Advances in Research

Volume 25, Issue 5, Page 67-79, 2024; Article no.AIR.121968
ISSN: 2348-0394, NLM ID: 101666096

Clinical Characteristics and Outcome Predictors in Drug-Resistant Tuberculosis: A Comprehensive Analysis

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/air/2024/v25i51138

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/121968

Original Research Article

Received: 30/06/2024
Accepted: 29/08/2024
Published: 02/09/2024

ABSTRACT

Background: Drug-resistant tuberculosis (DR-TB) poses significant challenges to public health, with poor outcomes frequently observed in affected patients. This study aims to evaluate the characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis at Liwa Hospital from January 2018 to May 2023.
Methods: A retrospective, cross-sectional single-center analysis was conducted on 408 patients admitted to Liwa Hospital. Among these, 28 patients diagnosed with drug-resistant tuberculosis (DR-TB) were selected for detailed analysis based on their treatment outcomes and clinical data. Inclusion criteria encompassed patients aged 18 years or older with confirmed drug-resistant TB, while patients younger than 18, those with latent tuberculosis, and those with extra-pulmonary tuberculosis were excluded.

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Cite as: *Pasha, Imtiaz, and Ashraf ALakkad. 2024. "Clinical Characteristics and Outcome Predictors in Drug-Resistant Tuberculosis: A Comprehensive Analysis". Advances in Research 25 (5):67-79. https://doi.org/10.9734/air/2024/v25i51138.*

Results: The majority of patients were between 18-40 years old (60.7%), predominantly male (85.7%), and Asian (96.4%). Comorbidities included diabetes (46.4%) and hypertension (21.4%). Clinical characteristics revealed cough (28.6%) and fever with cough (7.1%) as common symptoms. Primary resistance was observed in 92.9% of cases, with 96.4% being newly diagnosed TB cases. Adverse drug events were minimal, with 7.1% experiencing nausea and vomiting. Radiological findings showed unilateral TB in 53.6% and cavitary TB in 57.1% of cases. Laboratory analysis indicated elevated HbA1c (9.83 ± 3.25), CRP (25.94 ± 5.16 mg/L), and white blood cell count (9.94 ± 4.59 x 10^9 cells/L). Rifampicin resistance was the most prevalent (42.9%), followed by isoniazid resistance (25.0%). Regarding treatment outcomes, age, hypertension, and diabetes mellitus were found to be significantly associated with poor outcomes in patients (p=0.05).
Conclusion: The study identified significant associations between treatment outcomes and age, hypertension, and diabetes status, with higher proportions of poor outcomes observed in patients. Comprehensive management strategies targeting these factors are essential to improve outcomes in patients with drug-resistant TB. Further research is warranted to develop tailored interventions for this population.

Keywords: Multi drug resistant tuberculosis; salamtak database; epidemiology factors; treatment outcomes.

1. INTRODUCTION

Tuberculosis is a significant global health issue, ranking among the top 10 causes of illness and death worldwide. It is responsible for more deaths than any other single infectious agent [1]. According to the 2020 WHO Global Tuberculosis Report, there were a staggering 10 million cases of TB worldwide in 2019, with 1.4 million of those cases tragically resulting in death [2]. The majority of cases were reported in Europe, the Americas, the Mediterranean, the Western Pacific, Africa and South-East Asia [3].

According to global TB reports (2016), GHC member states have diverse burden trends ranging from 6.8 to 200 per million population. According to TB notifications rate, only Bahrain (100 per million population), Oman (79 per million population), and Saudi Arabia (89 per million population) were among the low-incidence countries. None of these countries showed major changes in their notification rate for the last three years. The Notification rate for Kuwait, Qatar, and the UAE were 200, 190 and 6.8 per million population, respectively [4].

Although the GHC members have a better financed health system, including TB diagnosis, control, and treatment as its main components, challenges remain. Most importantly, GHC member countries have the highest comparative diabetes prevalence in the world with five members ranked among the top 10 by the International Diabetic Federation. Since diabetes has been found to increase a person's TB acquisition risk, it is pertinent to develop a collaborative platform for controlling TB in diabetics [5].

Liwa hospital has been designated as one of the centers for inpatient care of Tuberculosis patients in the emirate of Abu Dhabi. Patients are referred from Abu Dhabi city, Al Dhafra region and Al Ain region for isolation and treatment of Pulmonary Tuberculosis.

Majority of patients continue their anti-Tubercular treatment in other health care centers after discharge as they being referred from them and few of them are loss to follow-up due to repatriation to their home country due to social or financial reasons are the few challenges faced by Liwa hospital.

Despite the declining global incidence of TB, the rise of multidrug-resistant TB in recent decades is a serious public health crisis and a threat to health security [3]. According to estimates from the WHO, more than half a million new cases of MDR-TB and RIF-resistant are reported every year [6]. In 2015, there were 10.4 million new cases of tuberculosis disease. Among these cases, 480,000 were confirmed to be multidrug-resistant TB, and 100,000 individuals received treatment with second-line TB drugs because they were rifampicin-resistant [6]. In addition, HIV/AIDS is a widely recognized factor that increases the risk of TB disease, drug resistance, and death related to TB [7]. Out of the 1.8 million TB deaths in 2015, a significant 22% were HIV confected [8]. Additionally, an alarming 35 percent of HIV expiries were attributed to TB, according to the World Health Organization [9].

