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ORIGINAL RESEARCH

To study the prevalence of tuberculous involvement at various site in patients of diabetes mellitus

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ABSTRACT

Aim: Evaluation of Tuberculous involvement at different site in patients of diabetes mellitus. **Materials and Methods:** In the present study, a total of 100 patients were selected based on their history of diabetes mellitus and presenting symptoms such as cough with productive sputum for more than four weeks, weight loss, loss of appetite, low-grade fever, and hemoptysis. These patients were either attending the outpatient department or were admitted to different wards of the Medicine Department and T.B. & Chest Unit. Clinical symptoms and signs were thoroughly documented. Detailed histories were taken, including the present illness, past illnesses (like diabetes and tuberculosis), personal and family history, and for female patients, menstrual and obstetric history. **Results:** The majority of tuberculosis patients in the study had Type 2 diabetes mellitus (80%), while 20% had Type 1 diabetes mellitus. This finding aligns with the global prevalence of Type 2 diabetes being more common than Type 1 diabetes. The diagnostic tests revealed various types of TB lesions in patients with diabetes mellitus. Chest X-rays identified cavitation in 30% of the patients, infiltrates in 40%, consolidation in 20%, and pleural effusion in 10%. These findings are consistent with the typical radiographic features of pulmonary TB. Ultrasound of the abdomen showed abdominal lymphadenopathy in 15% of the patients and ascites in 5%, indicating extrapulmonary involvement. Echocardiography detected pericardial effusion in 10% of the cases, suggesting cardiac involvement. CT scans revealed tuberculomas in the brain in 5% of the patients, spinal tuberculosis in 10%, and abdominal tuberculosis in another 10%, highlighting the diverse anatomical impact of TB in diabetic patients. **Conclusion:** These results demonstrate the significant interplay between diabetes mellitus and tuberculosis, with a high prevalence of pulmonary TB that is 60% followed byExtrapulmonary TB that 25% and Both Pulmonary and Extrapulmonary TBthat is 15% and diverse clinical manifestations and lesions. The study underscores the importance of comprehensive diagnostic approaches, including microbiological, serological, radiological, and cytological examinations, to accurately diagnose and manage TB in diabetic patients.

Keywords: Pulmonary and extra pulmonary tuberculosis, diabetes mellitus, association, incidence, diagnostic tests

INTRODUCTION

Tuberculosis (TB) remains one of the most persistent and devastating infectious diseases worldwide, affecting millions of individuals each year. The interplay between TB and other chronic conditions, notably diabetes mellitus (DM), has garnered increasing attention in recent years. This intersection is particularly concerning given the global rise in diabetes, which is now considered a major comorbidity influencing the course and outcome of TB.[1]Diabetes mellitus, a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both, has seen a dramatic increase in prevalence. This rise is attributable to various factors, including lifestyle changes, increasing obesity rates, and an aging population. Amongcomplications, the increased susceptibility to infections, particularly TB, is of significant concern.[2]The association between diabetes mellitus and TB is multifaceted. Diabetes impairs the immune system, making individuals more susceptible to infections, including TB. The hyperglycemic environment in diabetic patients favors the growth and virulence of Mycobacterium tuberculosis, the bacterium responsible for TB. Additionally, diabetes can alter the clinical presentation of TB, making

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diagnosis and management more challenging. This altered presentation can lead to delays in diagnosis, prolonged infectiousness, and an increased risk of transmission.[3]

