Thoracic Cancer

Open Access

Thoracic Cancer ISSN 1759-7706

CASE REPORT

New treatment of bronchopleural fistula following surgical resection of the dorsal segment of the left lower lobe: A case report

Ziyi Liu[1†], Jingyu Mao[1†], Meiqing Su[1], Chuangyong Mu[1], Tao Chen[1], Jun Zhao[2] & Junhong Jiang[1]

1 Department of Respiratory Medicine, The First Affiliated Hospital of Soochow University, Suzhou, China
2 Department of Thoracic Surgery, The First Affiliated Hospital of Soochow University, Suzhou, China

Keywords
Bronchopleural fistula; bronchoscopic interventional therapy; case; treatment.

Correspondence
Junhong Jiang, Department of Respiratory Medicine, The First Affiliated Hospital of Soochow University, 899 PinghaiSt. Suzhou, Jiangsu, 215006, China.
Tel: +86 138 1267 3528
Fax: +86 22 6797 2092
Email: jiang20001969@163.com

Jun Zhao, Department of Thoracic Surgery, The First Affiliated Hospital of Soochow University, Suzhou, Jiangsu, 215006, China.
Tel: +86 138 5039 9999
Fax: +86 22 6797 2277
Email: zhaojia0327@126.com

†These authors contributed equally.

Received: 24 August 2020;
Accepted: 20 October 2020.

doi: 10.1111/1759-7714.13734

Thoracic Cancer **12** (2021) 382–386

Abstract

Anatomical segment-based or subsegmental resection for early lung cancer surgery has been used in selected cases, although postoperative complications of bronchopleural fistula sometimes occur. Persistent air leaks can cause complications such as empyema and aspiration pneumonia, resulting in prolonged patient hospitalization. The traditional treatment for postoperative bronchopleural fistula is reoperation, but the advent of bronchoscopic interventional therapy usually prevents patients from needing a second operation. This article details a case of thoracoscopic segmentectomy of the left lower lung dorsal segment resulting in residual subsegmental pleural fistula, and because the use of pleural adhesives made the patient's fistula inappropriate for surgical repair, we finally used bronchoscopic injury of the airway mucosa combined with an absorbable gelatin sponge and an autologous blood closure method for successful treatment.

Introduction

Sublobectomy effectively preserved lung function, but did not reduce the incidence of postoperative air leakage(PAL). Postoperative PAL requires the differentiation of whether the air leak is derived from bronchial or pulmonary tissue, that is, bronchopleural fistula bronchopleuralfistula or alveolar pleural fistula Alveolopleuralfistula. The treatment of these two is different. Postoperative bronchopleural fistula is uncommon, but can increase patient suffering and prolong hospital stay. Current treatment measures for bronchopleural fistulas include reoperation and bronchoscopic intervention. Bronchoscopic interventions include bronchoscopic closure agents and occluder closure. This article details a case of thoracoscopic segmentectomy (left lower lung dorsal segment) leading to the formation of residual subsegmental pleural fistula,and because the use of pleural adhesives made the patient's fistula inappropriate for surgical repair, we finally used bronchoscopic injury of the airway mucosa combined with an absorbable gelatin sponge and an autologous blood closure method for successful treatment.

Case report

A 49-year-old female patient visited the Outpatient Department of Respiratory and Critical Care Medicine of

