BRONCHOPLEURAL FISTULA IN TUBERCULOSIS PATIENTS: SURGICAL CHALLENGES AND MANAGEMENT STRATEGIES

Toxirov Javoxirbek Alisher O'g'li
Central Asian medical university

Abstract: *Bronchopleural fistula (BPF) is a serious and potentially life-threatening complication of pulmonary tuberculosis, particularly in patients with cavitary disease or following surgical resection. Characterized by abnormal communication between the bronchial tree and pleural space, BPF can lead to persistent air leaks, empyema, respiratory failure, and high mortality. This article reviews the etiology, clinical features, and diagnostic approaches to BPF in TB patients, while emphasizing current surgical and minimally invasive interventions. Through timely recognition and a tailored therapeutic strategy, BPF can be successfully managed, improving patient outcomes and reducing morbidity in TB-endemic regions.*

Keywords: *bronchopleural fistula, tuberculosis, empyema, thoracic surgery, pulmonary complications, air leak, TB surgery*

Bronchopleural fistula (BPF) is a rare but dangerous complication of pulmonary tuberculosis, often occurring as a result of cavitary necrosis, ruptured lung abscesses, or post-surgical failure of bronchial stump closure. The condition is associated with poor prognosis if not managed promptly and correctly. Tuberculosis-related BPFs are most frequently observed in settings of chronic infection, where fibrotic changes and tissue destruction weaken the bronchial walls and compromise healing. Management of BPF in TB patients is especially complex due to coexisting empyema, poor lung function, malnutrition, and the presence of drug-resistant organisms. As a result, surgical intervention, often in combination with antimicrobial therapy and pleural drainage, remains a cornerstone of treatment in selected patients.

Bronchopleural fistula (BPF) is one of the most serious complications that can occur in patients with pulmonary tuberculosis. It represents an abnormal communication between the bronchial tree and the pleural space, resulting in continuous air leakage into the pleural cavity. In tuberculosis patients, this condition typically arises due to chronic cavitary disease, the rupture of a caseous lesion into the pleura, or as a postoperative complication following procedures like lobectomy or pneumonectomy. The development of BPF significantly worsens the clinical course of TB, leading to empyema, sepsis, respiratory insufficiency, and, if untreated, death. Despite its severity, with timely diagnosis and appropriate intervention, BPF is a manageable complication. However, the complexity of treating it in the context of TB—especially multi-drug-resistant TB—requires a multidisciplinary approach and a high level of surgical expertise.

The clinical presentation of bronchopleural fistula varies depending on its size, duration, and underlying cause. Small fistulas may present with subtle symptoms, such as persistent air leaks or subcutaneous emphysema, whereas large fistulas often lead to dramatic presentations including sudden onset dyspnea, massive air leaks through chest drains, pyopneumothorax, and septic shock. In some cases, the fistula may result in aspiration of infected pleural fluid into the contralateral lung, precipitating a fatal event. Hemoptysis is also a common feature, particularly when the fistula is associated with cavitary lesions eroding blood vessels. In post-surgical patients, early detection is critical, as BPFs typically occur within the first two weeks after lung resection, though late-onset forms have also been described.

Diagnosis of BPF relies on a combination of clinical suspicion, imaging, and endoscopic evaluation. Persistent air leaks through a chest tube after pulmonary resection should immediately raise concern. Chest X-rays may show hydropneumothorax, shifting mediastinum, or collapsed lung. However, computed tomography (CT) is the most sensitive imaging modality, allowing visualization of the fistulous tract, associated empyema, and condition of residual lung tissue. Bronchoscopy is essential in localizing the fistula, determining its size, and evaluating the status of the bronchial mucosa. In some cases, instillation of dyes such as methylene blue or fluorescein into the bronchial tree can help confirm the diagnosis and identify the exact location of the leak.

Management of BPF in TB patients is multifaceted and depends on several factors including the patient's general condition, the size and location of the fistula, presence of infection, lung reserve, and the duration of the leak. Initial management typically includes broad-spectrum antibiotics or anti-tubercular therapy tailored to sensitivity results, pleural drainage to prevent tension pneumothorax or empyema, and supportive care including oxygen therapy, nutritional support, and sepsis control. However, in most cases, conservative therapy alone is insufficient, particularly in large or chronic fistulas. This necessitates surgical or endoscopic interventions aimed at definitive closure.

Surgical treatment options range from direct closure of the fistula to more extensive procedures such as re-do lobectomy, completion pneumonectomy, thoracoplasty, or the use of vascularized muscle flaps. The most definitive treatment remains surgical closure of the bronchial defect, especially in patients who are fit for surgery and have localized disease. However, this is technically challenging, particularly in TB patients, due to the presence of dense pleural adhesions, infected tissue, and friable bronchial walls. Surgeons often employ intercostal muscle or omental flaps to reinforce the closure and promote healing. In complex cases where lung re-expansion is impossible, thoracoplasty—removal of multiple ribs to collapse the chest wall—may be performed to obliterate the pleural space and control infection.

In recent years, endoscopic techniques have emerged as promising alternatives or adjuncts to surgery, particularly in high-risk patients. These include bronchoscopic application of sealants (e.g., fibrin glue, cyanoacrylate), endobronchial valves, coils, or

spigots designed to block airflow through the fistula. Though less invasive, these techniques are generally effective only in small or moderate-sized fistulas and may require repeated procedures. In select cases, endoscopic closure has achieved success as a bridge to surgery or as a standalone treatment in patients unsuitable for open thoracotomy.

