDR)-TB is higher; various types of lesions of TB in diabetes mellitus are listed in **Table 1**.

TABLE 1: Tubercular diseases and a variety of tubercular lesions in diabetes mellitus.

Tuberculosis	• Minimal • Moderate • Advanced
Tuberculosis lesions	• Cavitary • Homogenous opacities • Heterogeneous opacities • Pleural effusion • Consolidation • Fibrosis

PATHOGENESIS

Tuberculosis is mainly transmitted via droplet nuclei. A higher prevalence of pulmonary TB in diabetes mellitus is attributed to an existing inadequate substrate for immunity formation due to disturbed protein metabolism. At the same time, higher chances of infection are due to low opsonic index, reduced antibacterial activity, poor tissue resistance, reduced collagen synthesis, impaired defensive function of reticulo-endothelial (RE) cells, and increased availability of tissue glycerol as a substrate that enhances the growth of TB bacilli. Prognosis is not favorable, and doctors must be vigilant to suspect infection in cases with uncontrolled hyperglycemia. Keeping the fasting blood sugar level at 100 mg/dL is the prudent target. Diagnosis and management with anti-TB drugs for an appropriate duration with maintenance of glucose status are rewarding and are not dependent on the type of hypoglycemic therapy [insulin or oral hypoglycemic agents (OHAs)] used.

EFFECT OF UNCONTROLLED PERSISTENT DIABETES MELLITUS

Bacterial chest infections are increased in the presence of hyperglycemia, and this is attributed to reduced availability of NADPH, producing decreased production of superoxide anion along with depressed respiratory burst, which would contribute to impaired chemotaxis, phagocytosis, and intracellular killing of microorganisms by granulocytes and mononuclear cells in diabetes mellitus. Similarly, impaired ability of alveolar macrophages in inhibiting fungal spore germination would enhance azygomytosis.

Comorbidities and altered pulmonary functions in two-third cases of diabetes mellitus, influence of obesity, muscle weakness, and congestive heart failure add to the agony. Reduced lung columns (in insulin-dependent diabetes mellitus), pulmonary elastic recoil, impaired pulmonary diffusion, and pulmonary epithelial permeability along with abnormal ventilatory response to hypoxia can cause unexpected cardiorespiratory arrest in diabetic patients, possibly due to increased sleep-related breathing disorder produced as a result of autonomic neuropathy. Diabetic patients (1) have reduced diffusion capacity for carbon monoxide, (2) have increased vascular injury (pulmonary microangiopathy), and (3) also contribute independently to airflow obstructive disease (due to systemic inflammation and endothelial dysfunction). Further, it is worsened by smoking, poor glycemic control, and other cardiopulmonary comorbidities.

Reduced gradient between pulmonary wedge pressure and serum colloid oncotic pressure may produce cerebral edema, which may cause neurogenic pulmonary edema due to increased permeability during acidosis. Acute respiratory distress syndrome (ARDS) can also occur because of cardiogenic pulmonary edema while treating diabetic ketoacidosis, which may produce alveolar hypoventilation due to hypokalemia and hypophosphatemia because of severe muscular weakness.

Bronchial asthma may rarely coexist with diabetes mellitus. Nevertheless, exacerbation of bronchospasm may occur in bronchial asthma during hypoglycemia. Diabetic autonomic neuropathy, on the other hand, reduces

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bronchial hyperreactivity possibly because of depressed cholinergic broncho-motor tone. Diabetic neuropathy hand persistent transudative pleural effusion due to left ventricular dysfunction may produce transient vocal cord paralysis. Pulmonary thromboembolism may get precipitated due to dehydration in a case of diabetic ketoacidosis. Tuberculosis can involve the tongue, palate, and draining lymph nodes. These lesions are painful, and histopathology reveals nonspecific inflammation with necrosis. Caseation is seen in deeper parts of the lesion where *Mycobacterium tuberculosis* may be demonstrable. Hyperglycemia enhances infection and inflammation by impairing chemotaxis, phagocytosis, and intracellular killing of microorganisms by granulocytes and mononuclear cells. In the oral cavity, it alters secretions in gingiva and salivary glands, which decreases pH, and along with microvascular damage, causes host tissue damage. Therefore, dental plaque, candidal infections, halitosis, periodontal infections, and tooth abscesses enhance the risk of caries and severely affect the gingival health. This further increases the risk of systemic diseases. Therefore, care of oral/periodontal hygiene is of utmost importance.