MDR-TB has been linked to several risk factors. Bilateral lung disease, higher bacilli burden on sputum microscopy, history of having a previous TB treatment, HIV infection, contact with a known TB patient, and receipt of multiple treatment courses have been identified as factors in various studies [10,11].

Regarding treatment, MDR-TB can be effectively treated with the use of second-line anti-TB drugs for a period of 9 to 20 months [3].

On the other hand, the treatment outcomes of MDR-TB cases are worse when compared to drug-susceptible TB cases [12]. In 2019, the success rate for treating patients with MDR-TB was only 57% worldwide [2]. Managing MDR-TB can be quite challenging for countries and national health systems [1]. As an illustration, culture-based methods may require a significant amount of time to yield results [13]. Additionally, these tools can be quite costly and demand advanced laboratory facilities, skilled personnel, and rigorous quality and infection control measures [12].

Numerous case-control studies or cohorts have documented the clinical characteristics and outcomes of patients with drug-resistant tuberculosis [8,12].

The study aims to evaluate various characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis.

2. METHODOLOGY

2.1 Study Design Population and Sample

A retrospective, cross-sectional single-center analysis was conducted at Liwa Hospital to evaluate various characteristics and factors associated with poor outcomes in patients with drug-resistant pulmonary tuberculosis. The study period spanned from January 2018 to May 2023.

The study included a total of 408 patients who were admitted to Liwa Hospital during the specified timeframe. Among these, 28 patients were diagnosed with drug-resistant tuberculosis (DR-TB) and selected for detailed analysis based on their treatment outcomes and clinical data (Fig. 1).

2.2 Inclusion and Exclusion Criteria

Inclusion criteria included patients aged 18 years or older with confirmed drug-resistant TB based on sputum AFB culture and DST, GeneXpert MTB/RIF, and admitted to Liwa Hospital from January 2018 to May 2023.

We excluded patients younger than 18 years old, those with latent tuberculosis, and those with extra-pulmonary tuberculosis.

2.3 Data Collection Procedure

Data was extracted from Salamtak databases. A standardized data collection form was used to gather relevant information from eligible patients. Data items included demographic details (age, sex, race, marital status), clinical characteristics (BMI, smoking, alcohol consumption, comorbidities such as diabetes mellitus and hypertension, history of TB), symptoms (fever, cough, loss of appetite, weight loss, hemoptysis), clinical signs (hypotension, respiratory rate > 24/min, temperature > 38°C, SpO2 < 94%), laboratory findings (CRP, hemoglobin, white blood cell count, creatinine, platelet count, AST, ALT), radiological findings (unilateral/bilateral disease, presence of cavitation on chest X-ray), microbiological data (sputum AFB microscopy results), drug resistance details (type, pattern), TB treatment history (new case/relapse/re-treatment), treatment regimen (directly observed treatment, number of drugs administered), adverse drug events (nausea, vomiting, abdominal pain, joint pain, weakness, jaundice/elevated liver enzymes), and treatment outcomes (death, cure, treatment completed, treatment failure, loss to follow-up/default).

2.4 Primary and Secondary Objectives

2.4.1 Primary objectives

To identify the epidemiological characteristics (age, sex, smoking, co-morbidities) associated with drug-resistant TB.

To evaluate the clinical characteristics associated with drug-resistant TB.

To assess the radiological and laboratory parameters associated with drug-resistant TB.

2.4.2 Secondary objectives

To identify epidemiological, clinical, radiological, and laboratory characteristics associated with treatment outcomes in drug-resistant TB.

2.5 Treatment Protocol

Treatment for isoniazid-resistant TB involved rifampicin, pyrazinamide, ethambutol, and levofloxacin over a 6-month duration. Ethambutol-resistant TB was managed with rifampicin and isoniazid for 6 months, with pyrazinamide included for the initial 2 months. Pyrazinamide-resistant TB required rifampicin and isoniazid for 9 months, with ethambutol continued until rifampicin and isoniazid susceptibility were confirmed.

For multidrug-resistant TB (MDR-TB), the treatment protocol begins with an intensive phase using a combination of moxifloxacin or levofloxacin, linezolid, clofazimine/Cycloserine, ethambutol, and pyrazinamide. This phase continued for 5-7 months beyond culture conversion, aiming to eradicate the resistant TB strains. The continuation phase then involved moxifloxacin or levofloxacin, linezolid, ethambutol, and pyrazinamide, maintained for a total duration of approximately 18-20 months after culture conversion.

Similarly, for rifampicin-resistant TB, the intensive phase included levofloxacin or moxifloxacin, linezolid, isoniazid, ethambutol, and pyrazinamide administered for 5-7 months following culture conversion. The subsequent continuation phase comprised levofloxacin or moxifloxacin, isoniazid, ethambutol, and pyrazinamide, with a total treatment duration extending to approximately 18-20 months post-culture conversion.

