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## Review

# Surgical Treatment of Complications of Pulmonary Tuberculosis, including Drug-Resistant Tuberculosis



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## SUMMARY

Surgery for drug-resistant tuberculosis has been shown to be safe and effective, with similar level of mortalities associated with surgical intervention observed with that for lung cancer. While surgery has been an option to treat TB in the pre-antibiotic era, it is now increasingly used to treat complications of pulmonary TB, particularly in patients with drug-resistant TB who do not respond to medical treatment. The two most frequent indications for lung resection in drug-resistant TB, are i) failed medical treatment with persistent sputum positivity or ii) patients who have had medical treatment and are sputum negative, but with persistent localized cavitary disease or bronchiectasis. Massive hemoptysis is a potentially life-threatening complication of TB. Lung resection is potentially curative in patients with massive hemoptysis and cavitary or bronchiectatic disease. Bronchial artery embolization in these patients has a high success rate but bears also the risk of recurrence. Lung resection can be safely undertaken in selected patients with HIV co-infection and pulmonary complications of TB. Ambulatory drainage is a novel, safe, affordable and effective method of draining a chronic TB associated *empyema thoracis*. We review here the current surgical treatment of the complications of pulmonary TB and discuss the experience from the Durban Cardiothoracic Surgery Unit for the surgical treatment of patients with complicated pulmonary TB.

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## 1. Introduction

Prior to the availability of anti-tuberculosis (TB) drugs, surgery was the only treatment option for the treatment of TB. However, with the advent of anti-tuberculosis drugs, antibiotic treatment

became the standard therapy for TB. Yet the battle against TB and the progress of the past several decades in TB treatment is at risk to be lost with the emergence of drug-resistant TB (DR-TB). Lung resection is increasingly being explored as a treatment option for patients with DR-TB who exhibit poor results in the antibiotic treatment regimens, or are in need for prolonged treatment with second line drugs or injectable drugs. This is particularly true for patients with extensively drug resistant TB (XDR-TB). Patients with DR-TB exhibiting lung destruction exhibit similar risks of surgery as compared to patients undergoing lung resection for bronchial carcinoma.<sup>1,2</sup> It is also recommended that lung resection should be the primary modality of treatment and not bronchial artery

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embolization for patients with life-threatening massive hemoptysis with localized cavitary lung disease. We discuss in this review the current literature in the field of surgical treatment for TB and discuss our experience (*i.e.* the Durban Cardiothoracic surgical team) concerning the management of patients undergoing lung resection. We also discuss a novel method of managing chronic TB associated empyema, not suitable for decortication.

The results of medical treatment particularly for XDR-TB are dismal with cure rates of 7% at 2 years and 5% at 5 years and mortality of 46% at 2 years and 73% at 5 years.<sup>3</sup> Surgery for pulmonary TB gave rise to the discipline of Thoracic Surgery. It is now more increasingly being investigated as treatment for drug-resistant tuberculosis in the presence of lung destruction.<sup>1,2,4</sup> Thoracic surgery has evolved from drainage of empyema through bronze cannula and 'collapse therapy' to the current status where intricate, extensive lung and chest wall resections can be undertaken for various lung pathologies. It can be broadly categorised into diagnostic interventions and therapeutic interventions. In the developed world, the majority of lung resections are for bronchial carcinoma. However, in the developing world, TB remains the main indication for lung resection.

## 2. Evolution of Surgical Treatment of Pulmonary TB

The early period for the surgical treatment of TB is reflected in the three decades of the nineteenth century, when collapse therapy was performed by open surgical pneumothorax with a high rate of asphyxia-associated death.<sup>5</sup> Induced pneumothorax was widely practiced in the pre-antibiotic era in more than 100,000 patients with pulmonary TB over a period of quarter century starting in 1882 until the early 20<sup>th</sup> century.<sup>6</sup> Lobectomy, open drainage, and instillation of antiseptics into cavities was tried in the beginning of 20<sup>th</sup> century. Improved collapse therapy and increased quality of thoracic surgery took place from 1930 onwards along with the advent of better diagnostic procedures with bronchoscopy, improvement in X-ray technique and development of bronchspirometry. Initially surgical intervention in Pulmonary TB was not viewed positively due to the high risks associated with TB (disease). Nevertheless, pneumonectomies, lobectomies, thoracoplasty (removal of ribs to collapse the chest wall) and pleurolytic operations were performed in selected patients with some success. Throughout 1950s, thousands of Pulmonary TB patients received surgical resection as adjunctive therapy to Streptomycin therapy.<sup>7</sup>

## 3. Lung Resection in TB

The classic indications for lung resection in TB are recurrent chest infections, recurrent minor hemoptysis, massive hemoptysis, DR-TB, any complication of TB (*empyema thoracis*, broncho-pleural fistula) persistent sputum positivity with irreversible pulmonary destruction: cavitation and/or bronchiectasis and suspicion of malignancy.<sup>8</sup> Surgery usually entails either lobectomy, bilobectomy, pneumonectomy or staged lobectomies for localized bilateral disease. Wedge or segmental resections are usually avoided due to the increased risk of a bronchopleural fistula. Occasionally, it is performed in the case of upper lobar disease warranting upper lobectomy as well as apical lower segmental disease, given that the basal segments are adequate to fill the pleural space.