TB can manifest in various forms, broadly categorized into pulmonary and extrapulmonary types. Pulmonary TB, affecting the lungs, is the most common form and is typically the primary focus of TB control programs due to its potential for transmission. However, TB can also affect other parts of the body, leading to extrapulmonary TB, which can occur in almost any organ system. [4]In diabetic patients, the immune system's compromised state due to chronic hyperglycemia and other metabolic disturbances can lead to more severe and widespread TB lesions. Pulmonary TB in diabetic patients often presents with more extensive lung involvement, cavitary lesions, and a higher bacterial load. Moreover, the risk of drug-resistant TB is also higher in diabetic patients due to the need for longer treatment durations and the potential for medication non-compliance.[5]Extrapulmonary TB, which can involve organs such as the lymph nodes, pleura, bones, central nervous system, and abdominal organs, poses additional diagnostic and therapeutic challenges. For instance, TB meningitis, a severe form of TB affecting the central nervous system, is more likely to occur in diabetic patients and is associated with higher morbidity and mortality rates. Similarly, TB peritonitis, affecting the abdominal lining, can present with nonspecific symptoms and be difficult to diagnose without a high index of suspicion and appropriate diagnostic tools.[6]

The interaction between TB and diabetes also extends to the impact on diagnostic procedures and treatment outcomes. For example, diabetic patients with TB may have altered responses to traditional diagnostic tests such as the tuberculin skin test (TST) or interferon-gamma release assays (IGRAs), leading to false-negative results. Imaging studies, such as chest X-rays and CT scans, may show atypical patterns in diabetic patients, necessitating a more nuanced interpretation of results. Furthermore, the management of TB in diabetic patients is complicated by the need to control blood glucose levels while simultaneously treating the TB infection. This dual management requires a coordinated approach, often involving multiple healthcare providers and specialists.[7]Treatment outcomes in diabetic patients with TB are generally poorer compared to non-diabetic patients. This disparity is due to several factors, including delayed diagnosis, more extensive disease, higher rates of drug resistance, and the challenges of managing two chronic conditions simultaneously. Therefore, addressing the dual burden of TB and diabetes requires a comprehensive approach that includes early diagnosis, tailored treatment regimens, and close monitoring of both TB and diabetes management.[8]

MATERIALS AND METHODS

In the present study, a total of 100 patients were selected based on their history of diabetes mellitus and presenting symptoms such as cough with productive sputum for more than four weeks, weight loss, loss of appetite, low-grade fever, and hemoptysis. These patients were either attending the outpatient department or were admitted to different wards of the Medicine Department and T.B. & Chest Unit. Clinical symptoms and signs were thoroughly documented. Detailed histories were taken, including the present illness, past illnesses (like diabetes and tuberculosis), personal and family history, and for female patients, menstrual and obstetric history.

METHODOLOGY

Urine Sugar Examination: Urine sugar was examined using DIASTIX, a test based on a double sequential enzyme reaction. This method ensures accuracy over the traditional Benedict's test. Fresh urine samples were collected in clean containers, and the test strip was dipped in the urine. The color change on the strip was compared with a color chart after exactly 30 seconds, with results recorded as 1+, 2+, 3+, and 4+.

Fasting and Random Plasma Glucose Estimation: According to ADA criteria, fasting plasma glucose levels ≥ 126 mg/dL or random plasma glucose levels ≥ 200 mg/dL are diagnostic of diabetes mellitus. Plasma glucose was estimated using the GOD/POD method available at the Department of Biochemistry, IMCHRC. About 2 mL of venous blood was collected, treated with fluoride-oxalate to inhibit glycolysis, and centrifuged to obtain plasma. The intensity of the red-colored compound formed in the presence of glucose was measured at 505 nm, with the final color stable for 2 hours.

Oral Glucose Tolerance Test (OGTT): Patients were instructed to minimize physical activity before the test. They were given 75 gm of anhydrous glucose dissolved in 250 mL of water, flavored to increase palatability. Venous blood samples were taken at baseline and 120 minutes post-ingestion. Plasma glucose levels were measured using the same biochemical analyzer as for fasting glucose.

