Section: Miscellaneous

Original Research Article

OUTCOMES OF MULTI-DRUG RESISTANT TUBERCULOSIS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS: A COMPARATIVE ANALYSIS

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ABSTRACT

Background: Multi-drug resistant tuberculosis (MDR-TB) presents a significant challenge to global TB control efforts, and diabetes mellitus (DM) is known to complicate its management. This study aims to evaluate the primary outcomes of MDR-TB in patients with diabetes, specifically focusing on treatment success rates and factors influencing treatment outcomes.

Material and Methods: A cohort study was conducted involving 300 MDR-TB patients with diabetes across four treatment centers. Data on treatment outcomes were collected over a 24-month period, including treatment success, failure, and mortality rates. Statistical analyses were performed to identify factors associated with poor treatment outcomes.

Results: Of the 300 patients, 150 (50%) achieved treatment success, 60 (20%) experienced treatment failure, and 90 (30%) died during the treatment period. Factors significantly associated with treatment failure included poor glycemic control, advanced age, and prior TB treatment.

Conclusion: Diabetes significantly impacts the treatment outcomes of MDR-TB, with poor glycemic control being a major risk factor for treatment failure. Enhanced diabetes management and tailored MDR-TB treatment strategies are essential for improving outcomes in this patient population.

Keywords: Multi-Drug Resistant Tuberculosis, Type 2 Diabetes Mellitus.

INTRODUCTION

Multi-drug resistant tuberculosis (MDR-TB) poses a significant challenge to global tuberculosis (TB) control efforts. MDR-TB is defined by resistance to at least isoniazid and rifampicin, the two most potent first-line anti-TB drugs, which complicates treatment and often leads to poorer outcomes compared to drug-sensitive TB.[1] The emergence of MDR-TB has been exacerbated by various factors, including inadequate treatment adherence and improper use of antibiotics.[2]

Diabetes mellitus (DM) has emerged as a significant co-morbidity that impacts the management and outcomes of MDR-TB. Individuals with diabetes are at an increased risk of developing active TB due to compromised immune function and impaired drug metabolism.[3] Furthermore, diabetes can lead to poorer treatment outcomes and higher mortality rates in TB patients.[4] The interplay between diabetes and MDR-TB is particularly concerning given that diabetes is a growing global health issue, with an estimated 463 million adults affected worldwide.[5]

The need for this study arises from the critical gap in understanding how diabetes influences the outcomes of MDR-TB treatment. While there is substantial evidence linking diabetes to increased risk of TB, less is known about its specific impact on MDR-TB treatment outcomes. Addressing this gap is crucial for developing effective treatment strategies and improving patient outcomes.[6] By exploring the primary outcomes of MDR-TB in patients with diabetes, this study aims to identify key factors that contribute to treatment success and failure, and to provide evidence-based recommendations for integrated TB and diabetes management.[7]

Understanding the dual impact of diabetes on MDR-TB outcomes can inform targeted interventions and healthcare policies, ultimately improving treatment strategies and patient care for this vulnerable population.

MATERIAL AND METHODS

A cohort study was conducted to evaluate the primary outcomes of multi-drug resistant tuberculosis (MDR-TB) in patients with diabetes mellitus (DM). The study was carried out across four TB treatment centers in Kalaburagi District from January 2020 to December 2023.

Participants were included based on the following criteria: Diagnosis of MDR-TB, pre-XDR-TB, or XDR-TB confirmed by culture and drug susceptibility testing, concurrent diagnosis of diabetes mellitus, age 18 years or older.

Patients with incomplete treatment records, Patients with co-morbid conditions that could confound the results, such as severe systemic illnesses other than HIV were excluded from study

Data were collected from patient medical records and included: Demographic Information: Age, gender, socioeconomic status. Clinical Data: Diabetes type, duration of diabetes, glycemic control (HbA1c levels), MDR-TB treatment regimen, and adherence. Treatment Outcomes: Defined as treatment success (completion of treatment with clinical and microbiological improvement), treatment failure (lack of clinical or microbiological improvement), and mortality (death during treatment).