## 4. Surgery for DR-TB

Renewed interest in surgical intervention in TB was driven by increasing failures in TB chemotherapy, *i.e.* with the advent of MDR-TB, the emergence of XDR-TB and TDR-TB that are resistant to most drugs in use. Surgery for DR-TB has been shown to be safe

and effective,<sup>9</sup> with operative mortalities similar to surgery for lung cancer.<sup>1</sup> We have also shown that surgery for XDR-TB and massive hemoptysis is safe.<sup>2,10</sup> There are two specific indications for lung resection in DR-TB, *i.e.* failed medical treatment with persistent sputum positivity and patients who have had medical treatment and are sputum negative, but have localized cavitary disease or bronchiectasis.<sup>11</sup> These are potential 'safe-havens' for mycobacteria that give rise to future relapses. Mycobacteria have developed mechanisms to overcome the host immune surveillance.<sup>12</sup> Little is known about this in the human lung, a potential area for future investigation. The first report on lung resection from our center reviewed 23 patients of MDR-TB including 10 sputum culture positive over a 5-year period between 1996–2000.<sup>13</sup> Pneumonectomy was performed in 17 patients and lobectomy in 6 individuals with no operative or postoperative mortality. Major complications developed in 4 patients (17.4%): 2 had post-pneumonectomy empyema and 2 underwent rethoracotomy for bleeding. The outcome was excellent with a cure rate of 95.6% (only 1 out of 10 remained sputum positive at the end of the follow-up period of the study). The Durban cardiothoracic surgical team suggested pulmonary resection as an important adjunct to medical therapy in carefully selected patients with localized disease with adequate pulmonary reserve, for patients who have multiple previous relapses, or for patients whose sputum remains positive after 4 to 6 months of appropriate medical treatment. In the authors' view, surgery offers high cure rates with acceptable morbidity and mortality.

The predominance of left-sided resection in the first series and other published reports suggested that the more horizontal course of the narrower left main bronchus and the smaller peribronchial space contribute to the left lung being more commonly involved. Preoperative sputum positivity is a recognized risk factor for post-pneumonectomy empyema, which developed in 2 of our patients, both of whom were sputum positive preoperatively. One of these patients was HIV positive with a preoperative empyema. Bronchial stump reinforcement has been advocated to prevent the postoperative development of bronchopleural fistula.

A subsequent report from our centre first reported surgical experience in XDR-TB in Africa reviewing 11 patients with confirmed XDR-TB referred for surgical resection between Jan 2007 to June 2010, due to failure of a treatment regimen appropriate for XDR-TB, complications of TB sequelae such as hemoptysis or recurrent chest infections.<sup>2</sup> Among these, 6 were excluded from surgical intervention due to bilateral, extensive cavitary disease. Five patients were surgically treated, two with pneumonectomies and three with upper lobectomies with no perioperative mortality or major morbidity with cure in all these patients. One of these five was also HIV infected and two others were health care workers. The Durban cardiothoracic surgical team has stressed the necessity of appropriately selecting candidates with DR-TB for surgical intervention and in particular the ones with persistent sputum positivity with second line chemotherapy based on drug susceptibility.

A different study, performed in Georgia, showed results from MDR-TB and adjunctive surgical resection: resection was performed in 37 MDR/XDR-TB patients with 5 new cases and 32 of retreatment cases with favourable outcome in 29 out of 37 (78%). These favorable data suggested adjunct surgical treatment in the management of M/XDR-TB.<sup>14</sup>

A systematic review and meta-analysis of adjunctive pulmonary resection for patients with MDR-TB with the inclusion of 15 studies (a total sample size of 949) showed the overall cure rate as high as 84%.<sup>15</sup> Aggressive use of resectional lung surgery was practiced at the National Jewish Medical and Research Center (NJMRC) which is a specialized hospital for DR-TB care. The report covered the period 1984 to 1998 and described the clinical management and outcome of 205 MDR-TB cases, of which

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