2.6 Statistical Analysis

Data was analyzed using SPSS V27. Descriptive statistics including frequency tables were used to summarize categorical variables such as demographic characteristics (age, sex, marital status), clinical features (symptoms, comorbidities), and treatment outcomes (cure, treatment completed, treatment failure, loss to follow-up). Continuous variables like age, laboratory parameters (e.g., CRP, hemoglobin), and BMI were presented as mean ± SD.

To assess associations between categorical variables (e.g., treatment outcomes and demographic, clinical, and other factors), the Chi-square test was used.

3. RESULTS

3.1 Distribution of TB Patients

Out of a total of 408 tuberculosis (TB) patients, 380 (93.1%) had non-resistant TB and 28 (6.9%) have DR-TB.

3.2 Epidemiological Characteristics of MDR TB Patients

The majority of patients were aged between 18-40 years (60.7%), followed by those aged 41-60 years (35.7%), and only one patient was over 60 years old (3.6%). The gender distribution showed a predominance of males (85.7%) compared to females (14.3%). Most patients were Asian (96.4%) with only one patient being African (3.6%).

The average Body Mass Index (BMI) among the patients was 20.95 ± 3.76. In terms of marital status, a slight majority were married (53.6%) compared to unmarried (46.4%).

Regarding comorbidities, a notable proportion of patients had diabetes (46.4%), while a smaller percentage had hypertension (21.4%). All patients were HIV-negative. A significant portion of the population data reported being smokers (35.7%), while alcohol consumption was less common (14.3%). A history of previous TB was reported by 10.7% of the patients, with the majority (89.3%) having no history of TB.

3.3 Clinical Characteristics of Patients

The study revealed that among the patients diagnosed with drug-resistant tuberculosis (TB), cough was the most common symptom, reported by 28.6% of individuals. Fever with cough was observed in 7.1% of cases, while 7.1% presented with cough accompanied by loss of appetite and weight loss. The rest of the symptom's percentages can be seen in Table 2.

Regarding drug resistance type, primary resistance was predominant, affecting 92.9% of patients, while acquired resistance was noted in 7.1% of cases. The majority of patients (96.4%) had newly diagnosed TB, with only one case (3.6%) classified as TB relapse.

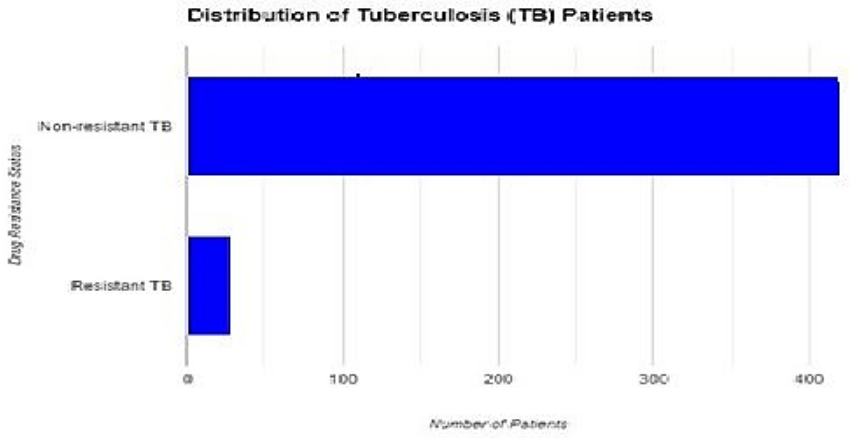

Fig. 1. Distribution of TB patients

Table 1. Epidemiological characteristics

Characteristics	Domain	N=28
Age		
	18-40	17(60.7%)
	41-60	10(35.7%)
	>60	1(3.6%)
Body Mass Index		20.95± 3.76
Gender		
	Male	24(85.7%)
	Female	4(14.3%)
Race		
	Asian	27(96.4%)
	African	1(3.6%)
Marital Status		
	Married	15(53.6%)
	Unmarried	13(46.4)
Comorbidities	Hypertension	6(21.4%)
	Diabetes	13(46.4%)
	HIV(Negative)	28(100%)
Smoking Status	Smokers	10(35.7%)
Alcohol Status	Alcohol Consumers	4(14.3%)
History of TB	Yes	3(10.7%)
	No	25(89.3%)

Directly observed treatment (DOT) was implemented for 75% of patients, while 7.1% did not undergo DOT, and it was unavailable for 17.9% of patients. More than four drugs were prescribed to 82.1% of patients, indicating complex treatment regimens.

Adverse drug events were reported in a minority of cases, with nausea and vomiting affecting 7.1% of patients, and elevated liver enzymes, neuritis, and hepatitis each observed in 3.6% of patients. The majority (82.1%) did not experience any adverse drug events.

All patients (100%) had positive sputum smear results, indicating active TB infection at the time of diagnosis.

3.4 Radiological Characteristics of Patients

Disease distribution revealed that 53.6% of individuals had unilateral TB involvement, while 46.4% exhibited bilateral disease. Cavitary TB was present in 57.1% of cases, indicating the presence of cavities in the lungs, while 42.9% did not show signs of cavitary TB.

