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CLINICAL FEATURES AND COURSE OF PULMONARY TUBERCULOSIS IN PATIENTS WITH DIABETES MELLITUS

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Abstract

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide. Concurrently, the global prevalence of diabetes mellitus (DM) continues to rise, creating a significant challenge for healthcare systems. Diabetes mellitus is recognized as an important risk factor for the development, progression, and unfavorable outcomes of pulmonary tuberculosis. The coexistence of these two diseases alters the clinical presentation, radiological manifestations, immune response, and treatment outcomes. Hyperglycemia impairs both innate and adaptive immunity, increasing susceptibility to Mycobacterium tuberculosis infection and reactivation of latent tuberculosis. Patients with diabetes frequently demonstrate more extensive pulmonary lesions, delayed sputum conversion, increased bacterial load, and higher rates of treatment failure and relapse. This review summarizes current evidence regarding the peculiarities of pulmonary tuberculosis in patients with diabetes mellitus, including epidemiological trends, pathogenetic mechanisms, clinical manifestations, diagnostic challenges, and therapeutic considerations.

Keywords: Pulmonary tuberculosis, diabetes mellitus, comorbidity, hyperglycemia, immune dysfunction, treatment outcomes.

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Introduction

Tuberculosis remains a major global public health concern despite advances in diagnostic and therapeutic approaches. According to the World Health Organization (WHO), approximately 10 million people develop tuberculosis annually, and more than one million deaths are attributed to the disease each year. Simultaneously, diabetes mellitus has become one of the fastest-growing non-communicable diseases worldwide.

The association between tuberculosis and diabetes has been recognized for centuries. Contemporary epidemiological studies demonstrate that individuals with diabetes have a two- to four-fold higher risk of developing active tuberculosis compared with non-diabetic individuals. The increasing prevalence of diabetes in countries with high tuberculosis burden has created a dual epidemic that significantly complicates disease control efforts.

The interaction between tuberculosis and diabetes is bidirectional. Diabetes increases susceptibility to tuberculosis infection and worsens treatment outcomes, while tuberculosis may induce transient hyperglycemia and complicate glycemic control. Understanding the peculiarities of pulmonary tuberculosis in diabetic patients is essential for improving clinical management and reducing disease burden.

Pathophysiological mechanisms and epidemiology

The increased susceptibility of diabetic patients to tuberculosis is primarily associated with immune dysfunction caused by chronic hyperglycemia.

Hyperglycemia impairs macrophage activation, decreases chemotaxis of neutrophils, and reduces phagocytic activity. Defects in cell-mediated immunity, particularly involving T lymphocytes, contribute significantly to impaired defense against Mycobacterium tuberculosis.

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Additionally, diabetes is associated with:

- Reduced production of interferon-gamma (IFN-γ);
- Impaired cytokine signaling;
- Altered antigen presentation;
- Increased oxidative stress;
- Microvascular complications reducing tissue perfusion.

These mechanisms collectively facilitate bacterial multiplication and progression of pulmonary lesions.

The prevalence of diabetes among patients with tuberculosis varies between countries but generally ranges from 10% to 30%. Regions with rapidly increasing rates of type 2 diabetes are experiencing a corresponding increase in TB-DM comorbidity.

Table 1. Risk of tuberculosis development in patients with diabetes

Population Group	Relative Risk of Active Tuberculosis
Non-diabetic individuals	1.0
Type 2 diabetes mellitus	2.5–3.5
Poorly controlled diabetes (HbA1c > 8%)	4.0–6.0
Diabetes with chronic complications	5.0–7.0

The risk increases proportionally with the severity and duration of diabetes as well as the degree of glycemic control.

Clinical characteristics and radiological features

Pulmonary tuberculosis in diabetic patients often demonstrates atypical and more severe clinical manifestations.

Common symptoms include persistent cough, fever, night sweats, weight loss, hemoptysis, fatigue.

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Several studies indicate that diabetic patients experience a longer duration of symptoms before diagnosis. Disease progression tends to be more aggressive, resulting in extensive pulmonary involvement.

Table 2. Comparison of clinical features in tuberculosis patients with and without diabetes

Clinical Feature	TB without DM (%)	TB with DM (%)
Cavitary lesions	38	61
Bilateral involvement	27	49
Positive sputum smear	58	76
Delayed sputum conversion	15	37
Treatment relapse	5	14

These findings suggest a substantially greater disease burden among diabetic individuals.

