THE ROLE OF MINIMALLY INVASIVE THORACIC SURGERY IN THE MANAGEMENT OF TUBERCULOUS EMPYEMA

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Abstract: *Tuberculous empyema remains a challenging complication of pulmonary tuberculosis, characterized by purulent pleural infection and thickened pleural peel leading to lung entrapment. Traditional management often involves prolonged antibiotic therapy and open surgical decortication, which can be associated with significant morbidity. Minimally invasive thoracic surgery, particularly video-assisted thoracoscopic surgery (VATS), has emerged as an effective alternative for diagnosis, drainage, and decortication in selected patients. This article reviews the pathophysiology, clinical presentation, and treatment modalities for tuberculous empyema, with a focus on the advantages, limitations, and outcomes of minimally invasive surgical approaches.*

Keywords: *tuberculous empyema, thoracic surgery, minimally invasive surgery, VATS, pleural infection, tuberculosis complications*

Empyema thoracis is a known complication of pulmonary tuberculosis, especially in cases with delayed diagnosis or incomplete treatment. Tuberculous empyema is characterized by the presence of thick purulent pleural fluid and a fibrous peel that restricts lung expansion, resulting in respiratory compromise. The conventional approach to managing tuberculous empyema involves prolonged anti-tubercular therapy combined with open thoracotomy and pleural decortication in chronic cases. However, open surgery is associated with significant pain, longer hospitalization, and increased risk of complications. With advances in surgical technology, minimally invasive techniques such as video-assisted thoracoscopic surgery (VATS) have revolutionized thoracic surgery by offering less invasive options that reduce morbidity and improve recovery. Understanding the role of VATS in tuberculous empyema is essential for optimizing patient outcomes in TB-endemic regions.

Tuberculous empyema is a severe pleural complication of pulmonary tuberculosis characterized by the accumulation of purulent fluid within the pleural cavity. Unlike tuberculous pleuritis, which typically involves sterile or paucibacillary exudate, tuberculous empyema contains active infection and often leads to thickening and fibrosis of the pleura, causing lung entrapment and impaired respiratory mechanics. This

condition presents unique diagnostic and therapeutic challenges, especially in endemic regions where delayed diagnosis and incomplete treatment are common.

The pathophysiology of tuberculous empyema involves prolonged pleural infection resulting in the formation of dense fibrinous adhesions and pleural peel, which encase the lung and prevent its re-expansion. The persistent infection may cause systemic symptoms such as fever, weight loss, and malaise, alongside respiratory complaints like dyspnea, chest pain, and productive cough. If untreated or inadequately managed, the disease can progress to chronic empyema with significant morbidity, including respiratory failure and poor quality of life.

Diagnosis of tuberculous empyema requires a combination of clinical suspicion, imaging studies, and microbiological confirmation. Chest radiographs typically show pleural effusion with loculations and lung collapse. Computed tomography (CT) scans provide detailed visualization of the pleural space, revealing thickened pleura, loculated fluid collections, and the extent of lung entrapment. Thoracentesis or pleural biopsy may yield Mycobacterium tuberculosis or characteristic granulomatous inflammation, confirming the diagnosis. However, the low sensitivity of pleural fluid analysis and the paucibacillary nature of TB often necessitate surgical exploration for definitive diagnosis and treatment.

Historically, the management of tuberculous empyema has involved prolonged courses of anti-tubercular therapy combined with drainage procedures. Initial management includes chest tube insertion for fluid evacuation, effective anti-tubercular drug regimens tailored to susceptibility patterns, and supportive care including nutritional support and respiratory physiotherapy. However, chest tube drainage alone is often insufficient due to the presence of thick pleural peel preventing lung re-expansion. Consequently, surgical intervention becomes necessary to achieve complete lung re-expansion, eradicate infection, and restore respiratory function.

Open thoracotomy with decortication, which involves surgical removal of the thickened pleural peel, has traditionally been the gold standard for treating chronic tuberculous empyema. While effective in restoring lung expansion and controlling infection, thoracotomy is associated with significant postoperative pain, prolonged hospital stays, increased risk of wound complications, and delayed return to normal activities. These factors are particularly challenging in resource-limited settings where patients may have limited access to rehabilitation and follow-up care.

Minimally invasive thoracic surgery, especially video-assisted thoracoscopic surgery (VATS), has transformed the surgical management of empyema over the past two decades. VATS allows surgeons to access the pleural space through small incisions using

a thoracoscope and specialized instruments, enabling precise decortication, debridement, and drainage while minimizing tissue trauma. The advantages of VATS over open thoracotomy include reduced postoperative pain, shorter hospital stay, decreased pulmonary complications, faster recovery, and improved cosmetic outcomes.