Table 2. Clinical characteristics of patients

Clinical Characteristics	Domain	N=28
Symptoms	Cough	8(28.6%)
	LOW	2(7.1%)
	Fever +Cough	2(7.1%)
	Cough+ Loss of Appetite+ Loss of weight	2(7.1%)
	Fever + Cough +Loss of Appetite +Loss of Weight	8(28.6%)
	Hemoptysis	1(3.6%)
	Loss of Appetite +Loss of weight	2(7.1%)
	All symptoms	1(3.6%)
	None	2(7.1%)
Drug resistance Type	Primary	26(92.9%)
	Acquired	
Type of TB	New	27(96.4%)
	Relapse	1(3.6%)
Directly Observed Treatment	Yes	21(75%)
	No	2(7.1%)
	Not available	5(17.9)
Number of Drugs Prescribed	<4	5(17.9%)
	>4	23(82.1%)
Adverse Drug Events	Nausea and Vomiting	2(7.1%)
	Elevated Liver Enzymes	1(3.6)
	Neuritis	1(3.6%)
	Hepatitis	1(3.6%)
	None	23(82.1%)
Sputum Smear	Positive	28(100%)
	Negative	0(0%)

Table 3. Radiological characteristics

Radiological Characteristics	Domain	N=28
Disease Side	Unilateral	15(53.6%)
	Bilateral	13(46.4%)
Cavitary TB	Yes	16(57.1%)
	No	12(42.9%)

Table 4. Laboratory characteristics

Laboratory Characteristics	N	Mean ±SD
HB1AC	14	9.8307±3.25323
CRP	19	25.94212±5.16363
Hemoglobin	24	129.4583±19.65126
WBC	24	9.9442±4.58622
Creatinine	25	69.1760±19.88373
Platelets	23	358.5652±99.74551
AST	25	24.7400±21.34520
ALT	25	29.2922±34.08677

3.5 Laboratory Characteristics of Patients

HbA1c was measured in 14 patients, with a mean of 9.83 ± 3.25. C-reactive protein (CRP) levels were available for 19 patients, averaging 25.94 ± 5.16 mg/L. Hemoglobin levels were assessed in 24 patients, showing a mean of 129.46 ± 19.65 g/L. White blood cell count (WBC) results from 24 patients averaged 9.94 ± 4.59 x 10^9 cells/L. Creatinine levels were measured in 25 patients, with a mean of 69.18 ± 19.88 µmol/L. Platelet counts from 23 patients averaged 358.57 ± 99.75 x 10^9 cells/L. Aspartate aminotransferase (AST) levels were

recorded in 25 patients, with a mean of 24.74 ± 21.35 U/L. Alanine aminotransferase (ALT) levels were also assessed in 25 patients, averaging 29.29 ± 34.09 U/L.

3.6 Drug Resistance Patterns

The graph shows the distribution of drug resistance patterns observed in the studied cases. Among the cases of tuberculosis analyzed, rifampicin resistance was the most prevalent, observed in 42.9% of cases. Isoniazid resistance followed closely, affecting 25.0% of cases. Resistance to both isoniazid and rifampicin was found in 10.7% of cases, while resistance to isoniazid, rifampicin, and pyrazinamide was seen in 14.3% of cases. More complex resistance patterns, such as resistance to isoniazid, pyrazinamide, ethambutol, and streptomycin combined, were present in 3.6% of cases. Additionally, a similar percentage showed resistance to isoniazid, rifampicin, and ethambutol.

3.7 Treatment Outcomes

Regarding treatment outcomes for tuberculosis patients, 3.6% of the patients died. 32.1% of the patients were cured, followed by 10.7% who are still undergoing treatment. A small number of patients (3.6%) were still in the hospital, and (50%) were lost to follow-up.

3.8 Treatment Outcomes by Epidemiological Characteristics

The analysis of treatment outcomes in tuberculosis (TB) patients revealed significant associations with age category, diabetes and hypertension status. Specifically, patients aged 18-40 years exhibited a notable relationship with treatment outcomes ($\chi^2 = 34.40$, $p < 0.01$), showing higher proportions in ongoing treatment. Additionally, hypertension status ($\chi^2 = 9.28$, $p = 0.05$), and diabetes status ($\chi^2 = 7.57$, $p = 0.05$) demonstrated significant associations with treatment outcomes showing higher proportions in the death, cured, and still in hospital categories compared to those without hypertension and Diabetes. A considerable proportion of patients were lost to follow-up during the study period.

3.9 Treatment Outcomes by Epidemiological Characteristics

Regarding clinical characteristics none of the clinical characteristics was found to be significantly associated with treatment outcomes.

