



# Bronchopleural fistula: prevention is still best

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## Introduction

In their paper, Dal Agnol and colleagues review the management of central bronchopleural fistula (BPF) following lung resections (1). BPF remains a complication much dreaded by thoracic surgeons. The diagnosis invariably evokes a sense of trepidation, and treatment presents a major therapeutic challenge. It carries a significant risk of morbidity, and mortality is reported to be between 16–72% (2,3).

BPF following lung resection can be usefully categorized, based on the time elapsed since surgery, into early or late fistula. This classification helps surgeons in their approach to a patient with BPF. Knowledge of the problem is key to the solution.

BPFs that develop acutely are usually due to bronchial stump dehiscence, technical or surgical failures. They usually warrant early reoperation to correct the error and re-establish an airtight stump. Late fistulae are more likely due to infection, chronic malnutrition or debility, or local tumour recurrence.

## Prevention of BPF

The incidence of BPF following resection is reported to be in the range of 1.5% to 28%, but may be up to 54.6% in post-pneumonectomy patients (4). Certain factors may increase the risk of BPF post-resection, such as immunosuppression or immunocompromised patients, neo-adjuvant radiotherapy and chemotherapy and malnutrition. Following lung resection, mechanical ventilation with positive pressure may predispose a patient to developing

BPF. Where possible, avoidance or mitigation of these factors is likely to reduce the risk of BPF.

Once in the operating room, meticulous surgical techniques should include protection of bronchial vascular supply and avoiding an over-long stump. Reinforcement of the stump using vascularized tissue and ensuring that the pleural space is not contaminated during surgery reduce the risk of developing BPF. A recent meta-analysis found that routine coverage of bronchial stump in high-risk patients led to a BPF risk only slightly higher than to low risk patients without stump coverage (5,6).

Sfyridis and colleagues are to be congratulated on conducting one of the only randomized trials in this area, which showed a reduced risk of BPF (0% *vs.* 8.8%,  $P=0.02$ ) after pneumonectomy in diabetics, when the stump was prophylactically covered with a pedicled intercostal muscle flap (7). There are therefore evidence-based strategies to reduce the incidence of BPF, which surgeons should be mindful of.

## Management

### Immediate

Patients with acute BPF often present with life-threatening tension pneumothorax or aspiration, whereas subacute and chronic BPF presentations are often insidious with empyema, general malaise and lethargy. A high index of suspicion is important, so that the necessary investigations can be carried out to confirm the diagnosis. Simple chest X-ray is an important first test. After pneumonectomy, a drop in the fluid level in the pneumonectomy space should always raise concern. Subsequently, usually with

a combination of CT chest with contrast and flexible bronchoscopy, the diagnosis can be confirmed. A thorough assessment of the anatomy of the BPF and the state of the contralateral lung can also be made. If the BPF is very small and not immediately obvious, dye injection endobronchially may enhance the sensitivity.

Management varies according to the individual patient, as they are a diverse group. As Dal Agnol and colleagues write, the principles are drainage of the pleural space, treatment of sepsis, followed by closure of the fistula and obliteration of any residual pleural space if possible (1). Success requires a collaborative effort with many professionals including microbiologists, physiotherapists and nutritionists.

We would emphasise the importance of addressing the risks of tension pneumothorax and contralateral aspiration pneumonia by drainage of the pleural space at the time of diagnosis. Siting an intercostal drain is the commonest approach, although an immediate pleural fenestration is another option after pneumonectomy.

Aggressive nutritional support, targeted antibiotic therapy and physical rehabilitation should be started at the earliest contact with health care professionals to optimize patients, to improve their reserve in withstanding the trauma of surgery and to enhance their recovery.

### *Surgical closure of the stump*

In an acute failure of the bronchial stump, expeditious surgical repair is recommended. If done in a timely fashion, the pleural contamination may be minimal and there should be no problematic residual space to deal with. In this scenario, the bronchial stump can be refashioned and reinforced with vascularized tissue such as intercostal muscle or a serratus anterior flap, although several other muscles and tissues in close proximity to the pleural cavity have been utilized. In more chronic situations, where the bronchus and nearby vascular tissues are often heavily scarred and difficult to dissect, trans-pericardial approaches can provide a safe approach to the carina for re-stapling.

In late BPF, the objectives are to control infection, drainage of the pleural cavity, optimize nutrition and to rehabilitate the patient. Timing of the surgery is more difficult to determine compared to repair in acute primary failure. Both the surgeon and patient need to be patient as definitive surgery carries a significant risk and there is probably only one attempt at a successful repair. Surgery should only be contemplated once all infective issues are controlled and the patient is medically optimized.

### *Surgical management of the pleural cavity*

The next surgical step is to address the pleural cavity. The objective is to obliterate the space. Options are either decortication of the lung to allow the remaining lung to re-expand and obliterate the space (when there is remaining lung) or whether the space needs to be obliterated by filling with other tissues, via thoracoplasty, or using a combination of both. In the literature, the outcomes are often reported collectively, rather than attributed to a specific surgical technique (2-4,8,9).

Surgeons should be aware of the evolving role of vacuum-assisted closure (VAC) devices in the management of the infected pleural space (10). Applied usually via a generous pleural fenestration, VAC devices can effectively drain the pleural space and encourage it to reduce in size. VAC devices may however struggle with air leaks, and mediastinal shift can be problematic (11).

Perhaps the most difficult decision is to know when not to operate. Long term drainage of the space either with a chest drain or open window thoracostomy may be the only viable treatment option in debilitated patients. Open window thoracostomy can be performed with minimal risks to a patient, even a critically unwell patient and can be a very effective management. There are multiple reports of successful conservative management, even in large BPF, with just long term drainage open window thoracostomy and regular dressing change (12,13).

### *Endobronchial therapies*

Endobronchial intervention with a variety of devices has emerged recently as a treatment option. Closure using different devices such as Amplatz devices or endobronchial valves could be useful in patients not medically fit for definitive surgical therapy (3,14).

Dal Agnol and colleagues cover the use of glues and sclerosants to seal small fistulae. Cell therapy using autologous adipose-derived stromal cell has also been successfully used endobronchially to treat BPF (15). Stenting is another approach, and has been applied with some success to large fistulae, often as a bridge to surgical closure (16). Custom stents, designed to reflect the change in caliber between distal trachea and contralateral main bronchus, are available. Finally, endobronchial valves have been applied successfully to the problem of refractory BPF by several groups (17). This approach requires enough residual airway length to seat the valve securely, and therefore is best suited to peripheral fistulae rather than more central postpneumectomy dehiscence.

An open mind, creative thinking and close partnership with other specialists, especially surgical expertise such as plastic surgeons will allow us to continually innovate and improve our strategy in managing BPF.

Fortunately, the incidence of BPF remains low. Perhaps this is another factor contributing to the lack of consensus in its management. What is available in the literature consists mainly of small series or case reports, and largely anecdotal. However, despite the lack of wisdom or insight into an air-tight or foolproof successful management strategy of BPF, especially post lung resection, the morbidity and mortality trend over the years seem to be improving. This is very encouraging. Perhaps, we are getting better at managing patients not only from a surgical point of view, but also through a thorough and holistic assessment and treatment of patients from all angles.

BPF has remained a stubbornly difficult problem to manage. There is room for improvements in management, but ultimately prevention is still best—for both patients and surgeons.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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