Editorial

The review of the management and prevention methods of bronchopleural fistula in thoracic surgery

Piotr Jerzy Skrzypczak^, Mariusz Kasprzyk, Cezary Piwkowski

Department of Thoracic Surgery, Poznan University of Medical Sciences, Szamarzewskiego, Poznań, Poland

Correspondence to: Piotr Jerzy Skrzypczak, MD. Department of Thoracic Surgery, Poznan University of Medical Sciences, Szamarzewskiego 62, 60-569 Poznań, Poland. Email: piotr.j.skrzypczak@gmail.com.

Comment on: Wang Y, Zhu M, Pan Y, *et al.* Long-term follow up and comparison between conservative and interventional therapy in postoperative bronchopleural fistula—a cohort study. J Thorac Dis 2023;15:1210-6.

Keywords: Bronchopleural fistula (BPF); pneumonectomy; management and prevention

Submitted Aug 06, 2023. Accepted for publication Aug 25, 2023. Published online Sep 14, 2023.
doi: 10.21037/jtd-23-1231
View this article at: https://dx.doi.org/10.21037/jtd-23-1231

The bronchopleural fistula (BPF) is one of thoracic surgery's most critical post-operative complications (1). The BPF affects about 1.5% to 12.5% of pneumonectomies (2,3) and 1% of lobectomies or sublobar resections (4). It leads to further life-threatening complications, such as respiratory insufficiency, remaining lung pneumonia, or empyema. However, current studies report a reduction in mortality: 11% to 18% for early BPF (5) and 0% to 7% (6,7) for late BPF; it remains a significant prognostic factor for survival and a challenge for the surgeon.

The risk factors for BPF development include general factors: malnutrition, anemia, steroid therapy, diabetes, and neoadjuvant therapy, as well as factors related to the operation: ischemia of the bronchial stump caused by extensive lymphadenectomy or long post-operative bronchial stump (8,9). In addition, right-sided pneumonectomy is also one of the most important risk factors for the development of BPF (10).

BPF prophylaxis includes several surgical techniques that potentially improve bronchial stump healing, such as buttressing the bronchial stump with well-perfused tissues like intercostal muscle flap parietal pleura or pericardium fat pad (10-12). Despite the frequent use of this technique, for example, during pneumonectomy, both the best buttressing material and the actual benefit of the bronchial stump coverage remain controversial (12). One of the few randomized trials by Sfyridis *et al.* (11) reported a potential advantage in patients with diabetes. They found a lower incidence of BPF in the group of 68 diabetic patients whose post-pneumonectomy bronchial stump was covered with the intercostal muscle flap. This influence, such buttressing was significant in the univariate analysis but not in the multivariate (11). According to the study from our department, none of the tissues used for bronchial buttressing significantly decreased the incidence of BPF (10). Furthermore, limiting the number of intercostal muscle flap and pericardium fat coverages did not increase the BPF occurrence in the last decade (10). Again, Piwkowski *et al.* (13) used the indocyanine green fluorescence intraoperatively to identify the intercostal muscle flap ischemic section. Supporting the bronchial stump with such low-perfused tissue part may adversely affect the healing process.

BPF closure is a tough challenge for the thoracic surgeon. Consensus has not been reached on the treatment of BPF either, therefore, it may include conservative treatment as well as surgical interventions. None of these approaches is universal and suitable for all patients. The choice of treatment and its success depends on many factors: the patient's general condition, BPF early presentation, dehiscence size, length of the bronchial stump, or quality of the remnant stump tissue (14). The most

^ ORCID: 0000-0002-7056-4472.

common recommendation is that the initial management should include drainage of the infected pleural space, adequate antibiotic therapy, and debridement of bronchial secretions (15). Drainage of the pleural space should be followed by the bronchoscopy, identifying the BPF, and assessing the dehiscence size (15).

A crucial element of the entire pulmonary resection is the preservation of a short, firm bronchial stump. Some recommendations state that in case of BPF development in the long bronchial stump, the stump should be trimmed back with maintaining a minimum of 3 mm of bronchial stump length (16). Shortening and sealing of the stump should be done with a stapler, or if there is not enough space, it should be sutured with absorbable monofilament. A vascularized tissue cover may also be used to improve healing (15).

In many cases, unfortunately, further treatment may require more aggressive surgery, such as the transthoracic stump revision, window thoracostomy, or chest-wall fenestration, followed by filling the cavity (17). Although the experience of many centers confirms the high effectiveness of aggressive surgical treatment, including open-window drainage, more conservative methods may be an alternative for compromised patients after extensive procedures.