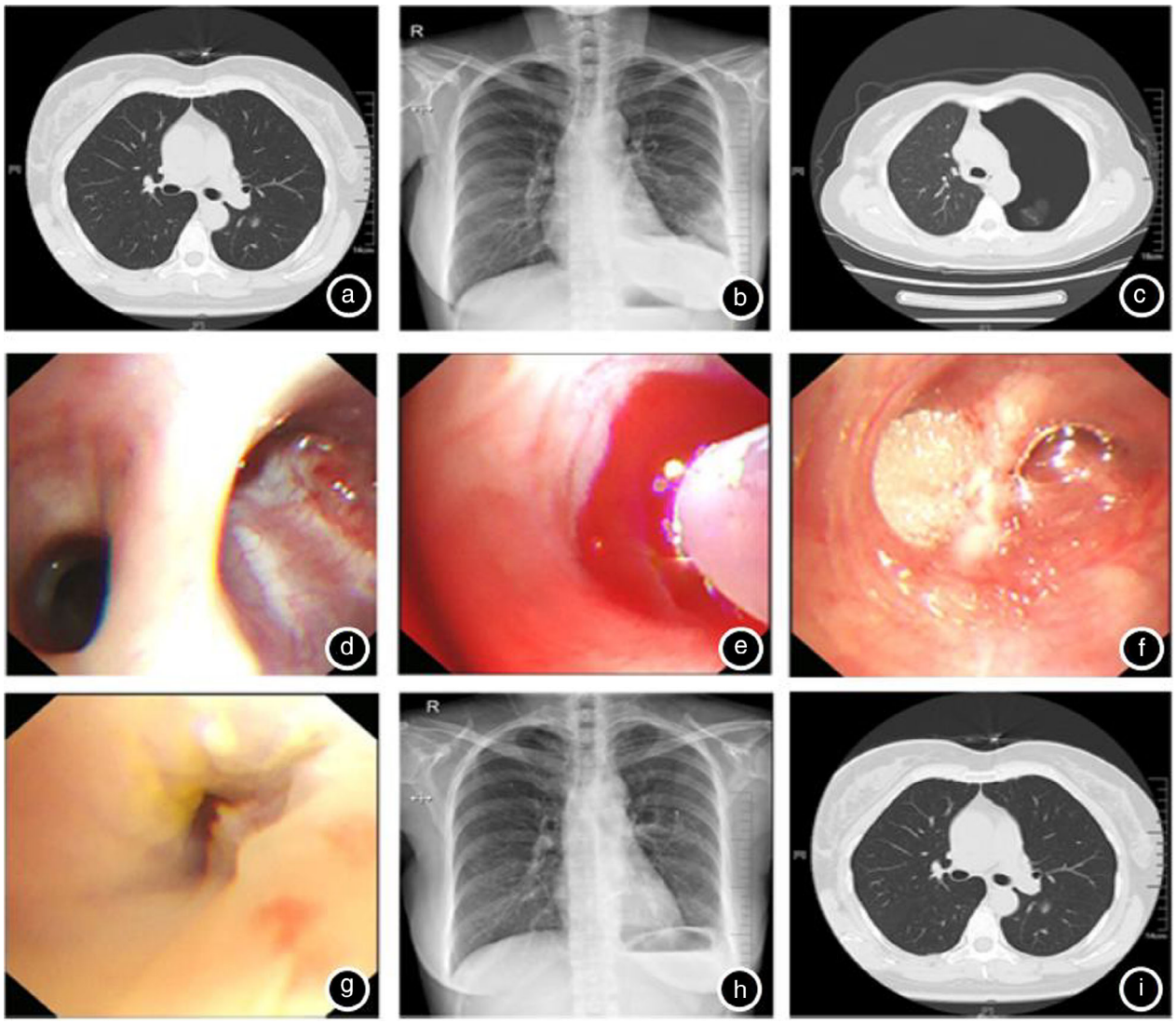

Figure 1 (**a**) Preoperative chest CT showed a small nodule in the dorsal segment of the left lower lung. (**b**) Chest radiography showed a small amount of pneumothorax 21 days after surgery. (**c**) Chest CT showed left hydropneumothorax, 90% compression of the left lung, and subcutaneous emphysema of the left chest wall more than one month after surgery. (**d**) Bronchoscopy showed fistula formation in the B6a subsegment of the dorsal segment of the left lower lobe. (**e**, **f**) Autologous blood, and absorbable gelatin sponge closure of the fistula. (**g**) Bronchoscopy showed that the fistula was significantly reduced after using the cytobrush combined with autologous blood and gelatin sponge closure. (**h**, **i**) Chest radiography and chest CT after the pneumothorax was resolved.

the First Affiliated Hospital of Soochow University with a history of progressive aggravation of chest tightness and shortness of breath for more than one month. The patient underwent chest computed tomography (CT) examination, and pulmonary nodules were observed in the dorsal segment of the left lower lobe, with a nodule size of 8 mm. There was no lymph node enlargement, which was staged as T1aN0M0 (Fig 1a). The patient had undergone right breast lumpectomy in May 2018, and intraoperative rapid pathology revealed right breast adenopathy. Because postoperative routine pathology revealed mucinous carcinoma, regional lymphadenectomy (right sentinel) was performed in June 2018. The patient had undergone local radiotherapy to the right breast from July to September 2018. The patient underwent preoperative examination and had normal pulmonary function without surgical contraindications. Therefore, the patient underwent thoracoscopic segmentectomy (left lower lung dorsal segment) on 1 November 2019. Intraoperative rapid pathology revealed that the specimen was wedge-stapled lung tissue, and 0.8 cm grayish white nodules were observed at the local frenum that were diagnosed as left lower lobe dorsal