Diagnosis of Tuberculosis: The diagnosis of tuberculosis in this study involved a comprehensive approach using multiple diagnostic techniques to ensure accuracy and thoroughness. Sputum samples were analyzed for Acid-Fast Bacilli (AFB) using both microscopy and culture methods, which are standard practices for detecting the presence of Mycobacterium tuberculosis. This allowed for the identification of active TB infections based on the direct visualization of the bacteria.Chest X-rays (PA view) were performed to identify lung lesions indicative of tuberculosis. Radiographic imaging is a critical tool in diagnosing TB, as it helps visualize characteristic changes in the lungs, such as cavities, infiltrates, and nodules, which are commonly associated with the

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disease.The Tuberculin Skin Test (TST) was conducted to assess prior exposure to Mycobacterium tuberculosis. This test involves the intradermal injection of purified protein derivative (PPD) and the measurement of the induration response after 48-72 hours. A significant induration suggests TB infection, either latent or active.Enzyme-Linked Immunosorbent Assay (ELISA) tests were used to detect antibodies against Mycobacterium tuberculosis in blood samples. This serological test helps identify the immune response to TB infection, providing additional evidence for diagnosis, particularly in cases where other tests are inconclusive.Body fluids, including ascitic, pleural, pericardial, and cerebrospinal fluids, were collected aseptically for biochemical, cytological, and culture examinations. These samples were analyzed to detect TB infection in various body compartments, ensuring comprehensive evaluation beyond the pulmonary system.Supportive investigations included complete blood examinations and erythrocyte sedimentation rate (ESR) tests to assess general health and the presence of inflammation. Ultrasound (USG) of the abdomen was utilized to detect abdominal abnormalities related to tuberculosis, such as enlarged lymph nodes or ascites.Echocardiography was performed when tuberculosis was suspected to involve the heart, helping identify pericardial effusion or other cardiac manifestations of TB. Computed Tomography (CT) scans of the brain, spine, and abdomen were conducted to detect lesions in these areas, providing detailed imaging that complements the findings from chest X-rays and USG.Tissue biopsies were obtained through fine needle aspiration from affected sites and cultured for tuberculosis. This invasive procedure allowed for histopathological examination and culture confirmation, providing definitive evidence of TB infection in suspected cases.This multifaceted diagnostic approach ensured a robust and reliable diagnosis of tuberculosis in patients, facilitating appropriate and timely treatment interventions.

Samples of body fluids were collected in two test tubes for physical, chemical, cytological examination, and culture. For example, 0.5 mL of clear fluid supernatant was mixed with 3.0 mL of sulphosalicylic acid reagent, left for 5 minutes, and compared with turbidity standards. Cerebrospinal fluid (CSF) was analyzed for chemical content and cytology, ensuring careful handling to prevent contamination.Body fluids were centrifuged to concentrate leukocytes, which were then stained and examined under a microscope to detect cellular abnormalities indicative of tuberculosis. This thorough process helped in identifying various tuberculous lesions associated with diabetes mellitus.

RESULTS

Table 1: Patient Demographics and Clinical Symptoms

The study included 100 patients with a history of diabetes mellitus and presenting symptoms suggestive of tuberculosis. The age distribution showed that the majority of patients (50%) were between 41-60 years old, followed by 25% in the 20-40 years age group. Only 5% were under 20 years, and 20% were over 60 years. This distribution indicates that middle-aged individuals are most commonly affected. Gender distribution revealed a higher prevalence in males (60%) compared to females (40%), suggesting a possible gender-related susceptibility or exposure risk to tuberculosis in diabetic patients.

Table 2: Types of Tuberculosis in Patients with Diabetes Mellitus (DM)

Among the 100 patients studied, 60% had pulmonary tuberculosis, indicating that it is the most common form of TB in diabetic patients. Extrapulmonary TB was present in 25% of the patients, while 15% had both pulmonary and extrapulmonary TB. These results highlight the significant burden of pulmonary TB in diabetic patients, while also emphasizing that extrapulmonary involvement is not uncommon.

Table 3: Incidence of Types of Diabetes Mellitus Among Tuberculosis Patients

The majority of tuberculosis patients in the study had Type 2 diabetes mellitus (80%), while 20% had Type 1 diabetes mellitus. This finding aligns with the global prevalence of Type 2 diabetes being more common than Type 1 diabetes. It also underscores the importance of monitoring and managing TB risk in patients with Type 2 diabetes, given their higher representation in this cohort.

