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Evaluating Surgical Outcomes and Efficacy in the Treatment of Multidrug-Resistant Tuberculosis: A Retrospective Analysis of Surgical Interventions

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ABSTRACT

Background: Multidrug-resistant tuberculosis (MDR-TB) poses a significant global health challenge, with increasing incidence rates complicating treatment efforts. Traditional medical therapies often fall short, leading to treatment failures and poorer patient outcomes. Surgical intervention has emerged as a viable option for select patients, offering a potential pathway to improve recovery and reduce bacterial load.

Objective: To evaluate the surgical outcomes of patients undergoing surgery for MDR-TB, focusing on the effectiveness of different surgical procedures.

Methodology: A cohort of 24 patients diagnosed with MDR-TB was analyzed for demographic data, sputum smear status, drug resistance profiles, and outcomes of surgical intervention. The types of surgical procedures performed included lobectomy, segmentectomy, and cavernoplasty. These patients were those MDR-TB patients who failed to achieved successful treatment outcome after enrolled on routine anti-MDR-TB treatment with second line drugs. All data were entered into SPSS version 20 for anlaysis.

Results: The majority of patients were male (70.8%) and current smokers (70.8%). Most patients presented with drug resistance to Isoniazid (INH) and rifampicin (RMP). After post-surgery, 83% of patients achieved smear-negative status four weeks postoperatively, with no operative mortality reported. Surgical complications were minimal, with a 70% cure rate noted after two years.

Conclusion: Surgical intervention significantly enhances treatment outcomes for patients with MDR-TB. The findings underscore the importance of integrating surgical strategies with lifestyle modifications and long-term medical management to optimize patient care.

Keywords: MDR-TB; Surgical Intervention; Lobectomy; Outcomes

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Introduction

Multidrug-resistant tuberculosis (MDR-TB) is a complex and persistent global health issue, a type of drug resistant TB, the causative organism of which showed resistance to least the two most effective first-line anti-TB drugs, isoniazid and rifampicin.[1,2] This resistance make complicated treatment protocols, often resulting in prolonged illness, increased risk of transmission, and higher mortality rates. MDR-TB typically develops due to inadequate treatment practices, including incomplete or improper therapy, as well as the spread of resistant strains from infected person to other members of the populations. The challenge is particularly high in low- and middle-income countries, where healthcare resources are often scarce. To combat MDR-TB, a comprehensive strategy is essential, combining effective treatment regimens, good treatment adherence, and public health initiatives aimed at prevention and early detection of disease.

There are various treatment strategies for MDR-TB, involving different second-line drugs that with lower efficacy, more side effects, and require longer treatment durations. Due these characteristics success rate of treatment strategies is very low as compared to international success rate for a healthier life. Many of the patients due these factors unable to complete this long duration of treatment.[3] Given the limitations of traditional chemotherapy; surgical interventions have gained renewed attention as a potential complementary approach to enhance the success rates of MDR-TB treatment. Surgical options, particularly lung resection or thoracoscopic procedures, have been shown to be effective in selected patients with localized disease. These procedures can remove necrotic lung tissue, significantly reduce the bacterial load, and create an environment that may enhance the efficacy of subsequent pharmacological therapies.[4] By physically eliminating infected tissue, surgery can improve respiratory function and overall patient health, making it easier for the remaining medication to combat any residual infection.

Moreover, surgery can be particularly beneficial for patients who present with extensive pulmonary damage, cavitary lesions, or who experience severe side effects from multidrug regimens that make continued treatment challenging.[5] For these individuals, the integration of surgical treatment into their care pathway may not only enhance their response to drugs but also significantly improve their quality of life. Surgical approaches can also offer a critical lifeline to those who have previously failed conventional therapy, providing a renewed chance for successful treatment.

Despite its potential benefits, surgical treatment for MDR-TB remains underutilized in clinical practice. This hesitation may come from past doubts about using surgery to treat infectious diseases and worries about the challenges and risks of performing surgery in areas with limited resources. Additionally, there may be a lack of awareness or training among healthcare providers regarding the criteria for patient selection and the timing of surgical interventions in the context of MDR-TB.

Recent studies are giving us a clearer understanding of how surgery can help treat MDR-TB. These studies suggest that adding surgery to the treatment plan may lead to better patient outcomes.[6,7] Evidence suggests that patients who undergo surgical intervention exhibit reduced treatment failure rates, shorter time to culture conversion, and increased overall survival compared to those who receive medical management alone.

