

## Postoperative Bronchial Stump Fistula Responding Well to Occlusion with Metallic Coils and Fibrin Glue via a Tracheostomy: A Case Report

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An 80-year-old man underwent middle and lower lobectomy of the right lung to treat squamous cell carcinoma (SCC) (4 cm in diameter) originating from the right B<sup>4</sup> bronchus. On the 4th postoperative day, a massive air leak from the thoracic drain was noted. At that time, a diagnosis of bronchial stump fistula was made on the basis of the bronchoscopic findings. Continuous thoracic drainage, aspiration of sputum via a tracheostomy and intravenous administration of antibiotics were performed immediately after the diagnosis. However, the patient's condition was complicated by aspiration pneumonia. On the 11th postoperative day, bronchoscopic procedure to close the bronchial fistula was performed via the tracheostomy. During this procedure, metallic coils were first inserted into the fistula to serve as the core for occlusion. Then, instead of directly infusing fibrin glue, several small beans-sized pieces of Surgicell cotton (Johnson & Johnson Co., Cincinnati, OH) soaked in fluid A (concentrated fibrinogen) and the same number of Surgicell cotton pieces soaked in fluid B (thrombin) were alternately inserted into the fistula, to allow closure of the bronchial fistula. After this procedure, the embolus created remained in place without being expectorated, and the aspiration pneumonia entered remission, allowing the patient to be discharged from the hospital on the 24th postoperative day. At preset, 14 months after surgery, the patient is in good condition. This technique allows simple and reliable closure of a fistula if a tracheostomy is available. It should be selected as a therapy of first choice when dealing with patients with a postoperative bronchial stump fistula in poor general condition. Patients undergoing right pneumonectomy or middle and lower lobectomy of the right lung should be considered as belonging to a high risk group for bronchial fistula and as requiring preventable measures (e.g., covering the stump with an intercostal muscle flap). (*Ann Thorac Cardiovasc Surg* 2005; 11: 104–8)

**Key words:** bronchial stump fistula, postoperative complication, metallic coil, fibrin glue, tracheostomy

### Introduction

Bronchial stump fistula after resection of the lung is often intractable. It is one of the difficult-to-treat postop-

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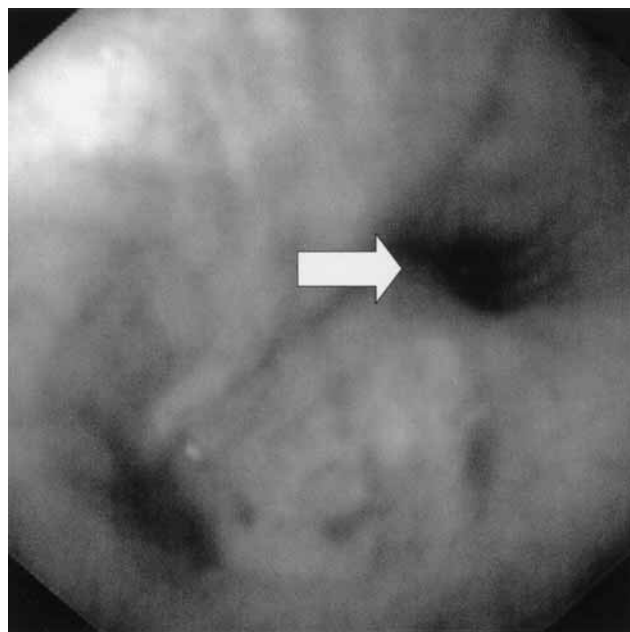
erative complications. In the past, bronchoscopic occlusion using adhesives (Histoacryl, fibrin glue, etc.) was reported as a means of treating bronchial fistula.<sup>1)</sup> However, since the embolus created with an adhesive alone was often blown away by coughing, this method was not adequately effective. Later, Watanabe et al.<sup>2)</sup> reported the effectiveness of a non-surgical method of treating bronchial fistula, involving infusion of an adhesive to fix metallic coils which served as a core of occlusion. As a method of occlusion more reliable than the technique reported by Watanabe et al., we recently devised a technique of occlusion using metallic coils and fibrin glue-immersed Surgicell cotton pieces which are inserted via

a tracheostomy. We successfully applied this technique to a case of postoperative bronchial stump fistula. This paper will present this technique as a means of closing a bronchial fistula that is more reliable than previous techniques, with reference to the literature.