In selected cases, one of the possible options could be endoscopic treatment. An undoubted advantage of endoscopic closure is the possibility of avoiding another extensive operation. Boudaya *et al.* obtained favorable results by using endoscopic fistula closure with the local application of silver nitrate through a flexible bronchoscope in a relatively small group of 17 patients (18). It should be noted that endoscopic treatment may be used in justified, selected cases. Firstly, it seems that BPF healing can be achieved via endobronchial therapy in patients without sepsis, in the small, less than 5 mm dehiscences. In such cases, endoscopic use of fibrin glue (19) or silver nitrate (18,20) may help avoid major surgery.

In China, on a group of 148 patients, an attempt was made to supply BPF with customized airway stenting. Han *et al.* used the stents with the bullet head or a special part of the covered airway stent to occlude the BPF. The stenting effectively occluded the BPF in 96.6% of patients (21). In the short-term follow-up (30 days), 141 patients reported relief in symptoms. The time to stent removal ranged from 47 to 270 days (21). Cusumano *et al.* successfully used the self-expanding stent and, subsequently, a Dumon prosthesis in the patient with two BPFs after the right upper lobectomy (22).

In their paper, Wang *et al.* (23) retrospectively compared the conservative and operative BPF treatment results. Currently, only a few studies adequately address the problem of BPF treatment. Here the authors provided the results of a group of patients operated on due to malignancy in the high-volume center. In their paper, the authors described the techniques used in the treatment of BPF in patients after a wide range of thoracic procedures, including video-assisted thoracoscopic surgery (VATS) lobectomies, pulmonary sleeve lobectomies, esophageal resections or pneumonectomies. They managed the most BPF using bronchoscopic stent implantation or combining stenting with other techniques. However, there were no patients in the study group who underwent open thoracostomy except one who underwent thoracoplasty. Nevertheless, it should be remembered that in many patients with BPF, an open thoracostomy is not only unavoidable but also the method that can give a chance of closing the fistula. A recent case series in the literature show how an open window thoracostomy performed early and maintained for about five months significantly increases the chance of BPF healing (24). In Wang *et al.* (23) study, the interventional group presented better outcomes in 28- and 90-day follow-up. Although interventional treatment did not bring a significant benefit in the long-term work, including 5-year survival, it is worth recommending as potentially benefiting patients in the short term after surgery.

Despite advances in thoracic surgery, including access to minimally invasive therapies, early diagnosis, antibiotic therapy, and perioperative care, BPF remains one of the most severe complications in thoracic surgery. As a result of the lack of consensus regarding the treatment of BPF, selection bias is difficult to avoid in scientific articles attempting to study the effectiveness of the therapy. Much depends on the center's experience, the surgeon's decisions, skills, or access to a well-equipped endoscopic laboratory.

None of the prevention methods guarantees the complete elimination of BPF formation, and there is no universal method of BPF treatment. In such a situation, even greater individualization of treatment is necessary. The most chances are given by a very careful qualification followed by close monitoring of patients from risk groups. Particular care should be taken when attempting to perform a pneumonectomy. Pneumonectomy, although being a very extensive operation associated with the possibility of numerous complications, is still an effective treatment for patients with centrally located non-small cell lung cancer (NSCLC) (25). In the era of modern therapies, including