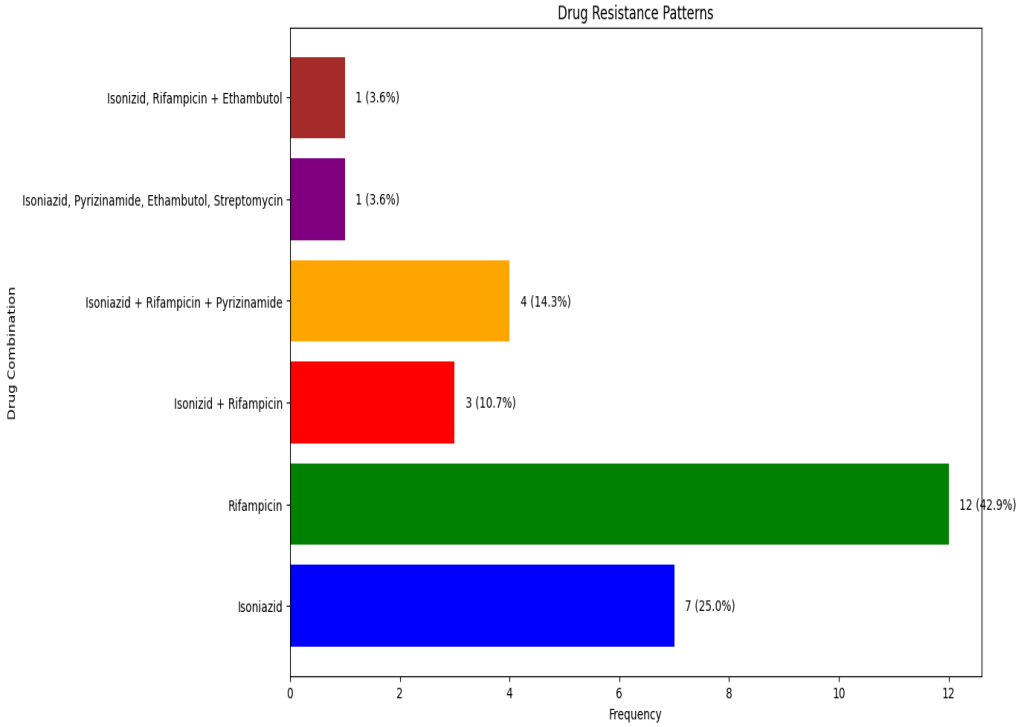

Fig. 2. Drug resistance patterns

Table 5. Distribution of Treatment Outcomes by Epidemiological Characteristics in Tuberculosis Patients

Characteristics	Treatment Outcomes					X^2	P value
Age Category	**Death**	**Cured**	**Ongoing treatment**	**Loss of Follow up**	**Still in hospital**		
18-40	0 (0.0%)	0 (0.0%)	6 (21.4%)	10 (35.7%)	1 (3.6%)		
41-60	0 (0.0%)	3 (10.7%)	3 (10.7%)	4 (14.3%)	0 (0.0%)	34.40	<0.01
>60	1 (3.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Gender Distribution							
Male	1 (4.2%)	2 (8.3%)	8 (33.3%)	12 (50.0%)	1 (4.2%)		
Female	0 (0.0%)	1 (25.0%)	1 (25.0%)	2 (50.0%)	0 (0.0%)	1.29	0.862
Race Distribution							
Asian	1 (3.7%)	3 (11.1%)	9 (33.3%)	13 (48.1%)	1 (3.7%)		
African	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	1.03	0.90
Marital Status							
Married	1 (6.7%)	3 (20.0%)	5 (33.3%)	6 (40.0%)	0 (0.0%)	5.28	0.260S
Unmarried	0 (0.0%)	0 (0.0%)	4 (30.8%)	8 (61.5%)	1 (7.7%)		
Smoking Status							
Yes	0 (0.0%)	1 (10.0%)	3 (30.0%)	6 (60.0%)	0 (0.0%)	1.45	0.835
No	1 (5.6%)	2 (11.1%)	6 (33.3%)	8 (44.4%)	1 (5.6%)		
Alcohol Status							
Yes	0 (0.0%)	0 (0.0%)	2 (50.0%)	2 (50.0%)	0 (0.0%)	1.29	0.862
No	1 (4.2%)	3 (12.5%)	7 (29.2%)	12 (50.0%)	1 (4.2%)		
Diabetes							
Yes	1 (7.7%)	3 (23.1%)	5 (38.5%)	4 (30.8%)	0 (0.0%)		
No	0 (0.0%)	0 (0.0%)	4 (26.7%)	10 (66.7%)	1 (6.7%)	7.57	0.05
Hypertension							
Yes	1 (16.7%)	2 (33.3%)	2 (33.3%)	1 (16.7%)	0 (0.0%)		
No	0 (0.0%)	1 (4.5%)	7 (31.8%)	13 (59.1%)	1 (4.5%)	9.28	0.05
History Of TB							
Yes	0 (0.0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	0 (0.0%)		
No	1 (4.0%)	2 (8.0%)	8 (32.0%)	13 (52.0%)	1 (4.0%)	2.03	0.730

Table 6. Distribution of Treatment Outcomes by Clinical Characteristics in Tuberculosis Patients