## Case Report

The patient was an 80-year-old man. In June 2003, he was found to have an abnormal chest shadow on X-ray during a health check-up. He consulted a nearby clinic for a detailed examination. At that clinic, he was diagnosed as having squamous cell carcinoma (SCC) originating from the middle lobe of the right lung (causing complete obstruction of the B<sup>4</sup> bronchus). He was then referred to our department for surgical treatment. On admission, no abnormality was revealed in hematological tests or urinalysis. All tumor markers tested in the normal range, with carcinoembryonic antigen (CEA) being 3.2 ng/ml (normal range: 0-5.0 ng/ml), SCC antigen being 0.8 ng/ml (normal range: 0-1.5 ng/ml) and neuron-specific enolase (NSE) being 6.3 ng/ml (normal range: 0-10 ng/ml). Chest CT scans revealed a tumor (4×3 cm) which had occluded the B<sup>4</sup> bronchus. The tumor seemed to have invaded the bronchi and pulmonary artery within the lower lobe. Metastasis to mediastinal lymph nodes (No. 3 and 4) was also suggested. The respiratory function test revealed obstructive disorder of the respiratory system. Vital capacity (VC) was 3.39L, %VC was 86.6%, forced expiratory volume in 1 second (FEV<sub>1.0</sub>) was 1.18L and FEV<sub>1.0</sub>% was 37.9%. Arterial blood gas analysis suggested a mild ventilation disorder, with pH being 7.355, arterial partial pressure of carbon dioxide (PaCO<sub>2</sub>) being 48.7 mmHg, arterial partial pressure of oxygen (PaO<sub>2</sub>) being 76.1 mmHg and base excess (BE) being 0.6.

On the basis of these test results, the patient was diagnosed as having SCC, originating from the middle lobe of the right lung, with a high probability of having invaded the bronchi and pulmonary artery within the lower lobe of the right lung. We judged that curative resection would be possible by middle and lower lobectomy + mediastinal lymph node dissection. The patient was thus operated on August 25, 2003. Intraoperatively, the cancer was confirmed at the base of the middle lobe of the right lung, 4 cm in size and having invaded the pulmonary artery and bronchi within the lower lobe. As planned, middle and lower lobectomy was performed. The bronchi after resection were closed by the Sweet technique, using TX30-3.5 (Johnson & Johnson CO., Cincinnati,

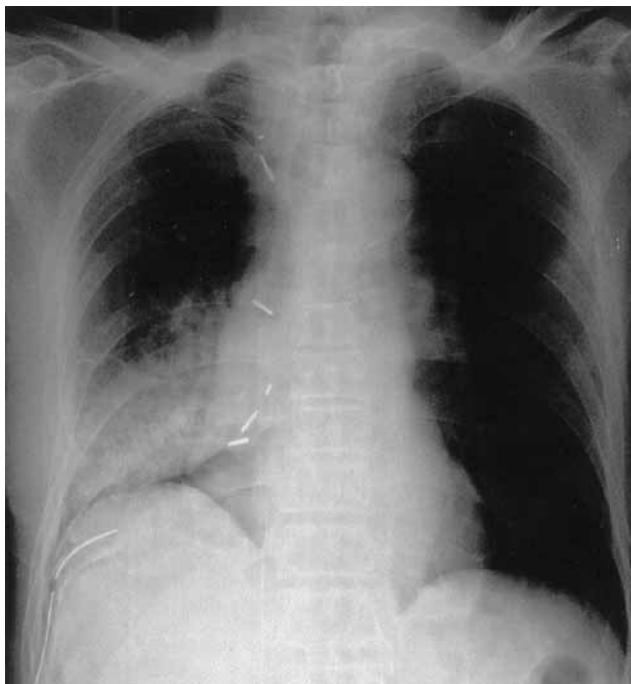


**Fig. 1.** Bronchoscopic findings (before occlusion). A bronchial fistula (about 2 mm in diameter) is seen at the lateral edge of the stump of the intermediate bronchus.

OH). The bronchial stump was not covered. Then the mediastinal lymph nodes dissection was added. A thoracic drain was left in the thoracic cavity, to complete the operation. The tumor was histopathologically rated as a well-differentiated SCC (3.5 cm in diameter), originating from the middle lobe of the right lung. The tumor had directly invaded the pulmonary artery. Of the excised lymph nodes, the No. 11i nodes had been affected by the tumor. The metastatic tumors in these lymph nodes had directly invaded the wall of the middle lobe bronchi (affecting the submucosal layer beyond the cartilage).

The patient followed an uneventful course until he suddenly developed a massive air leak from the thoracic drain on the 4th day postoperatively. At that time, bronchoscopy revealed a fistula (about 2 mm in diameter) at the lateral edge of the bronchial stump (Fig. 1). On the 5th day postoperatively, tracheostomy was carried out, and continuous thoracic drainage at a pressure of -10 cm H<sub>2</sub>O was performed. However, aspiration pneumonia developed on the side which had been operated on (Fig. 2), requiring bronchoscopic closure of the bronchial fistula.

