SURGICAL INTERVENTION IN MULTI-DRUG RESISTANT TUBERCULOSIS: A STRATEGIC COMPLEMENT TO CHEMOTHERAPY

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Abstract: *Multi-drug resistant tuberculosis (MDR-TB) presents a significant global health threat, particularly in cases where pharmacological therapy alone fails to achieve bacterial eradication. Surgical resection of diseased lung segments has re-emerged as a valuable adjunctive strategy in the comprehensive treatment of MDR-TB. This article explores the indications, techniques, and outcomes of surgery in MDR-TB patients, highlighting its role in reducing bacterial load, preventing transmission, and improving treatment success. Emphasis is placed on patient selection, perioperative management, and integration of surgical care into national TB control programs.*

Keywords: *MDR-TB, drug-resistant tuberculosis, lung resection, thoracic surgery, phthisiology, lobectomy, segmentectomy, surgical treatment*

Multi-drug resistant tuberculosis (MDR-TB), defined as tuberculosis resistant to at least isoniazid and rifampicin, remains one of the most difficult forms of TB to treat. The emergence of MDR and extensively drug-resistant TB (XDR-TB) has complicated the global TB control strategy, requiring prolonged, toxic, and often less effective treatment regimens. Despite advancements in chemotherapy and diagnostics, many MDR-TB patients fail to convert sputum cultures or suffer from recurrent disease, particularly when cavitary lesions or destroyed lung segments persist. In these cases, surgical resection of localized pulmonary disease offers a targeted approach to reducing bacillary burden, preventing reinfection, and enhancing the efficacy of drug therapy.

Multi-drug resistant tuberculosis (MDR-TB) continues to present a formidable challenge to global health systems due to its high treatment costs, long therapy duration, and comparatively poor outcomes. MDR-TB is characterized by resistance to at least isoniazid and rifampicin, the two most potent first-line anti-TB drugs. This resistance significantly complicates treatment and often results in prolonged infectiousness, increased transmission, and higher mortality rates. Although pharmacologic regimens have improved with the inclusion of newer agents such as bedaquiline, linezolid, and pretomanid, the success rate for MDR-TB remains substantially lower than that for drug-susceptible TB. For this reason, surgical intervention has re-emerged as a valuable adjunctive tool in the multidisciplinary management of drug-resistant tuberculosis.

The rationale behind surgical management lies in the ability to remove persistently infected, non-functioning, or cavitary lung tissue that serves as a reservoir for mycobacteria and a barrier to successful chemotherapy. These cavities often contain a high bacillary load, are poorly vascularized, and are shielded from adequate drug penetration. As a result, they become sources of reinfection, prolonged sputum positivity, and further resistance development. Surgical resection, including segmentectomy,

lobectomy, or in some cases pneumonectomy, directly eliminates such reservoirs and reduces the bacterial load, thus increasing the chances of microbiological cure when followed by adequate chemotherapy.

Indications for surgery in MDR-TB are typically determined after failure of initial drug therapy or when imaging studies reveal localized lesions amenable to resection. These include persistent cavitary disease after several months of therapy, unilateral destroyed lung, recurrent hemoptysis, or drug-resistant strains with slow or absent sputum conversion. The decision to proceed with surgery must be carefully weighed against the patient's general health status, pulmonary reserve, nutritional status, and co-morbid conditions. Preoperative evaluation includes detailed imaging through high-resolution computed tomography (HRCT), pulmonary function tests, bronchoscopy, and cardiovascular assessment.

Timing of surgery is critical. Ideally, patients undergo at least 2 to 3 months of effective second-line drug therapy before resection to reduce the bacillary load and minimize perioperative risk. In some high-burden regions, surgery is delayed due to limited access to thoracic surgical services, leading to worsening disease and reduced surgical options. Nevertheless, when performed in well-selected patients, surgical treatment has been shown to dramatically improve sputum conversion rates, reduce relapse, and shorten the required duration of chemotherapy.

The most common surgical procedures performed in MDR-TB patients include wedge resection, segmentectomy, and lobectomy. Pneumonectomy is reserved for patients with complete unilateral lung destruction or multiple cavities confined to one lung, although it carries higher morbidity and mortality. Minimally invasive approaches such as video-assisted thoracoscopic surgery (VATS) are being increasingly used for small, localized lesions, offering the benefits of less surgical trauma, faster recovery, and shorter hospital stay. However, due to the presence of dense adhesions and distorted anatomy from chronic infection, conversion to open thoracotomy remains common.