Clinical Characteristics	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital	X^2	P value
Symptoms							
Cough	0 (0.0%)	0 (0.0%)	3 (37.5%)	5 (62.5%)	0 (0.0%)		
LOA	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)		
Fever + Cough	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)		
Cough + LOA + LOW	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)		
Fever + Cough + LOA + LOW	0 (0.0%)	2 (25.0%)	3 (37.5%)	3 (37.5%)	0 (0.0%)		
Hemoptysis	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
LOA + LOW	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)	43.72	0.081
ALL	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)		
NONE	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)		
Drug resistance Patterns	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital		
Isoniazid	1 (14.3%)	0 (0.0%)	2 (28.6%)	3 (42.9%)	1 (14.3%)		
Rifampicin	0 (0.0%)	3 (25.0%)	5 (41.7%)	4 (33.3%)	0 (0.0%)		
Isoniazid + Rifampicin	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (100.0%)	0 (0.0%)		
Isoniazid + Rifampicin + Pyrizinamide	0 (0.0%)	0 (0.0%)	1 (25.0%)	3 (75.0%)	0 (0.0%)		
Isoniazid, Pyrizinamide, Ethambutol, Streptomycin	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)		
Isoniazid, Rifampicin + Ethambutol	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	16.886	0.660
Type of TB							
New case	1 (3.7%)	3 (11.1%)	9 (33.3%)	13 (48.1%)	1 (3.7%)	1.037	0.904
Relapse	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)		
Directly Observed Treatment							
Yes	0 (0.0%)	3 (14.3%)	7 (33.3%)	10 (47.6%)	1 (4.8%)		
No	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)	7.80	0.453
Number of drugs							
<4	<4	1 (3.6%)	0 (0.0%)	1 (3.6%)	3 (10.7%)		
>4	>4	0 (0.0%)	3 (10.7%)	8 (28.6%)	11 (39.3%)	5.87	0.209
Adverse Drug Events							
Nausea and Vomiting	0 (0.0%)	1 (33.3%)	0 (0.0%)	1 (7.1%)	0 (0.0%)		
Elevated liver enzymes	0 (0.0%)	1 (33.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Neuritis	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	0 (0.0%)		
Hepatitis	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (7.1%)	0 (0.0%)	15.31	0.51
None	1 (100.0%)	1 (33.3%)	9 (100.0%)	11 (78.6%)	1 (100.0%)		

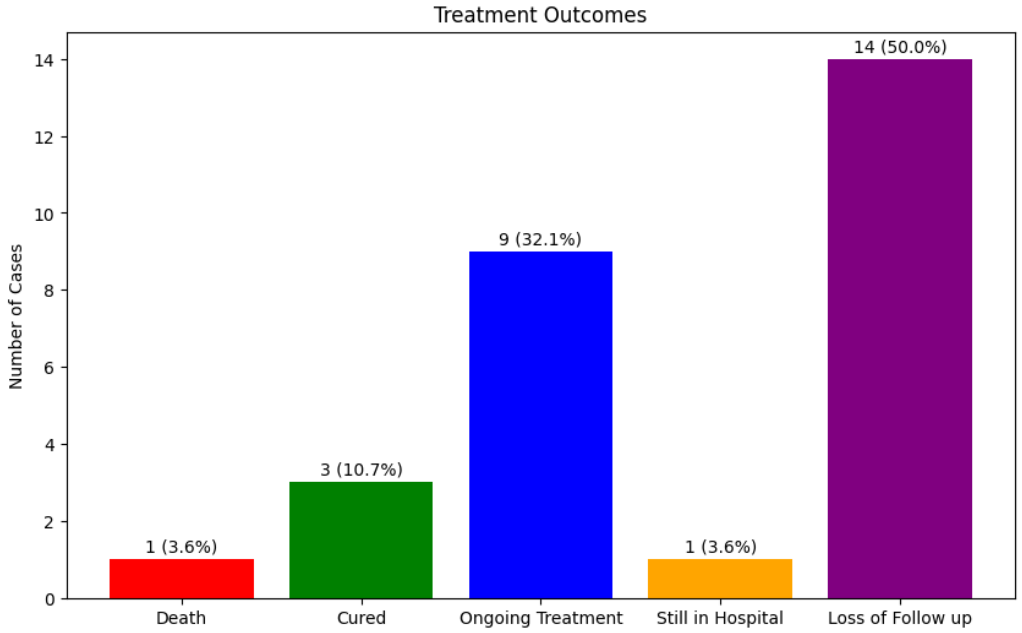

Fig. 3. Treatment outcomes

Table 7. Distribution of Treatment Outcomes by Radiological Characteristics in Tuberculosis Patients

Radiological Characteristics	Death	Cured	Ongoing treatment	Loss of Follow up	Still in hospital	X^2	P value
Disease Side							
Unilateral	1 (6.7%)	3 (20.0%)	4 (26.7%)	7 (46.7%)	0 (0.0%)		
Bilateral	0 (0.0%)	0 (0.0%)	5 (38.5%)	7 (53.8%)	1 (7.7%)	4.99	0.288
Cavitary TB							
Yes	1 (6.3%)	1 (6.3%)	6 (37.5%)	7 (43.8%)	1 (6.3%)		
No	0 (0.0%)	2 (16.7%)	3 (25.0%)	7 (58.3%)	0 (0.0%)	2.81	0.588

3.10 Treatment Outcomes by Radiological Characteristics

None of the radiological characteristics was found to be associated with treatment outcomes. Additionally, For laboratory characteristics, we employed a linear regression test. None of the laboratory parameters predicted poor or better treatment outcomes for TB patients having resistant type as p values of >0.05 were obtained.