segment adherent growing predominant adenocarcinoma, and segmentectomy was subsequently performed. Postoperative pathology indicated adenocarcinoma of the dorsal segment of the left lower lobe without pleural involvement. Immunohistochemistry showed that cancer cells were CK7 (+), TTF-1 (+), napsin (+), Ki-67 (+ 5%), PD-L122C3 (−), CK5/6 (−), and ALK (D5F3) (−). Chest radiography within one week after surgery showed no pneumothorax. A small amount of pneumothorax was observed upon re-examination of the chest radiographs 21 days after discharge (Fig 1b), and no special treatment was provided at that time. Subsequently, the patient had aggravated shortness of breath and felt gas overflowing from the thoracic cavity to the left breast during expiration. On 24 December, the patient visited the respiratory outpatient department, and chest computed tomography (CT) showed left hydropneumothorax, 90% compression of the left lung, and subcutaneous emphysema of the left chest wall (Fig 1c). The patient was admitted for pneumothorax treatment. The detailed treatment process of the patient can be seen in (Fig 2).

After hospitalization, the patient was given thoracic cavity combined with continuous closed thoracic drainage, and the symptoms of shortness of breath were improved, but the thoracic air leakage was not significantly improved. The severity of air leakage was grade IV according to the air leakage grade proposed by CerRJ.[1] Therefore, the patient was transferred to thoracic surgery for treatment, and was given pleural cavity injection of pleural adhesive polymer, which failed to solve the problem of thoracic air leakage, and she was still grade IV. The respiratory physician recommended bronchoscopy to ascertain the cause of the air leak. The first bronchoscopy revealed that the B6a subsegment at the surgical end of the dorsal segment of the left lower lobe had failed to seal completely, and the mucosa was more hypertrophic (Fig 1d). It was clarified that the cause of persistent air leakage after surgery was bronchopleural fistula, which was located in the B6a subsegment of the dorsal segment accompanied by fistula formation, and the size of the fistula was about 5 mm in diameter. For the first bronchoscopic treatment, 10 mL of autologous blood was injected into the fistula via a guiding sheath (modified for bronchoscopic cell brush with the core removed) (Fig 1e). Soon, the air leakage in the thoracic cavity stopped, the thoracic drainage tube was continuously clamped, and chest radiography revealed pulmonary recruitment. However, after removal of the chest drainage tube, the patient developed chest tightness and shortness of breath again, and the chest cavity still continued to leak, with air leakage grade IV. On the second bronchoscopic treatment, after finding the fistula, air bubble spillage was observed by injecting normal saline. Therefore, the respiratory physician took autologous blood and thrombin to block the fistula and applied continuous closed thoracic drainage, but the air leakage still persisted. On the third bronchoscopic treatment, after the respiratory physician found the fistula site, a small amount of bubble overflow was observed when normal saline was injected. Therefore, the doctor used an absorbable gelatin sponge (produced by Nanjing Jinling Pharmaceutical Factory, a subsidiary of Jinling Pharmaceutical Co., Ltd.) combined with autologous blood for occlusion twice, yet the air leak still persisted at grade IV. Since the location of the patient's fistula was not conducive to occluder closure, in the fourth bronchoscopic treatment the respiratory physician repeatedly scratched the fistula mucosa with a cytobrush to stimulate its mucosal proliferation and produce granulation, combined with an absorbable gelatin sponge combined with autologous blood closure. After treatment, the patient's air leakage gradually decreased and was downgraded to grade 2. The operation steps were as follows: first, the fistula mucosa was repeatedly brushed and scraped with a bronchoscopic cytobrush more than 100 times. Second, a precut absorbable gelatin sponge of appropriate size was put into the front channel of the modified cytobrush (by pulling out the inner core of the cytobrush, using the outer tube as the blocking agent to guide the sheath, and using the inner core with the cytobrush bristles removed as the pusher), repeatedly placing the trimmed absorbable gelatin sponge many times until it was filled (Fig 1f). Finally, 10 mL of autologous blood was drawn and injected into the fistula along the outer tube again. One week later, bronchoscopy showed granulation hyperplasia of the fistula, making the fistula orifice smaller (Fig 1g). Therefore, the fifth treatment again used repeated brushing of the fistula mucosa with a cytobrush and simultaneous closure with a gelatin sponge combined with autologous blood. There was no gas overflow from the patient's chest tube after the procedure. Re-examination by chest X-ray showed complete pulmonary re-expansion, so the drainage tube was removed (Fig 1h). Two months later, the chest CT revealed no pneumothorax or left lower atelectasis (Fig 1i).