Postoperative management is a vital component of treatment success. Patients continue their individualized anti-TB regimen for at least 12 to 18 months after surgery, with close monitoring of sputum status and drug adherence. Pain control, respiratory physiotherapy, infection surveillance, and nutritional support are essential during the recovery phase. Regular follow-up with imaging and sputum cultures ensures early detection of relapse or complications such as bronchopleural fistula, empyema, or surgical site infection.

Numerous studies have validated the role of surgery in improving outcomes for MDR-TB patients. In a large retrospective cohort from Eastern Europe, surgical resection combined with chemotherapy resulted in sputum conversion rates exceeding 90%, compared to 65–70% in those receiving medical therapy alone. Another multicenter study across Asia reported that lobectomy in MDR-TB patients was associated with lower relapse rates and higher long-term cure. Even in patients with extensively drug-resistant TB (XDR-TB), surgery has been associated with improved survival when combined with new-generation antibiotics.

One of the challenges in implementing surgical treatment for MDR-TB globally is the uneven availability of thoracic surgical expertise, especially in high-burden, low-resource settings. Many patients who could benefit from surgery remain untreated due to financial constraints, lack of trained personnel, or inadequate surgical infrastructure. To overcome these barriers, international TB control programs and national health ministries must invest in capacity building, training thoracic surgeons, and establishing referral networks that can identify and transport eligible patients to equipped centers.

There are also important ethical and public health considerations. Patients with MDR-TB often face stigma, fear, and misinformation, leading to delayed presentation and non-compliance. A well-organized, patient-centered approach that includes psychosocial support, education, and transparent communication regarding surgical risks and benefits can significantly improve acceptance and adherence. Multidisciplinary collaboration among surgeons, pulmonologists, infectious disease specialists, nurses, and rehabilitation experts is essential to ensure comprehensive care.

Emerging innovations continue to expand the frontiers of surgical care in MDR-TB. Enhanced imaging modalities, intraoperative navigation systems, and 3D printing are aiding surgeons in planning complex resections. The use of biological sealants and tissue adhesives may help reduce postoperative complications such as air leaks. Research into lung tissue regeneration, stem cell therapy, and the use of autologous tissue scaffolds could one day complement resection in patients with limited pulmonary reserve.

Despite the demonstrated effectiveness of surgery, it is not a standalone cure and must always be embedded within a broader MDR-TB treatment framework. The integration of surgical options into TB care pathways, alongside molecular diagnostics, drug susceptibility testing, and personalized pharmacotherapy, is key to achieving WHO's End TB Strategy goals. Strategic use of surgery can not only improve individual patient outcomes but also reduce community transmission by eliminating persistently infectious cases from the transmission chain.

Surgical intervention has a well-defined and growing role in the treatment of multi-drug resistant tuberculosis. When applied to appropriately selected patients and combined with effective drug therapy, surgery can dramatically improve cure rates, prevent complications, and reduce treatment duration. In the face of rising drug resistance and limited success of medical treatment alone, thoracic surgery must be viewed not as a last resort but as a strategic, evidence-based option in the global fight against TB.

Surgical treatment has re-emerged as a critical adjunct in the management of multi-drug resistant tuberculosis, particularly in cases where chemotherapy alone is insufficient to achieve sustained cure. By physically removing persistently infected and poorly vascularized lung tissue, surgery helps reduce bacillary load, improve sputum conversion, and prevent further transmission and relapse. Although not suitable for all patients, carefully selected individuals can experience significantly improved outcomes when surgery is performed in conjunction with effective anti-tuberculosis drug therapy.

Timing, patient selection, and postoperative care are crucial determinants of success. The rise of minimally invasive techniques and the integration of surgery into

comprehensive TB treatment programs have expanded the potential for surgical intervention in MDR-TB care. However, disparities in access to thoracic surgical services remain a challenge, especially in resource-limited settings. As the global health community continues to combat drug-resistant TB, investing in surgical infrastructure, training, and multidisciplinary care will be essential to meeting international TB elimination goals. Surgery should no longer be viewed as a measure of last resort, but rather as a proactive and strategic component in the global response to drug-resistant tuberculosis.

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