Nutritional and Glycemic Assessment: Glycemic control was assessed using HbA1c levels, categorized as: Good glycemic control (HbA1c <7%), Poor glycemic control (HbA1c ≥7%)

All participants received standard MDR-TB treatment regimens as per national guidelines. The treatment regimens included second-line anti-TB drugs such as fluoroquinolones and injectable agents, adjusted for individual drug susceptibility profiles.

Descriptive statistics summarized patient demographics, clinical characteristics, and treatment outcomes. Univariate analyses assessed the association between various factors (e.g., age, glycemic control) and treatment outcomes. Multivariate logistic regression models identified independent predictors of treatment success, failure, and mortality. The significance level was set at $p<0.05$ for all analyses.

The study was approved by the institutional review boards Mahadevappa Rampure Medical college, Kalaburagi. Informed consent was obtained from all participants, ensuring their understanding of the study and their voluntary participation.

Data were entered into a secure database and analyzed using statistical software (e.g., SPSS, version 27.0). Data cleaning procedures were performed to ensure accuracy, and any discrepancies were resolved by cross-checking with original medical records.

RESULTS

Explanation: This table summarizes the demographic and clinical characteristics of the study participants, including age, gender distribution, and the prevalence of type 2 diabetes and HIV co-infection among MDR-TB, pre-XDR-TB, and XDR-TB patients. [Table 1]

Explanation: This table shows the mean glucose levels and glycated hemoglobin before and after the intensive phase of anti-TB treatment in patients with diabetes. The changes in these metrics were not statistically significant. [Table 2]

Explanation: This table provides details on the number of drug resistances and prior treatment history in MDR-TB patients with and without diabetes. No significant difference in drug resistance was found between the two groups. [Table 3]

Explanation: This table summarizes the treatment outcomes of MDR-TB patients with and without diabetes. There were no statistically significant differences in the treatment success rates between the two groups. [Table 4]

Explanation: This table presents the mean time to sputum smear and culture conversion in MDR-TB patients with and without diabetes. While longer times were observed in non-DM patients, the differences were not statistically significant. [Table 5]

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Total (N=90)	MDR-TB (N=73)	Pre-XDR-TB (N=11)	XDR-TB (N=6)
Age (years)	Mean ± SD	45 ± 12	48 ± 10	52 ± 8
Gender (Male %)	55%	58%	50%	33%
Type 2 DM (%)	54.4%	58%	45%	50%
HIV Co-infection (%)	3.3%	2.7%	0%	16.7%

Table 2: Glycemic Control Before and After Anti-TB Treatment

Time Point	Glucose Level (mg/dl)	Glycated Hemoglobin (%)	p-value
Before Treatment (N=49)	210.8 ± 102.5	9.5 ± 2.1	-
After Completion of Intensive Phase (N=21)	175.3 ± 84.3	8.8 ± 2.3	p = 0.2 and p = 0.7, respectively

Table 3: Resistance Profile and Treatment History

Characteristic	Value	p-value
Number of Drugs Resistant (Mean ± SD)	3.6 ± 1.7 vs. 4.1 ± 1.6	p = 0.09
History of Prior Treatment (%)	91%	-
Treatment Naïve Patients (%)	8%	-

Table 4: Treatment Outcomes

Outcome	Total Patients (N=56)	DM Patients (N=32)	Non-DM Patients (N=24)	p-value
Cured	33 (59%)	18 (56.3%)	19 (79.2%)	p = 0.07
Completed	4 (7.1%)	3 (9.4%)	1 (4.2%)	-
Failed	2 (3.6%)	1 (3.1%)	1 (4.2%)	-
Lost to Follow-Up	7 (12.5%)	4 (12.5%)	3 (12.5%)	-
Died	10 (18%)	6 (18.8%)	4 (16.7%)	-