Discussion

With chest CT as a screening tool for lung cancer, the detection rate of early lung cancer is increasing. There is no prognostic difference between lobectomy and sublobectomy in patients with clinical T1aN0 adenocarcinoma.[2] A large multicenter clinical study on surgical methods found that the incidence rate of pneumothorax after lobectomy was 12% (44/357 cases), the incidence rate after sublobectomy was 10% (36/340), the incidence rate of prolonged air leakage (more than five days) after lobectomy was 9% (33/357), and the incidence rate after

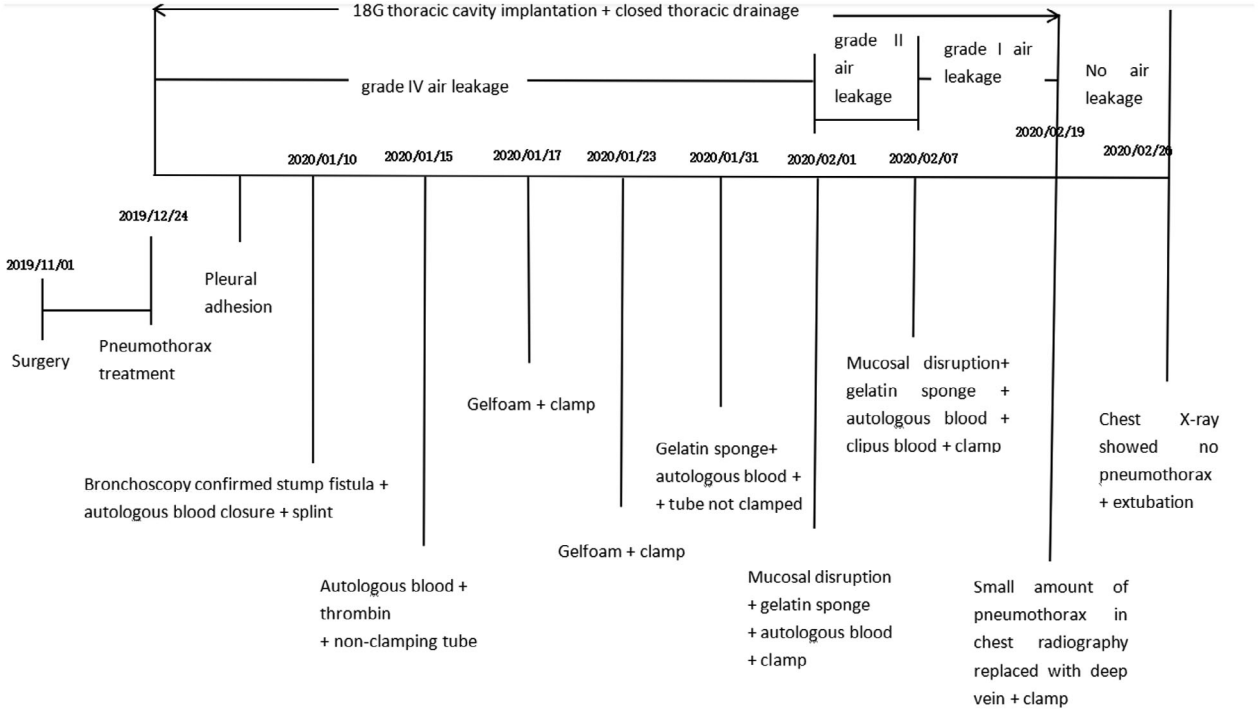

Figure 2 Treatment flow of bronchopleural fistula.

sublobectomy was 7% (25/340).[3] Sublobectomy effectively preserves lung function, but it does not reduce the incidence of postoperative air leakage. Postoperative persistent air leak (PAL) refers to air being able to enter the pleural space through the airway or alveolar space that directly communicates with the pleura.[4] Persistent air leaks can cause complications such as empyema and aspiration pneumonia, resulting in prolonged patient hospitalization. The occurrence of PAL after surgery requires determination of whether the air leak originates from bronchial or pulmonary tissue; that is, whether it is a bronchopleural fistula or an alveolopleural fistula. The treatment of the two is different, and the best way to differentiate the two air leaks is via bronchoscopy.[5] The current patient was diagnosed with bronchopleural fistula by bronchoscopy one month after operation. The reasons for delayed diagnosis were that the chest X-ray before discharge showed no pneumothorax, and during postoperative outpatient follow-up, the patient's clinical symptoms were not obvious. The chest X-ray at that time suggested a small amount of pneumothorax, which failed to attract the attention of the physician.