By conducting of the present research, examining its clinical results, and determining which patients may benefit from surgery, the study aims to show how surgical options can be effectively included in MDR-TB care. Ultimately, the research hopes to contribute to the discussion on effective strategies to combat this serious disease, highlighting the importance of new approaches to enhance patient outcomes and address the urgent public health challenge of MDR-TB.

Objective

To evaluate the surgical outcomes of patients undergoing surgery for MDR-TB, focusing on the effectiveness of different surgical procedures.

Methodology

We conducted a retrospective record study on 24 patients with multidrug-resistant tuberculosis (MDR-TB) from Khyber Pakhtunkhwa who underwent surgical resection between January 2015 to March 2022. This study was employing a multi-faceted approach to evaluate the effectiveness of surgical treatment in enhancing the success rate of multidrug-resistant tuberculosis (MDR-TB). A retrospective cohort study design will be utilized to analyze patient outcomes before and after surgical interventions for MDR-TB.

The present study included records of all such cases who did not achieve successful treatment outcome with standard anti MDR-TB treatment. The patients were selected for surgery following consultations with both a pulmonologist and a surgeon.

Data were collected from medical records, including demographic information (age, sex, comorbidities), clinical characteristics (severity of disease, bacterial load), treatment details (type of surgery, duration of medical therapy), and outcomes (treatment success rates, time to culture conversion, mortality rates). Primary outcomes included treatment success rate, defined as clinical improvement and negative culture results after

Table 1. Demographic and Clinical Characteristics of Patients with MDR-TB

Characteristic	Value
Total Cases	24
Mean Age	48 years (range: above 18-60 years)
Smoking Status	
Current Smokers	70.8% (17 patients; 16 men and 1 woman)
Former Smokers	8.4% (2 patients)
Non- smokers	20.8% (5 patients)

treatment, time to culture conversion, measured from the start of treatment to the first negative culture result, and overall mortality rate.

Descriptive statistics were used to summarize demographic and clinical characteristics. Comparative analyses were performed using chi-square tests for categorical variables and t-tests for continuous variables, as appropriate. Multivariate logistic regression was utilized to adjust for potential confounders and determine the independent effect of surgical treatment on outcomes.

Approval was obtained from the institutional review board (IRB) prior to data collection. Informed consent was not required for retrospective data collection; however, patient confidentiality was maintained throughout the study. Potential limitations included the retrospective nature of the study, which may have introduced selection bias, and the reliance on historical medical records, which could have led to incomplete data. Additionally, the results may not have been generalizable to all populations, particularly in settings with different healthcare resources.

Result

The sample size of our study was 24. The majority of patients were male (70.8%) and 29.2 were female (Figure 1).

Among study cases 75.0% of the patients were resided in urban areas (Figure 2).

Mean age of study cases was 48 years ranging from 18 to 60 years. Among study case, 70.8% were current smokers, indicating significant lifestyle factors that may impact their health outcomes (Table 1).

Among study cases, most common resistance was to isoniazid and rifampicin, affecting 10 patients, while combinations involving pyrazinamide and streptomycin also contributed to the resistance patterns. This highlights the complexity of treating MDR-TB due to the