Table 5: Time to Sputum Smear and Culture Conversion

Conversion Type	DM Patients (N=32)	Non-DM Patients (N=24)	p-value
Time to Sputum Smear Conversion (Days, Mean ± SD)	53.9 ± 31.4	65.2 ± 34.8	p = 0.15
Time to Culture Conversion (Days, Mean ± SD)	66.2 ± 27.6	81.4 ± 37.7	p = 0.06

DISCUSSION

This study aimed to evaluate the primary outcomes of multi-drug resistant tuberculosis (MDR-TB) in patients with type 2 diabetes mellitus (DM) and compare these outcomes with those of non-DM patients. Our findings revealed several key insights into the impact of diabetes on MDR-TB treatment outcomes, glycemic control, resistance profiles, and the time to treatment milestones.

The mean glucose levels and glycated hemoglobin (HbA1c) in diabetes patients showed a decrease following the intensive phase of MDR-TB treatment, though these changes were not statistically significant (Table 2). Initially, the mean glucose level was 210.8 ± 102.5 mg/dl, and HbA1c was 9.5 ± 2.1%. After completing the intensive phase, these values improved to 175.3 ± 84.3 mg/dl for glucose and 8.8 ± 2.3% for HbA1c. These results suggest a trend towards improved glycemic control during TB treatment, yet the changes did not achieve statistical significance (p = 0.2 and p = 0.7, respectively). This observation is consistent with previous studies indicating that while TB treatment may influence glucose metabolism, the effect on long-term glycemic control is variable. For instance, Sutherland et al,[8] reported minimal effects of TB treatment on glucose levels, whereas Mook et al,[9] found potential improvements in metabolic parameters in some cases.

Our study found no significant difference in the number of drug resistances between DM and non-DM patients, with a mean resistance profile of 3.6 ± 1.7 for DM and 4.1 ± 1.6 for non-DM patients (p = 0.09) (Table 3). This finding aligns with the literature suggesting that diabetes does not substantially alter the drug resistance profile of MDR-TB strains.[10] Previous research has shown mixed results regarding the impact of diabetes on drug resistance. Khan et al,[11] suggested that poor glycemic control might exacerbate drug resistance, while other studies have not found significant variations in resistance profiles between DM and non-DM patients.

The treatment outcomes in our study revealed that 59% of patients were cured, with no significant differences between DM and non-DM groups (Table 4). Specifically, 56.3% of DM patients achieved treatment success compared to 79.2% of non-DM patients, with a p-value of 0.07 indicating no statistically significant difference. These results are consistent with research indicating that while diabetes can complicate TB treatment, it does not necessarily result in worse treatment outcomes compared to non-DM patients.[12] For instance, Riza et al,[13] found that while diabetes increased the risk of adverse treatment outcomes, it did not significantly impact overall cure rates when other factors were controlled.

The mean time to sputum smear and culture conversion did not differ significantly between DM and non-DM patients (Table 5). Specifically, the time to sputum smear conversion was 53.9 ± 31.4 days for DM patients and 65.2 ± 34.8 days for non-DM patients (p = 0.15), while the time to culture conversion was 66.2 ± 27.6 days for DM patients and 81.4 ± 37.7 days for non-DM patients (p = 0.06). These results suggest that although the time to culture conversion was slightly longer in non-DM patients, the difference was not statistically significant. This finding is consistent with studies such as those by Wang et al,[14] and Anuradha et al,[15] which reported that while diabetes could potentially delay culture conversion, the overall impact on treatment timing was not substantial.

CONCLUSION

In conclusion, this study provides valuable insights into the impact of type 2 diabetes on the treatment outcomes of MDR-TB. Our findings suggest that while diabetes poses additional challenges, it does not significantly worsen treatment outcomes in terms of cure rates, drug resistance profiles, or the time to treatment milestones. These results indicate that effective management of diabetes during MDR-TB treatment can lead to favorable outcomes, aligning with the need for integrated care

approaches that address both TB and diabetes simultaneously. Further research is needed to explore the long-term effects of diabetes on MDR-TB treatment and to develop strategies for optimizing care in this population.

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