In tuberculous empyema, the application of VATS presents both opportunities and challenges. Early-stage empyema with predominantly fluid collections and minimal pleural thickening is particularly amenable to VATS drainage and debridement. However, chronic empyema with extensive pleural fibrosis and dense adhesions can limit the feasibility of complete VATS decortication. In such cases, conversion to open thoracotomy may be necessary to achieve adequate lung re-expansion.

Several studies have demonstrated the safety and efficacy of VATS in the management of tuberculous empyema. Reports from high-burden countries indicate that VATS decortication leads to favorable outcomes, including improved lung function, reduced morbidity, and low complication rates. Furthermore, VATS facilitates better visualization of the pleural cavity, allowing thorough debridement and removal of infected tissue, which is essential in controlling the disease. The minimally invasive approach also allows for simultaneous biopsy or resection of suspicious pleural nodules, aiding in diagnosis.

Patient selection is critical to the success of VATS in tuberculous empyema. Ideal candidates include those with early to intermediate-stage disease, good pulmonary reserve, and limited comorbidities. Preoperative evaluation with imaging and pulmonary function testing helps determine the extent of pleural disease and operative risk. In contrast, patients with advanced disease, extensive pleural thickening, or poor cardiopulmonary status may be better served by open thoracotomy or conservative management.

An important consideration in tuberculous empyema is the presence of multidrug-resistant tuberculosis (MDR-TB), which complicates both medical and surgical treatment. Surgical intervention in MDR-TB patients requires meticulous perioperative planning, including prolonged anti-tubercular therapy guided by drug susceptibility testing, optimization of nutritional status, and careful postoperative monitoring. Despite these challenges, studies suggest that surgery, including VATS decortication, remains a valuable adjunct in the management of MDR-TB empyema by reducing bacterial load and facilitating drug penetration.

Postoperative care following VATS for tuberculous empyema involves pain management, respiratory physiotherapy to promote lung expansion, antibiotic therapy continuation, and nutritional support. Close monitoring for complications such as prolonged air leak, bleeding, wound infection, or recurrent empyema is essential. Long-

term follow-up is necessary to assess lung function recovery and ensure eradication of infection.

While the benefits of minimally invasive surgery are well recognized, barriers to widespread adoption exist, especially in low-resource settings. These include the need for specialized equipment, trained thoracic surgeons, and perioperative intensive care facilities. Addressing these gaps requires investment in healthcare infrastructure, surgical training programs, and integration of thoracic surgical services into national tuberculosis control programs.

Minimally invasive thoracic surgery, particularly VATS, has emerged as an effective and less morbid option for the management of tuberculous empyema. Its ability to provide thorough drainage and decortication with reduced patient morbidity offers significant advantages over traditional open surgery. Careful patient selection, early surgical referral, and integration with comprehensive anti-tubercular therapy are key to optimizing outcomes. As tuberculosis control efforts continue, expanding access to minimally invasive thoracic surgery in endemic regions could markedly improve the quality of care and prognosis for patients with tuberculous empyema.

Tuberculous empyema remains a complex and challenging complication of pulmonary tuberculosis, often leading to significant morbidity due to persistent infection and pleural fibrosis. While traditional management involving prolonged medical therapy and open thoracotomy has been effective, it is frequently associated with considerable postoperative pain, extended hospitalization, and delayed recovery. The advent of minimally invasive thoracic surgery, particularly video-assisted thoracoscopic surgery (VATS), has revolutionized the treatment landscape by offering a less invasive yet effective option for drainage and decortication.

VATS provides numerous benefits including reduced surgical trauma, decreased postoperative pain, shorter hospital stays, and quicker return to daily activities. It allows for meticulous pleural debridement and lung re-expansion, which are critical in achieving infection control and restoring respiratory function. Nonetheless, patient selection remains crucial, with the best outcomes observed in early to intermediate-stage empyema and patients with adequate pulmonary reserve.

Expanding access to minimally invasive surgical techniques in tuberculosis-endemic and resource-limited settings is essential to improve patient outcomes. This requires investment in surgical infrastructure, training, and integration of thoracic surgical care into national tuberculosis programs. Ultimately, combining effective anti-tubercular therapy with timely minimally invasive surgical intervention represents a comprehensive strategy to manage tuberculous empyema and reduce its associated burden.

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