Metabolic disorders and lung involvement require elaborated diagnostic procedures to establish the diagnosis. At the same time, these facilities may not be available at all centers or may not be affordable for all patients. Hence, the clinical acumen used is rewarding. Achieving and maintaining 100 mg/dL levels of glucose in the blood wisely stand for a fruitful outcome.

CONCLUSION

Diabetes mellitus and chest infections including TB are directly related in case of uncontrolled hyperglycemia due to higher susceptibility, sustenance, and reduced bactericidal activity and tissue resistance because of the inability of granulocytes, mononuclear cells, and even alveolar macrophages to contain infection. The sibling risk factor of hyperglycemia, further influenced by obesity, smoking, alcohol intake, and lack of exercise, adds to cardiopulmonary dysfunctions. Comorbidities and diabetic ketoacidosis would add agony to the existing problem. Maintenance of fasting blood glucose as/around 100 mg/dL would prevent as well as help in the early recovery of accompanying chest disorders in diabetes mellitus. Uncontrolled diabetes mellitus precipitates comorbidities, especially in the form of infections. It also delays the diagnosis of TB. Misuse of corticosteroids in diabetic patients during COVID-19 has yielded a number of systemic infections, including TB and malignant disorders, due to suppression of immunity. Further treatment outcome in TB is also affected by uncontrolled sugar levels in diabetes mellitus. Metformin has shown a potential prophylactic value.

FURTHER READINGS

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The book "Clinical Medicine Update 2025" is an official publication of IACM. It contains chapters written by various reputed speakers at IACMCON 2025 held at Chandigarh from 14 to 16 November, 2025. The authors are from institutions like PGI Chandigarh, Rohtak, and different AIIMS and other reputed institutions all over India and abroad. The theme of the conference is "Blending Art and Science in Clinical Medicine". The chapters are also a mixture of clinical topics as well as advanced research topics in medicine. The book will be very useful for students, teachers, and medical practitioners.



BL Bhardwaj is a highly experienced Consultant in Internal Medicine with a distinguished career spanning more than 40 years in clinical practice, teaching, and research. Dr Bhardwaj began his medical journey with an MBBS (1975–1980) and MD in Medicine (1985–1987) from Government Medical College (GMC), Patiala, Punjab, India, followed by specialized training in bronchoscopy and pulmonary medicine from PGI Chandigarh in 1995. He did a Fellowship in Echocardiography from Medvarsity in 2024. He also did a certificate course in advanced cardiology from Harvard USA. With extensive teaching experience, Dr Bhardwaj has held leadership roles at renowned institutions, including Professor & Head of Medicine and Cardiology, and Principal of Government Medical College, Patiala and then Principal of Adesh Medical College Shahabad, Kurukshetra, India. Later he remained Vice-Chancellor of MMU Sadopur, Ambala, Punjab. Presently, he is working as Pro Vice-Chancellor Medical at Desh Bhagat University, Fatehgarh Sahib, Punjab. He is also a visiting consultant at Manipal Hospitals. Dr Bhardwaj has published about 50 research and review papers and co-authored four books, one on hematology and transfusion medicine for technicians and three on pulmonary medicine. He has delivered over 100 scientific lectures at national and international medical conferences on key topics like diabetes, infectious diseases, and hematology. His dedication has earned him numerous awards and honors from prestigious national and international institutions. In November 2024, he was conferred Oration Award by West Bengal chapter of IACM. He is regularly invited as an expert panelist and examiner for various universities, the Union Public Service Commission (UPSC), and state commissions across India. He is President Elect IACM and Chairman of the scientific committee for IACMCON 2025 to be held at Chandigarh.

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