One of the most challenging scenarios is managing BPF in the context of empyema. In these cases, open drainage procedures such as Eloesser flap or Clagett window are often used as temporary measures to control infection and allow for local wound management. Once the infection is under control, definitive closure of the fistula may be attempted. These staged procedures require prolonged hospitalization and close follow-up but can lead to satisfactory outcomes when executed properly. The integration of plastic surgery techniques to manage complex wounds has also enhanced the success rates of these approaches.

Outcomes of BPF treatment in TB patients vary depending on the timing of intervention and the patient's general condition. Early detection and prompt surgical management are associated with higher success rates and lower mortality. Delayed treatment, on the other hand, often results in prolonged air leaks, recurrent infections, and respiratory failure. Malnutrition and co-morbidities such as HIV/AIDS, diabetes, or chronic kidney disease further complicate recovery and increase postoperative morbidity. Hence, comprehensive perioperative support is essential, including intensive nutritional rehabilitation, aggressive infection control, and extended anti-tuberculosis therapy.

The prevention of BPF should be a priority in all surgical TB cases. Careful surgical technique, proper bronchial stump closure, reinforcement with vascularized tissue, and meticulous postoperative monitoring can significantly reduce the risk. Avoiding pneumonectomy whenever possible, and preferring lobectomy or segmentectomy, has also been associated with lower rates of BPF. Intraoperative measures such as bronchial stump coverage with autologous tissue and preoperative optimization of nutritional status are effective preventive strategies.

In resource-limited settings, access to specialized thoracic surgical services remains a significant barrier to optimal BPF care. Many patients present late, after developing chronic empyema or severe sepsis, limiting the available treatment options. Therefore, building capacity in thoracic surgery, developing regional referral networks, and training local health professionals in early recognition and management of post-TB complications are essential steps toward improving outcomes. Collaboration between pulmonologists, surgeons, infectious disease specialists, and rehabilitation experts is crucial in forming comprehensive care pathways.

Future directions in the management of BPF include the development of biodegradable bronchial stents, tissue engineering approaches to promote bronchial healing, and the use of biological matrices or stem-cell-infused scaffolds to close large defects. Additionally, research into early biomarkers for bronchial stump failure may allow earlier detection

and intervention. Ultimately, as tuberculosis control programs continue to evolve, integrating long-term follow-up for surgical complications and post-TB sequelae will be vital to reducing the burden of this devastating disease.

Bronchopleural fistula remains one of the most serious and challenging complications encountered in the management of pulmonary tuberculosis, particularly in patients with cavitary disease or following thoracic surgery. Its presence significantly worsens clinical outcomes by causing persistent air leaks, empyema, respiratory failure, and increased mortality. Early recognition, accurate localization, and a multidisciplinary treatment approach combining antimicrobial therapy, pleural drainage, and surgical or endoscopic interventions are essential for successful management.

Surgical closure of the fistula, often reinforced with vascularized tissue flaps, remains the gold standard treatment in suitable candidates. Endoscopic techniques provide promising less invasive alternatives, especially for high-risk or inoperable patients. Prevention through meticulous surgical technique and perioperative care is equally important to reduce incidence. Despite advances, resource limitations in TB-endemic regions continue to impede timely access to specialized care.

Strengthening thoracic surgical services, enhancing multidisciplinary collaboration, and investing in innovative therapeutic modalities will be key to improving outcomes for TB patients with bronchopleural fistula. Continued research and capacity building are essential to reduce the morbidity and mortality associated with this complex complication.

References

1. Light, R. W. (2016). *Pleural Diseases* (6th ed.). Philadelphia: Lippincott Williams & Wilkins.
2. Shah, S., & Desai, M. (2018). "Bronchopleural fistula: Pathogenesis, diagnosis, and management." *Indian Journal of Thoracic and Cardiovascular Surgery*, 34(1), 1–10.
3. Lo, C. Y., et al. (2020). "Surgical management of bronchopleural fistula in tuberculosis patients." *European Journal of Cardiothoracic Surgery*, 57(3), 569–576.
4. Chen, K. H., & Hsu, H. H. (2019). "Endoscopic approaches to bronchopleural fistula closure." *Respiratory Medicine*, 156, 53–60.
5. Ganiev, B., & Ismoilova, G. (2022). "Thoracic surgical challenges in drug-resistant tuberculosis." *Central Asian Journal of Pulmonary Medicine*, 4(2), 45–52.
6. Kim, S. J., et al. (2017). "Outcomes of bronchopleural fistula repair in tuberculosis patients." *Annals of Thoracic Surgery*, 104(2), 431–438.
7. Marom, E. M., & Munden, R. F. (2017). "Imaging of bronchopleural fistula." *Seminars in Ultrasound, CT, and MRI*, 38(3), 313–323.
8. Saha, S., & Mandal, A. (2021). "Management strategies for bronchopleural fistula in low-resource settings." *Journal of Thoracic Disease*, 13(7), 4267–4276.
9. World Health Organization. (2023). *Global Tuberculosis Report*. Geneva: WHO.
10. Jindal, S. K. (2019). "Tuberculosis: Management of complications." *Indian Journal of Chest Diseases and Allied Sciences*, 61(1), 1–7.