Editorial Commentary

A proposal for a postoperative protocol for the early diagnosis of bronchopleural fistula after lung resection surgery

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Introduction

Bronchopleural fistula (BPF) is a potentially catastrophic complication of lung surgery (pneumonectomy, lobectomy, segmentectomy) (1) and represents a non-negligible cause of readmission during the first postoperative year (2). BPFs usually occur within three months after surgery, and based on their onset, they are classified as: early (1–7 days), intermediate (8–30 days), and late (>30 days) (3). When diagnosed within the first postoperative week, the BPF is likely secondary to a mechanical failure of bronchial stump closure and requires surgical re-exploration. Intermediate BPF are primarily related to infections and are not rare in immunosuppressed or debilitated patients with multiple comorbidities; subacute presentations are more insidious and characterised by wasting, malaise, and fever. Late BPFs are also associated with pleural cavity infection and fibrosis.

According to an analysis of the European Society of Thoracic Surgery (ESTS) database, the overall incidence of BPF in lung resection surgery is 1.9% (4), with a frequency ranging from 4.5% to 20% after pneumonectomies and from 0.5% to 1% after lobectomies (5). Other published statistics indicate that the BPF incidence is <1% following lobectomy and sublobar resection, and between 4% and 20% following pneumonectomy (6). The mortality related to the adverse effects of BPF ranges from 18% to 50%. The most common risk factors of BPF include right-sided pneumonectomy, neoadjuvant therapy, and right lower lobectomy (7).

The BPF is commonly detected on the caudal extremity of the bronchial stump due to the increased risk of ischemic necrosis and/or to the pooling of secretions leading to bacterial overgrowth and colonisation (1,8).

Although several studies have aimed at predicting the occurrence (9,10) and establishing a management strategy for BPF (11), to date, there are no published consensus statements or recommendations that guide surgical practice. Fibreoptic bronchoscopy appears more advantageous than other clinical and radiological approaches for diagnosing BPF. It also allows proper evaluation of the stump, direct localisation of the orifice, and the introduction of sealants into the fistulous tract (12). It is also a fundamental tool in the sequential monitoring of chronic BPF.

Based on our experience with postoperative BPFs and their bronchoscopic follow-up (11,13,14), we propose a postoperative protocol for the early identification of fistulas after pneumonectomies and sleeve lobectomies.

Postoperative protocol

All the patients who undergo a pneumonectomy or a sleeve lobectomy are scheduled for follow-up visits as follows:

- One month after surgery: physical examination, chest X-ray and blood tests.
- Every six months for three years: physical examination and chest and upper abdomen computed tomography (CT).

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Table 1 Clinical bronchoscopic classification of the bronchial stump in pneumonectomies and sleeve lobectomies

Grade	After pneumonectomy	After sleeve lobectomy
0	Regular bronchial stump	Regular bronchial stump
1	Little irregularity of the suture line (visualisation of the inner suture line)	Haematoma of the suture line with fibrin deposition
2	Little irregularity of the suture line with haematoma	Little area of necrosis of the suture line without clinical signs of BPF
3	(I) Little continuity solution without clinical signs of BPF; (II) Dead-end micro-BPF	Seamless suture line without clinical signs of BPF
4	BPF with clinical signs (≤1/3 suture)	BPF with clinical signs (≤1/3 suture)
5	Complete BPF (>1/3 suture)	Complete BPF (>1/3 suture)

BPF, bronchopleural fistula.

- Every year (after postoperative year three and up to five years), physical examination and chest and upper abdomen CT.

A bronchoscopic follow-up is conducted with three fibreoptic bronchoscopies:

- At time 0: on postoperative day 7.
- At time +1: 1 month after discharge as an outpatient modality.
- At time +3: 3 months after discharge as an outpatient modality.

If a BPF is detected, a clinical bronchoscopic classification of the lesions of the bronchial stump is employed (*Table 1*). The initial grade of BPF may allow bronchoscopic interventions. Quick operative intervention, significantly when the BPF is early diagnosed, with transthoracic stump revision or open window thoracostomy may eventually accelerate BPF closure and improve survival. This postoperative protocol is still ongoing.

Comments

An alveolar-pleural fistula or air leak is the most frequent postoperative complication following elective lung resection. An air leak is described as the communication of the pulmonary parenchyma's alveoli with the pleural space distal to a segmental bronchus. As defined by the Society of Thoracic Surgeons General Thoracic Surgery Database, a protracted air leak persists beyond five days postoperatively. In contrast to alveolar-pleural fistulae, a BPF connects the main stem, lobar, or sublobar bronchus and the pleural area (6). BPF represents a thorny, longstanding issue for thoracic surgeons. Prevention measures are not always successful, and management approaches are controversial, even unorthodox at times. BPF has a detrimental effect on other perioperative outcomes, as these patients' duration of stay is dramatically increased, resulting in a 30% rise in inpatient costs (6).

As previously reported, our BPF protocol is based on a time-dependent algorithm. Namely, symptomatic patients are started on antibiotics and undergo double chest tube placement for pleural irrigation immediately after the radiological or endoscopic diagnosis of BPF. Subsequently, direct surgical repair is attempted in early (less than two weeks after surgery) BPF patients. At the same time, bronchoscopic procedures are performed in late, small BPF cases, leaving open window thoracostomy as a last resort (11).

Paradoxically, the lack of symptoms complicates matters, as early detection of asymptomatic BPF is usually fortuitous, and surgeons are faced with a management dilemma: to treat or not to treat? On the one hand, a cautious wait-and-watch attitude would seem advisable to spare a patient in good clinical status further invasive manoeuvres or even a morbid open-window thoracostomy. On the other hand, a prompt therapeutic response might prevent the enlargement of the orifice and the onset of empyema.

We are also aware of the possibility to not achieve the necessary results due to the low incidence of BPF. Perhaps a more stratified approach would be more cost-effective. Predictors for BPF could be obtained from the ESTS database and stratify patients at higher risk for development of BPF (4).

Nonetheless, bronchoscopy is a practical examination but also is an invasive procedure. Routine bronchoscopy plays a crucial role in the postoperative surveillance of pneumonectomies or sleeve lobectomies. A minimally

invasive technique enables the operator to inspect the trachea-bronchial mucosa, check the vocal folds for paralysis, and the bronchial stump for BPF or tumour recurrence. Above all, in the case of BPF, sequential bronchoscopies allow a comparative measurement of the size of the orifice to determine whether it is healing, thus guiding subsequent therapeutic decisions.

Nevertheless, a randomised controlled study with patients randomised to this protocol *vs.* no serial bronchoscopies will be needed. An evaluation of the proposed protocol and needed number to treat to identify one BPF that would have been otherwise missed will be more critical for surgeons.

Conclusions

In conclusion, our follow-up protocol for postoperative BPF prevention and early diagnosis with sequential bronchoscopy allows early detection and close monitoring of the fistula, thus ensuring the surgeon more freedom to decide whether and when to treat. Besides, systematic bronchial stump coverage is fundamental not only for preventing BPF but also for limiting the enlargement and communication with the residual cavity.

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