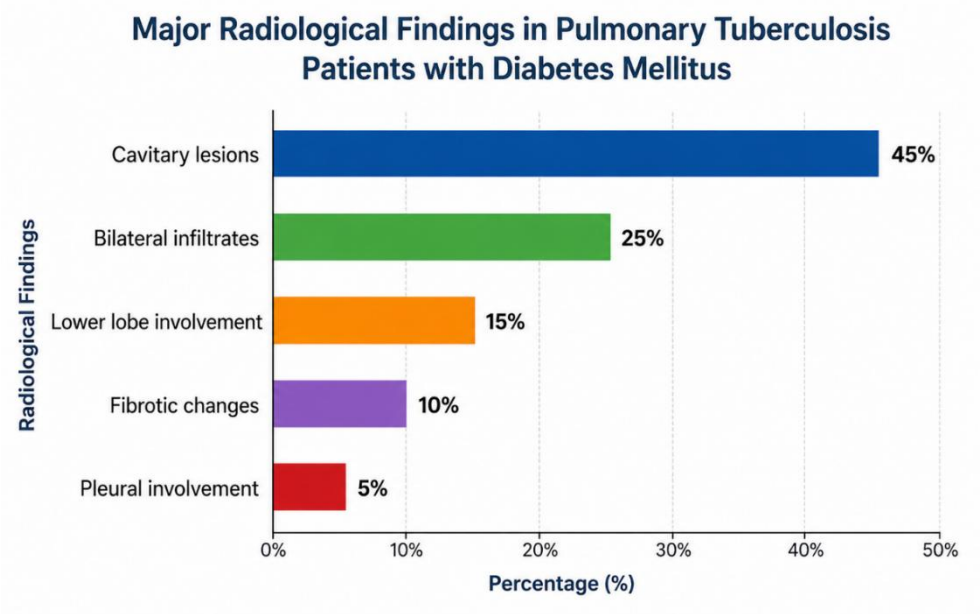

Diagram 1.

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Microbiological characteristics and treatment outcomes

Patients with diabetes frequently exhibit higher bacillary loads. Positive sputum smears and cultures are observed more frequently than in non-diabetic tuberculosis patients.

Several studies report increased bacterial burden, delayed sputum culture conversion, longer infectious period, greater transmission potential.

Hyperglycemia may create favorable conditions for mycobacterial persistence and survival.

Diabetes negatively influences the effectiveness of anti-tuberculosis therapy.

Major complications include delayed sputum conversion, increased treatment failure, drug interactions, higher mortality, increased relapse rates.

Poor glycemic control is a particularly significant predictor of unfavorable outcomes.

Integrated management of both diseases significantly improves prognosis.

Diagnosing tuberculosis in diabetic patients presents several challenges. Atypical radiographic patterns, overlapping symptoms with other respiratory diseases, and altered immune responses may delay recognition.

Healthcare providers should maintain a high index of suspicion for tuberculosis in diabetic individuals presenting with chronic respiratory symptoms, unexplained weight loss, or persistent fever.

Screening programs targeting diabetic populations may facilitate earlier diagnosis and improve treatment outcomes.

Several preventive measures are recommended:

1. Routine TB screening among high-risk diabetic patients.
2. Strict glycemic control.
3. Patient education regarding TB symptoms.
4. Early initiation of anti-tuberculosis therapy.
5. Integrated TB-DM management programs.

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The implementation of coordinated public health strategies is crucial for controlling the dual burden of tuberculosis and diabetes.

Conclusion

The coexistence of pulmonary tuberculosis and diabetes mellitus represents a significant clinical, epidemiological, and public health challenge worldwide. The growing prevalence of diabetes, particularly in low- and middle-income countries where tuberculosis remains endemic, has contributed to an increasing number of patients affected by both conditions simultaneously. Evidence from numerous studies demonstrates that diabetes mellitus not only increases the risk of developing active tuberculosis but also significantly influences the clinical course, radiological presentation, microbiological characteristics, and treatment outcomes of the disease. Chronic hyperglycemia impairs both innate and adaptive immune responses, reducing the body's ability to control Mycobacterium tuberculosis infection and promoting disease progression.

Patients with concomitant diabetes and pulmonary tuberculosis often present with more severe clinical manifestations, extensive pulmonary involvement, higher bacterial loads, and delayed sputum conversion compared with non-diabetic individuals. Furthermore, poor glycemic control is strongly associated with an increased risk of treatment failure, disease relapse, prolonged infectiousness, and mortality. These findings highlight the importance of recognizing diabetes mellitus as a major determinant of tuberculosis prognosis and treatment effectiveness.

Early detection of both diseases, regular screening of high-risk populations, and comprehensive management strategies are essential for improving patient outcomes. Close monitoring of blood glucose levels throughout anti-tuberculosis treatment, optimization of antidiabetic therapy, and careful management of potential drug interactions can significantly enhance treatment success rates. In addition, multidisciplinary cooperation among pulmonologists, endocrinologists,

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infectious disease specialists, and primary healthcare providers is crucial for ensuring effective patient care.

From a public health perspective, integrated tuberculosis–diabetes control programs should be considered a priority, particularly in regions with a high burden of both diseases. Strengthening healthcare infrastructure, expanding screening initiatives, increasing patient awareness, and improving access to diagnostic and therapeutic services may substantially reduce the morbidity and mortality associated with this dual disease burden. Future research should focus on elucidating the molecular mechanisms underlying the interaction between diabetes and tuberculosis, identifying biomarkers associated with poor outcomes, and developing personalized therapeutic approaches for affected patients.

In conclusion, diabetes mellitus significantly alters the natural history of pulmonary tuberculosis and remains one of the most important comorbid conditions affecting disease progression and treatment outcomes. Comprehensive clinical management, effective glycemic control, early diagnosis, and coordinated public health interventions are essential for reducing the impact of these interconnected diseases and improving the quality of life and long-term prognosis of affected individuals

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