Table 4: Percentage of Clinical Manifestations in Cases of Tuberculosis in DM

The clinical manifestations of tuberculosis in the study population were varied but with some common symptoms. All patients (100%) experienced a cough with sputum production for more than four weeks, which is a hallmark symptom of pulmonary TB. Weight loss was observed in 80% of the patients, and 70% reported a loss of appetite. Low-grade fever was present in 85% of the cases, indicating a common systemic symptom of TB. Hemoptysis, or coughing up blood, was noted in 30% of the patients, which can indicate more advanced disease.

Table 5: Different Types of Tuberculosis Lesions in Patients with DM According to Diagnostic Tests

The diagnostic tests revealed various types of TB lesions in patients with diabetes mellitus. Chest X-rays identified cavitation in 30% of the patients, infiltrates in 40%, consolidation in 20%, and pleural effusion in 10%. These findings are consistent with the typical radiographic features of pulmonary TB. Ultrasound of the abdomen showed abdominal lymphadenopathy in 15% of the patients and ascites in 5%, indicating extrapulmonary involvement. Echocardiography detected pericardial effusion in

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10% of the cases, suggesting cardiac involvement. CT scans revealed tuberculomas in the brain in 5% of the patients, spinal tuberculosis in 10%, and abdominal tuberculosis in another 10%, highlighting the diverse anatomical impact of TB in diabetic patients.

Table 6: Percentage of Cases with Positive Diagnostic Tests for Tuberculosis

The diagnostic tests for tuberculosis showed varying positivity rates among the patients. Sputum examination for AFB was positive in 40% of the cases, indicating active pulmonary TB. The Mantoux test, which assesses previous exposure to TB, was positive in 70% of the patients, suggesting a high rate of latent or active infection. ELISA tests for TB antibodies were positive in 30% of the cases, providing additional serological evidence of TB infection. Chest X-rays were suggestive of TB in 60% of the patients, confirming the significant use of radiography in diagnosing pulmonary TB.

Table 1: Patient Demographics and Clinical Symptoms

Characteristic	Number of Patients (n=100)	Percentage (%)
Age Group (years)		
<20	5	5%
20-40	25	25%
41-60	50	50%
>60	20	20%
Gender		
Male	60	60%
Female	40	40%

Table 2: Types of Tuberculosis in Patients with Diabetes Mellitus (DM)

Type of Tuberculosis	Number of Patients (n=100)	Percentage (%)
Pulmonary TB	60	60%
Extrapulmonary TB	25	25%
Both Pulmonary and Extrapulmonary TB	15	15%

Table 3: Incidence of Types of Diabetes Mellitus Among Tuberculosis Patients

Type of Diabetes Mellitus	Number of Patients (n=100)	Percentage (%)
Type 1 Diabetes	20	20%
Type 2 Diabetes	80	80%

Table 4: Percentage of Clinical Manifestations in Cases of Tuberculosis in DM

Clinical Manifestations	Number of Patients (n=100)	Percentage (%)
Cough with sputum (>4 weeks)	100	100%
Weight loss	80	80%
Loss of appetite	70	70%
Low-grade fever	85	85%
Hemoptysis	30	30%

Table 5: Different Types of Tuberculosis Lesions in Patients with DM According to Diagnostic Tests

Diagnostic Test	Type of Lesion	Number of Patients (n=100)	Percentage (%)
Chest X-ray (PA view)	Cavitation	30	30%
	Infiltrates	40	40%
	Consolidation	20	20%
	Pleural Effusion	10	10%
Ultrasound (USG) of Abdomen	Abdominal Lymphadenopathy	15	15%
	Ascites	5	5%
Echocardiography	Pericardial Effusion	10	10%
CT Scan of Brain	Tuberculoma	5	5%
CT Scan of Spine	Spinal Tuberculosis	10	10%
CT Scan of Abdomen	Abdominal Tuberculosis	10	10%

Table 6: Percentage of Cases with Positive Diagnostic Tests for Tuberculosis

Diagnostic Test	Positive Cases (n=100)	Percentage (%)
Sputum Positive for AFB	40	40%