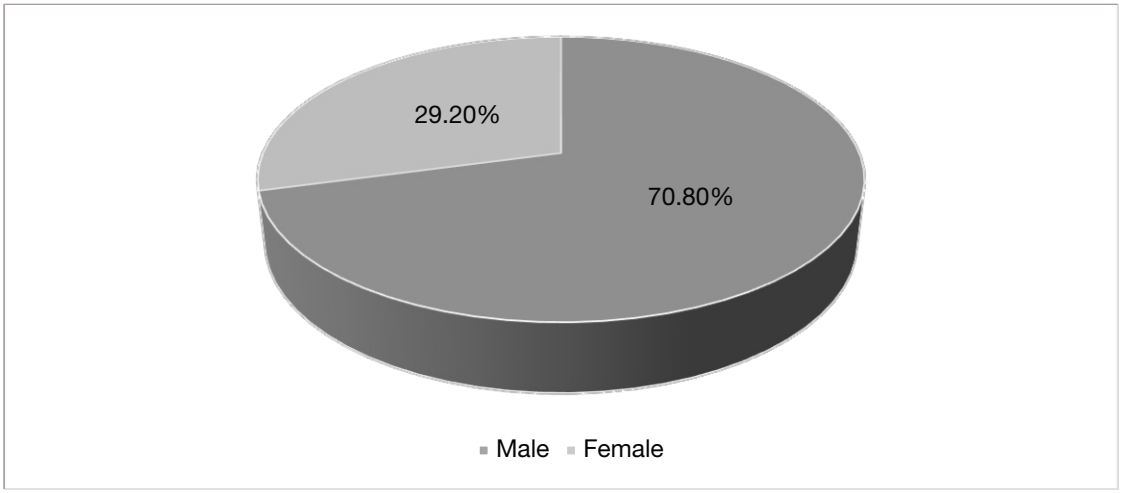

Figure 1. Gender distribution of study cases

Table 2. Distribution of Drug Resistance Patterns in MDR-TB Patients

Drug Resistance	Number of Patients
INH and RMP	10
Isoniazid, Rifampicin, Pyrazinamide	2
Isoniazid, Rifampicin, Streptomycin	4
Isoniazid, Rifampicin, Ethambutol	3
Isoniazid, Rifampicin, Pyrazinamide, Ethambutol	2
Isoniazid, Rifampicin, Streptomycin, Ethambutol	3

varying resistance profiles observed in the patient population (Table 2).

At the time of selecting cases for surgery, 70.8% of the patients had both positive AFB microscopy and culture results, while 8.4% had a negative smear but a positive culture (Table 3).

Among the study cases, 8.4% of patients with MDR-TB were also diagnosed with Diabetes Mellitus (DM). In addition to DM, other comorbidities such as cardiovascular disease, COPD, gastrointestinal diseases, and liver disease were also present among the patients (Table 4).

Table 5 summarizes the surgical indications, procedures, and postoperative outcomes for 24 patients. The majority underwent lobectomy due to medical treatment failure, with minimal complications reported and no operative mortality. Four weeks post-surgery, 83% of patients were smear-negative, indicating a positive response to treatment. Postoperative chemotherapy was continued for a total of 24 months (Table 5).

Discussion

The study examined the demographic and clinical characteristics of 24 patients diagnosed with multidrug-resistant tuberculosis (MDR-TB), revealing significant lifestyle factors influencing health outcomes. These were those patients that failed to response successfully against anti MDR-TB treatment. After failure in routine treatment, consultants refereed such patients for surgery with the help of cardiothoracic surgeons.

In the present study, 24 patients were such patients where culture remained positive after treatment and required surgery. Among these patients, The primary resistance observed was to isoniazid and rifampicin, which was seen in 41.6% of the patients, which aligns with the study conducted by Javaid et al. (2020), where 65% of patients exhibited similar resistance profiles.[8] Another study by Khan et al also point out the same findings.[9] This highlights the ongoing challenge of treating MDR-TB,

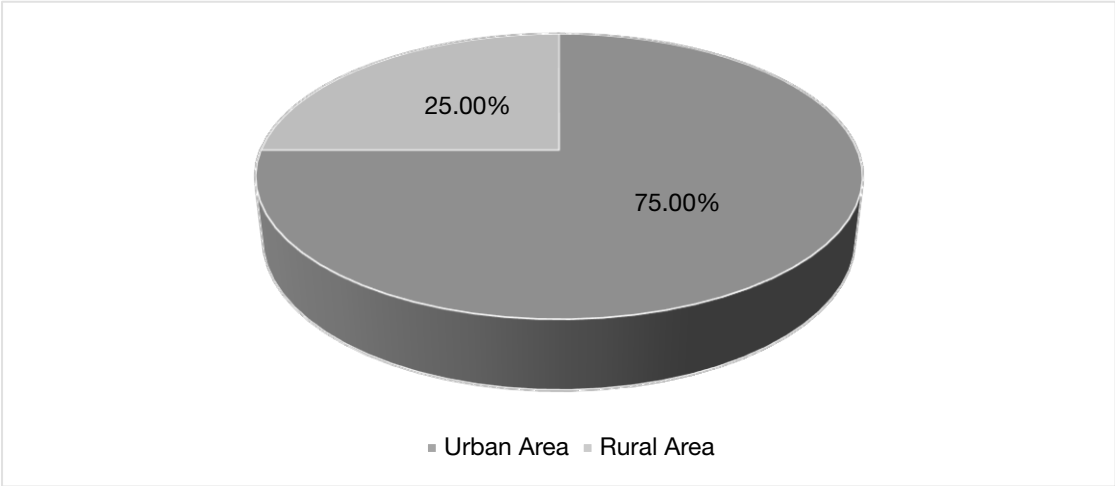

Figure 2. Distribution of study cases on the basis of their residence

Table 3. Sputum Smear and Culture Status of Patients Before Surgery

Sputum Smear Status	Number of Patients	Percentage
Microscopy Positive, Culture Positive	17	70.8%
Microscopy Positive, Culture Negative	5	20.8%
Microscopy Negative, Culture Positive	2	8.4%
Total	24	100%

given the limited pharmacological options available for patients who exhibit resistance to first-line drugs. The variability in drug resistance patterns, particularly with additional resistance to pyrazinamide and streptomycin, necessitates a tailored approach to drug selection for each patient. This complexity in resistance profiles can complicate therapeutic decisions, as seen in both our study and corroborating literature.