4. DISCUSSION

This retrospective, cross-sectional study conducted at Liwa Hospital aimed to evaluate various characteristics and factors associated with poor outcomes in patients diagnosed with drug-resistant pulmonary tuberculosis. The study period spanned from January 2018 to May 2023, encompassing a total of 400 TB patients, among whom 28 were diagnosed with multidrug-resistant TB and selected for detailed analysis based on their treatment outcomes and clinical data.

In our study, the majority of patients were aged between 18-40 years (60.7%), a study also revealed that individuals in the age range of 21-30 years and 31-40 years were more frequently impacted, with an average age of 28.43 ± 14.32 years, compared to other age groups [14].

Similarly, in research directed by Mukherjee et al [15] a group of individuals between the ages of 21-30, with an average age of 32.52 years, were found to be frequently affected by MDR-TB. Studies conducted by Gaude et al. and Kapadia et al. also found that individuals in similar age groups were commonly affected [15,16]. Increased participation from the middle age group may be attributed to their active lifestyles

and interactions with individuals who have various health conditions.

In the present study, there were a total of 28 patients. Out of these, 24 (85.7%) were males and 4 (14.3%) were females and had MDR TB. Studies conducted by Gaude and Kapadia have consistently shown a significant male presence in the research [15,16]. Male dominance can be explained by their greater participation in outdoor activities compared to females.

Regarding resistance patterns, in a study out of a total of 277 cases, multidrug-resistant/rifampicin-resistant tuberculosis (MDR/RR-TB) accounted for 265 cases (95.67%), cases of isoniazid monoresistance were 8 (2.89%), and extensively drug-resistant tuberculosis (XDR-TB) cases were 4 (1.44%). In the present study, among the cases of drug resistance tuberculosis analyzed, rifampicin resistance was the most prevalent, observed in 42.9% of cases. Isoniazid resistance followed closely, affecting 25.0% of cases. Resistance to both isoniazid and rifampicin was found in 10.7% of cases, while resistance to isoniazid, rifampicin, and pyrazinamide was seen in 14.3% of cases. More complex resistance patterns, such as resistance to isoniazid, pyrazinamide, ethambutol, and streptomycin combined, were present in 3.6% of cases.

Regarding treatment outcomes, in our study, 3.6% of the patients died. 32.1% of the patients were cured, followed by 10.7% who are still undergoing treatment. A small number of patients (3.6%) were still in the hospital, and (50%) were lost to follow-up.

Likewise, in a study, a significant majority of 177 (63.9%) cases were able to achieve successful treatment outcomes. Out of these, 153 individuals (55.2%) successfully recovered, while 24 individuals (8.7%) finished their treatment. Out of the remaining 100 patients who did not have successful outcomes, 60 unfortunately passed away, 32 were lost to follow-up, and 8 were deemed to have treatment failure [17].

In the present study, the researchers discovered that having other medical conditions was linked to a higher chance of experiencing a negative treatment outcome in patients with drug-resistant tuberculosis. This study result aligns with a meta-analysis [18] and a study conducted in Brazil and Yemen [19,20]. In our study, both hypertensive and diabetic patients were associated with negative outcomes as they were still receiving the treatment and were not fully recovered. Additionally, in the present study, both age (18-40) and (41-60) groups were still receiving treatment and were not cured. This finding is aligned with another study, in which the middle age group faced poorer treatment outcomes [18].

The study revealed 50% of patients were lost to follow-up and highlighted the importance of better awareness, motivational counselling of patients and family members, and community involvement in TB diagnosis and treatment. The enhanced efforts of treatment supporters, health Staff, and family & community persons are required to motivate and support the patients. Further research to devise appropriate strategies to improve treatment compliance should be undertaken as part of TB control in high endemic areas/communities [21].

Our study has also several limitations. First, the retrospective nature of the study limited the data on detailed medical information on the participants. Second, being a single-center study, the findings may not be generalizable to other settings with different patient populations or healthcare systems. Third, the relatively small sample size of 28 MDR-TB cases limits the statistical power to detect significant associations. Despite these limitations, the study has notable strengths. It provides a comprehensive analysis of various epidemiological, clinical, radiological, and laboratory characteristics associated with drug-resistant TB, contributing valuable insights to the existing body of knowledge. Furthermore, the use of standardized data collection forms ensures consistency and reliability in the gathered data. To enhance future research, we recommend conducting multi-center studies with larger sample sizes to improve generalizability and statistical power. Additionally, prospective studies could provide more accurate and detailed data, helping to identify and mitigate factors associated with poor outcomes in drug-resistant TB patients more effectively.