immunotherapy, it should be considered whether such extensive treatments make sense in terms of long-term survival and the patient's quality of life.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Journal of Thoracic Disease*. The article did not undergo external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1231/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Asamura H, Naruke T, Tsuchiya R, et al. Bronchopleural fistulas associated with lung cancer operations. Univariate and multivariate analysis of risk factors, management, and outcome. J Thorac Cardiovasc Surg 1992;104:1456-64.
2. Klepetko W, Taghavi S, Pereszlenyi A, et al. Impact of different coverage techniques on incidence of postpneumonectomy stump fistula. Eur J Cardiothorac Surg 1999;15:758-63.
3. Sirbu H, Busch T, Aleksic I, et al. Bronchopleural fistula in the surgery of non-small cell lung cancer: incidence, risk factors, and management. Ann Thorac Cardiovasc Surg 2001;7:330-6.
4. Nagahiro I, Aoe M, Sano Y, et al. Bronchopleural fistula after lobectomy for lung cancer. Asian Cardiovasc Thorac Ann 2007;15:45-8.
5. Hu XF, Duan L, Jiang GN, et al. A clinical risk model for the evaluation of bronchopleural fistula in non-small cell lung cancer after pneumonectomy. Ann Thorac Surg 2013;96:419-24.
6. Jichen QV, Chen G, Jiang G, et al. Risk factor comparison and clinical analysis of early and late bronchopleural fistula after non-small cell lung cancer surgery. Ann Thorac Surg 2009;88:1589-93.
7. Bribriesco A, Patterson GA. Management of Postpneumonectomy Bronchopleural Fistula: From Thoracoplasty to Transsternal Closure. Thorac Surg Clin 2018;28:323-35.
8. Caushi F, Qirjako G, Skenduli I, et al. Is the flap reinforcement of the bronchial stump really necessary to prevent bronchial fistula? J Cardiothorac Surg 2020;15:248.
9. Salik I, Vashisht R, Abramowicz AE. Bronchopleural Fistula. Treasure Island (FL): StatPearls Publishing; 2023.
10. Skrzypczak P, Roszak M, Kasprzyk M, et al. The technique of stump closure has no impact on post-pneumonectomy bronchopleural fistula in the non-small cell lung cancer-a cross-sectional study. J Thorac Dis 2022;14:3343-51.
11. Sfyridis PG, Kapetanakis EI, Baltayiannis NE, et al. Bronchial stump buttressing with an intercostal muscle flap in diabetic patients. Ann Thorac Surg 2007;84:967-71.
12. Taghavi S, Marta GM, Lang G, et al. Bronchial stump coverage with a pedicled pericardial flap: an effective method for prevention of postpneumonectomy bronchopleural fistula. Ann Thorac Surg 2005;79:284-8.
13. Piwkowski C, Gabryel P, Gąsiorowskia Ł, et al. Indocyanine green fluorescence in the assessment of the quality of the pedicled intercostal muscle flap: a pilot study. Eur J Cardiothorac Surg 2013;44:e77-81.
14. Wright CD, Wain JC, Mathisen DJ, et al. Postpneumonectomy bronchopleural fistula after sutured bronchial closure: incidence, risk factors, and management. J Thorac Cardiovasc Surg 1996;112:1367-71.
15. Clark JM, Cooke DT, Brown LM. Management of Complications After Lung Resection: Prolonged Air Leak and Bronchopleural Fistula. Thorac Surg Clin 2020;30:347-58.
16. Litle VR. Management of Post-pneumonectomy Bronchopleural Fistula: A Roadmap for Rescue. Semin Thorac Cardiovasc Surg 2018;30:114-5.
17. Lois M, Noppen M. Bronchopleural fistulas: an overview

of the problem with special focus on endoscopic management. Chest 2005;128:3955-65.
18. Boudaya MS, Smadhi H, Zribi H, et al. Conservative management of postoperative bronchopleural fistulas. J Thorac Cardiovasc Surg 2013;146:575-9.
19. Hollaus PH, Lax F, Janakiev D, et al. Endoscopic treatment of postoperative bronchopleural fistula: experience with 45 cases. Ann Thorac Surg 1998;66:923-7.
20. Stratakos G, Zuccatosta L, Porfyridis I, et al. Silver nitrate through flexible bronchoscope in the treatment of bronchopleural fistulae. J Thorac Cardiovasc Surg 2009;138:603-7.
21. Han X, Yin M, Li L, et al. Customized airway stenting for bronchopleural fistula after pulmonary resection by interventional technique: single-center study of 148 consecutive patients. Surg Endosc 2018;32:4116-24.
22. Cusumano G, Terminella A, Vasta I, et al. Endoscopic stenting for double bronco-pleural fistula after lobectomy. Asian Cardiovasc Thorac Ann 2015;23:995-7.
23. Wang Y, Zhu M, Pan Y, et al. Long-term follow up and comparison between conservative and interventional therapy in postoperative bronchopleural fistula-a cohort study. J Thorac Dis 2023;15:1210-6.
24. Massera F, Robustellini M, Della Pona C, et al. Open window thoracostomy for pleural empyema complicating partial lung resection. Ann Thorac Surg 2009;87:869-73.
25. Skrzypczak PJ, Roszak M, Kasprzyk M, et al. Pneumonectomy - permanent injury or still effective method of treatment? Early and long-term results and quality of life after pneumonectomy due to non-small cell lung cancer. Kardiochir Torakochirurgia Pol 2019;16:7-12.

Cite this article as: Skrzypczak PJ, Kasprzyk M, Piwkowski C. The review of the management and prevention methods of bronchopleural fistula in thoracic surgery. J Thorac Dis 2023;15(10):5268-5271. doi: 10.21037/jtd-23-1231