The present study reported that all patients had positive sputum smears at the time of surgery, with a significant proportion having both positive microscopy and culture results (70.8%). This aligns with findings from a larger cohort study by Alene et al. (2018), which found that 75% of their MDR-TB patients had similar preoperative results.[10] Such high positivity rates underscore the severity of disease at presentation, necessitating prompt and effective surgical interventions.

Lobectomy, performed in the majority of cases (14 patients), is often considered the gold standard for resecting extensively infected lung tissue, particularly in patients with localized disease and significant cavitary lesions.[11,12] This approach not only helps in reducing the bacterial load but also improves respiratory function. The decision to opt for lobectomy aligns with the findings from Mohsin et al. (2007). In the systematic review by Mohsin et al. (2007), which included approximately 150 patients undergoing surgical intervention for multidrug-resistant tuberculosis (MDR-TB), lobectomy was the most common procedure, performed in 60% of cases. The review reported a 76% smear-negative rate four weeks post-surgery and an overall cure rate of 70% after two years, highlighting the effectiveness and safety of surgical management in this challenging patient population.

Segmentectomy was performed in 3 patients and is generally indicated for those with smaller or more localized lesions where complete lobar resection may not be warranted. This less extensive procedure can preserve more lung tissue, which is critical for maintaining respiratory function, especially in patients with underlying comorbidities like COPD or cardiovascular diseases.

Cavernoplasty (speleoplasty) was performed in 7 patients, a procedure aimed at reconstructing the lung parenchyma following the removal of cavities caused by extensive disease. This surgical technique is particularly valuable in managing complications arising from MDR-TB, as it allows for the reestablishment of lung integrity while minimizing the risk of postoperative complications. The choice of cavernoplasty reflects the need for tailored surgical strategies that address both the extent of disease and the preservation of lung function.[13]

The surgical outcomes were encouraging, with no operative mortality and a postoperative smear-negative

Table 4. Presence of different comorbidities found among study cases

Comorbidity	Number of Patients (%)
Diabetes Mellitus	2 (8.4%)
Cardiovascular Diseases	6 (25.0%)
COPD	4 (16.7%)
Gastrointestinal Diseases	6 (25.0%)
Liver Diseases	6 (25.0%)
Total	24 (100.0%)

Table 5. Surgical Indications, Procedures, and Postoperative Outcomes of study cases

Category	Details	Number of Patients (%)
Indications for Surgery	Medical Treatment Failure	18 (75.0%)
	Persistent Cavitary Lesion	3 (12.5%)
	Massive Hemoptysis	3 (12.5%)
Type of Surgery	Lobectomy	14 (58.4)
	Segmentectomy	3 (12.5%)
	Cavernoplasty (Speleoplasty)	7 (29.2%)
Postoperative Complications	Minor Complications	6 (25.0%)
	Wound Infections	3 (12.5%)
	Minor Haemorrhages	2 (8.4%)
	Minor Pneumothorax	1 (4.2%
Operative Mortality		0 (0.0%)
Postoperative Smear Results	Smear-Negative	20 (83.4%)
	Smear-Positive	4 (16.8%)

rate of 83%. The low rate of complications and the continuation of chemotherapy for 24 months also reflect a comprehensive approach to managing MDR-TB, reinforcing the necessity for integrated treatment strategies that address both surgical and pharmacological needs.
Therefore, study provides valuable insights into the demographics, resistance patterns, and surgical outcomes associated with MDR-TB. It highlights the critical role of lifestyle factors and comorbidities in treatment efficacy and underscores the importance of tailored interventions. Future research should focus on larger cohorts to validate these findings and explore the long-term outcomes of surgical interventions in MDR-TB.

Conclusion

In conclusion, this study underscores the critical role of surgical intervention in the management of multidrug-resistant tuberculosis (MDR-TB), particularly for patients with localized disease or those who have failed medical treatment. The high rates of postoperative smear negativity and the favorable long-term outcomes observed highlight the effectiveness of surgical procedures such as lobectomy and cavernoplasty. Additionally, the association of lifestyle factors and comorbidities emphasizes the need for a comprehensive treatment approach that integrates lifestyle modifications and continuous medical management. As MDR-TB continues to pose significant public health challenges, further research is essential to refine surgical strategies and optimize patient outcomes in diverse clinical settings.

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