5. CONCLUSION

The study identified significant associations between treatment outcomes and age, hypertension, and diabetes status, with higher proportions of poor outcomes observed in patients. DM patients often present with other comorbidities such as heart and renal diseases, thus making the treatment more complex with unfavorable outcomes. Comprehensive

management strategies targeting these factors are essential to improve outcomes in patients with drug-resistant TB. Further research is warranted to develop tailored interventions for this population.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mirzayev F, Viney K, Linh NN, Gonzalez-Angulo L, Gegia M, Jaramillo E, et al. World health organization recommendations on the treatment of drug-resistant tuberculosis, 2020 update. 2021;57(6).
2. Organization WH. Marketing of breast-milk substitutes: National implementation of the international code, status report 2020: World Health Organization; 2020.
3. Mase SR, Chorba TJCicm. Treatment of drug-resistant tuberculosis. 2019;40(4): 775-95.
4. World Health Organization. Global tuberculosis report 2016. WHO: Geneva; 2016 [cited 2018 February].
5. Al Awaidy S.T., Khamis F. Tuberculosis in gulf health council member states: Opportunities and challenges towards TB elimination. Oman Med. J. 2018;33:181–183.
   DOI: 10.5001/omj.2018.35.
6. Chakaya J, Petersen E, Nantanda R, Mungai BN, Migliori GB, Amanullah F, et al. The WHO Global Tuberculosis 2021 Report–not-so-good news and turning the tide back to End TB. 2022;124:S26-S9.
7. Migliori GB, Tiberi S, Zumla A, Petersen E, Chakaya JM, Wejse C, et al. MDR/XDR-TB management of patients and contacts: Challenges facing the new decade. The 2020 clinical update by the Global Tuberculosis Network. 2020;92:S15-S25.
8. Baya B, Achenbach CJ, Kone B, Toloba Y, Dabitao DK, Diarra B, et al. Clinical risk factors associated with multidrug-resistant tuberculosis (MDR-TB) in Mali. International Journal of infectious diseases: IJID: Official publication of the International Society for Infectious Diseases. 2019;81:149-55.
9. Linh NN, Viney K, Gegia M, Falzon D, Glaziou P, Floyd K, et al. World health organization treatment outcome definitions for tuberculosis: 2021 update. Eur Respiratory Soc; 2021.
10. Mulu W, Mekkonnen D, Yimer M, Admassu A, Abera BJAhs. Risk factors for multidrug-resistant tuberculosis patients in Amhara National Regional State. 2015;15(2):368-77.
11. Chuchottaworn C, Thanachartwet V, Sangsayunh P, Than TZM, Sahassananda D, Surabotsophon M, et al. Risk factors for multidrug-resistant tuberculosis among patients with pulmonary tuberculosis at the Central Chest Institute of Thailand. 2015; 10(10):e0139986.
12. Davies-Teye B, Vanotoo L, Dziedzom A, Biredu M, Eleeza J, Fa BJViH. Factors associated with multi-drug resistant tuberculosis incidence in Ghana: A 1: 2 unmatched case-control study, 2017. 2017;20(9):A641.
13. Sylverken AA, Kwarteng A, Twumasi-Ankrah S, Owusu M, Arthur RA, Dumevi RM, et al. The burden of drug resistance tuberculosis in Ghana; results of the First National Survey. 2021;16(6):e0252819.
14. Shah AM, Shah RB, Dave PNJNJoP, Pharmacy, Pharmacology. Factors contributing to the development of multidrug-resistant tuberculosis. 2018; 8(10):1463-9.
15. Lahiri SK. Sociodemographic and clinical profile of multi-drug resistant tuberculosis patients: A study at drug-resistant tuberculosis centers of Kolkata.
16. Kapadia Vishakha K, Tripathi Sanjay BJDJNP. Analysis of 63 patients of MDR

TB on DOTS plus regimen: An LG hospital, TB Unit, Ahmedabad experience. 2013;52.

17. Khan FU, Rehman AU, Khan FU, Hayat K, Khan A, Ahmad N, et al. Assessment of factors associated with unfavorable outcomes among drug-resistant TB Patients: A 6-Year Retrospective Study from Pakistan. International Journal of Environmental Research and Public Health. 2022;19(3).
18. Alemu A, Bitew ZW, Worku TJIJoID. Poor treatment outcome and its predictors among drug-resistant tuberculosis patients in Ethiopia: A systematic review and meta-analysis. 2020;98:420-39.
19. Bastos ML, Cosme LB, Fregona G, do Prado TN, Bertolde AI, Zandonade E, et al. Treatment outcomes of MDR-tuberculosis patients in Brazil: A retrospective cohort analysis. 2017;17:1-12.
20. Jaber AAS, Ibrahim BJBid. Evaluation of risk factors associated with drug-resistant tuberculosis in Yemen: Data from centers with high drug resistance. 2019;19:1-9.
21. Brode SK, Varadi R, McNamee J, Malek N, Stewart S, Jamieson FB, et al. Multidrug-Resistant Tuberculosis: Treatment and outcomes of 93 patients. 2015;22(2):97-102.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/121968