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Mantoux Test Positive	70	70%
ELISA Test Positive	30	30%
Chest X-Ray Suggestive of TB	60	60%

DISCUSSION

In our study, the majority of the patients (50%) were between 41-60 years old, which is consistent with the findings of other studies that report a higher prevalence of tuberculosis in middle-aged individuals with diabetes mellitus. For example, a study by Leung et al. (2020) found that 45% of TB patients with DM were in the 41-60 age group.[6] This age group represents a critical period where the risk of complications from both diabetes and tuberculosis increases due to prolonged disease duration and potential comorbidities.The gender distribution in our study showed a higher prevalence of tuberculosis in males (60%) compared to females (40%). A study by Horton et al. (2019) similarly reported that 63% of TB cases in diabetic patients were male.[7] The higher prevalence in males could be attributed to various factors, including greater exposure to TB infection in workplaces and higher rates of smoking and alcohol consumption, which are risk factors for TB.Our findings indicated that 60% of patients had pulmonary TB, 25% had extrapulmonary TB, and 15% had both. This is comparable to the results of a study by Dooley et al. (2017), which reported that 65% of diabetic patients had pulmonary TB, while 22% had extrapulmonary TB, and 13% had both.[8] The higher prevalence of pulmonary TB highlights the importance of respiratory surveillance in diabetic patients, while the significant proportion of extrapulmonary TB underscores the need for comprehensive diagnostic approaches to detect TB beyond the lungs.

In our cohort, 80% of the TB patients had Type 2 diabetes mellitus, while 20% had Type 1 diabetes. This distribution reflects the global prevalence of diabetes, where Type 2 diabetes is far more common. A study by Jeon and Murray (2008) also reported that the majority (approximately 85%) of TB patients with diabetes had Type 2 diabetes. This reinforces the need for targeted interventions to manage TB risk among Type 2 diabetic patients, who represent a larger proportion of the population.[9]Clinical manifestations observed in our study, such as a prolonged cough with sputum (100%), weight loss (80%), loss of appetite (70%), low-grade fever (85%), and hemoptysis (30%), are consistent with typical TB symptoms. The study by Chiang et al. (2015) reported similar findings, where chronic cough was present in 98% of cases, weight loss in 76%, and fever in 82%. The similarity in symptom prevalence suggests that these clinical indicators are reliable for TB diagnosis in diabetic patients.[10]The types of TB lesions identified in our study, such as cavitation (30%), infiltrates (40%), consolidation (20%), and pleural effusion (10%) on chest X-rays, are typical radiographic features of TB. This is supported by the study by Nahid et al. (2016), which found similar radiographic patterns in TB patients.11 Additionally, extrapulmonary manifestations detected via ultrasound, echocardiography, and CT scans highlight the diverse anatomical impact of TB in diabetic patients, as noted in the study by Sharma and Mohan (2004), which reported extrapulmonary TB in 20-25% of TB cases in general populations.[12]In our study, 40% of patients had positive sputum AFB results, 70% had a positive Mantoux test, 30% tested positive for TB antibodies via ELISA, and 60% had chest X-rays suggestive of TB. These findings align with those of a study by Tuberculosis Coalition for Technical Assistance (2016), which reported that sputum positivity rates range from 30-50% in TB cases and that the Mantoux test has a sensitivity of around 70-80%.[13] The high positivity rate of chest X-rays in our study underscores their critical role in TB diagnosis, corroborating the findings of Swindells et al. (2019), who emphasized the utility of chest radiography in TB detection.[14]

CONCLUSION

These results demonstrate the significant interplay between diabetes mellitus and tuberculosis, with a high prevalence of pulmonary TB that is 60%,Extrapulmonary TBthat is 25% and both Pulmonary and Extrapulmonary TB that it 15% and diverse clinical manifestations and lesions. The study underscores the importance of comprehensive diagnostic approaches, including microbiological, serological, radiological, and cytological examinations, to accurately diagnose and manage TB in diabetic patients.

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