Currently, the treatment measures for bronchopleural fistula include reoperation and bronchoscopic intervention. Bronchoscopic interventions include bronchoscopic closure agents and occluder closure. In patients with contraindications for surgery or underlying diseases with poor prognosis, clinicians choose selective bronchial occlusion (SBO) as an economical, safe, and minimally invasive bronchoscopic interventional technique.[6] SBO refers to the selective temporary closure of the draining bronchi leading to pleural fistulas (or ruptures) to block or significantly reduce the amount of air leakage from pleural fistulas. There are many forms of plugging agents reported in the literature; for example, autologous blood, autologous blood + thrombin,[7] n-butyl cyanoacrylate glue,[8] and EWS (endobronchial Watanabe spigot, a silicone-made bronchial filler).[9] The absorbable gelatin sponge is a water-soluble hemostatic material made from purified porcine gelatin that has ultra-strong water absorption and is cheap and widely used in clinical practice.

Autologous blood occlusion and autologous blood combined with absorbable gelatin sponge occlusion were unsuccessful in the treatment of this patient. The reasons may be that there was a large fistula, so that the closure material could not successfully occlude it, and due to the anatomical location of the fistula, a fine bronchoscope was required to see it. It was therefore very difficult for the respiratory physician to implant the occluder. This patient could not receive surgery to repair the bronchopleural fistula because of the use of a pleural cavity adhesive. The surgical risk was high, so only endoscopic treatment was appropriate. Although bronchoscopic interventions prolong the length of hospital stay, the patient benefit ratio is high.

Why do we use methods that disrupt the mucosa leading to tissue granulation hyperplasia? When our team studied a rabbit model of airway stenosis constructed by benign airways, we found that scraping the tracheal mucosa with a brush could lead to granulation hyperplasia in the first two weeks, and in the fourth week, granulation gradually forms scar contracture, which eventually leads to tracheal stenosis. Therefore, we used a method for destroying the tracheal mucosa to lead to granulation hyperplasia to make the fistula smaller, while using an absorbable gelatin sponge and autologous blood closure, so as to treat persistent air leakage. We dynamically used bronchoscopic monitoring during granulation to avoid obstructing the adjacent bronchus.

At the same time, we found that after applying the closure agent, when the chest drainage tube was not clamped, the thoracic pressure in the open state was affected by coughing, resulting in expectoration of the closure agent. Therefore, we recommend that after successful occlusion, the drainage tube is clamped and the clamped tube is intermittently released to observe the air leakage.

In summary, here we report for the first time the use of bronchoscopic injury of airway mucosa combined with an absorbable gelatin sponge and autologous blood closure to successfully solve the problem of bronchopleural fistula after segmentectomy in a patient with early lung cancer. This method is simple and easy, without significant side effects, and can be used as the preferred treatment by clinicians.

Disclosure

No authors report any conflict of interest.

References

1 Cerfolio RJ, Tummala RP, Holman WL *et al.* A prospective algorithm for the management of air leaks after pulmonary resection. *Ann Thorac Surg* 1998; **66**: 1726–30.
2 Altorki NK, Yip R, Hanaoka T *et al*. Sublobar resection is equivalent to lobectomy for clinical stage 1A lung cancer in solid nodules. *J Thorac Cardiovasc Surg* 2014; **147**: 754–64.
3 Altorki NK, Wang X, Wigle D *et al.* Perioperative mortality and morbidity after sublobar versus lobar resection for early-stage non-small-cell lung cancer: Post-hoc analysis of an international, randomised, phase 3 trial (CALGB/Alliance 140503). *Lancet Respir Med* 2018; **6**: 915–24.
4 Fuso L, Varone F, Nachira D *et al.* Incidence and management of post-lobectomy and pneumonectomy bronchopleural fistula. *Lung* 2016; **194**: 299–305.
5 Mueller MR, Marzluf BA. The anticipation and management of air leaks and residual spaces post lung resection. *J Thorac Dis* 2014; **6**: 271–84.
6 Zeng Y, Hong M, Zhang H *et al.* Transbronchoscopic selective bronchial occlusion for intractable pneumothorax. *Respirology* 2010; **15**: 168–71.
7 Lillington GA, Stevens RP, DeNardo GL. Bronchoscopic location of bronchopleural fistula with xenon-133. *J Nucl Med* 1982; **23**: 322–3.
8 Sarkar A, Ghosh S, Bardhan S. Endobronchial sealing of bronchopleural fistula following capnographic detection: A new mode of therapy. *Indian J Chest Dis Allied Sci* 2008; **50**: 203–8.
9 Morikawa S, Okamura T, Minezawa T *et al.* A simple method of bronchial occlusion with silicone spigots (Endobronchial Watanabe Spigot; EWS(R)) using a curette. *Ther Adv Respir Dis*. 2016; **10**: 518–524.