Before adhesive was infused into the bronchial fistula, metallic coils designed for endovascular embolization were inserted into the bronchial fistula to serve as a core of occlusion. This technique used 4 straight type coils (TRUFILL Pushable Coil, Cordis Co., Cincinnati, OH),

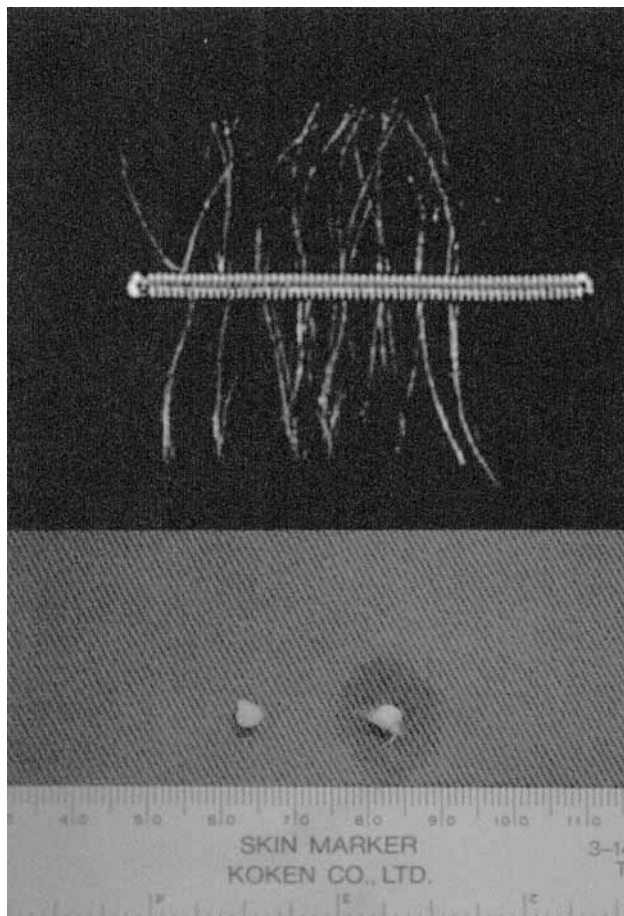


**Fig. 2.** Chest X-ray (before occlusion). A sign of aspiration pneumonia is visible on the operated side.

7 cm in size (Fig. 3). Then, small bean-sized pieces of cotton (Surgicell Absorbable Hemostat, Johnson & Johnson Co., Cincinnati, OH), soaked in either fluid A (concentrated fibrinogen) or B (thrombin) of fibrin glue, were inserted with biopsy forceps through the biopsy channel of the bronchoscopy into the bronchial fistula, via the tracheostomy. In this way, three pieces of cotton pre-soaked in fluid A and another three pieces of cotton pre-soaked in fluid B were pushed with biopsy forceps into the fistula in an alternating fashion (A → B → A → B → A → B), to close the bronchial fistula in a reliable manner (Fig. 4). The air leak from the thoracic drain stopped immediately after closure of the fistula. The patient did not develop empyema, and the thoracic drain was withdrawn 4 days after fistula closure. Since embolus expectoration was not seen and the aspiration pneumonia was resolved (Fig. 5), the patient was discharged from the hospital 35 days after the first operation (24 days after closure of the fistula). At present, 14 months after surgery, the patient is in good condition.

## Discussion

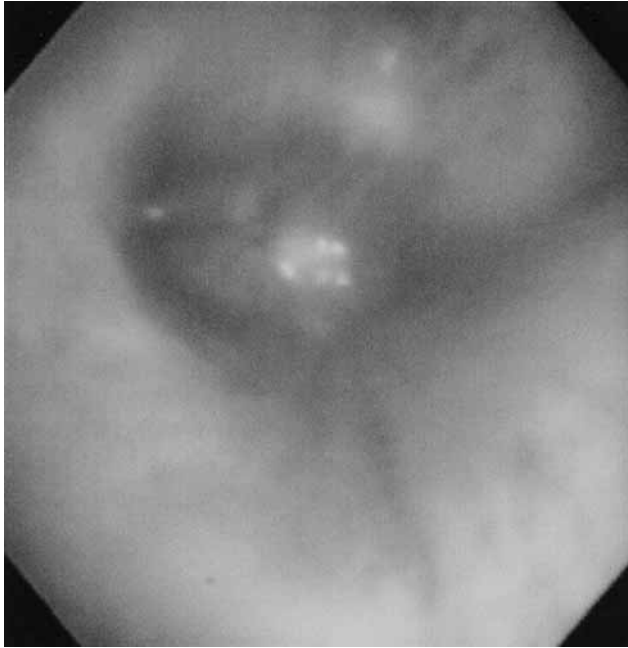
Postoperative bronchial fistula is the most difficult-to-treat complication after resection of the lung and it is one of the most troublesome complications faced by respiratory



**Fig. 3.** Metallic coil (TRUFILL Pushable Coil, straight type) and small bean-sized pieces of cotton (Surgicell Absorbable Hemostat) for occlusion.

surgeons. If infection due to bronchial fistula spreads to the thoracic cavity, empyema can develop, sometimes causing further complications (such as the ipsilateral or the contralateral aspiration pneumonia) which are sometimes fatal. The treatment for this complication usually include prevention of infection, closure of the fistula, and cleansing and decreasing of the empyemic cavity. Practically, thoracic drainage is often performed to deal with this complication. If the condition does not undergo remission, invasive treatment is then administered. In recent years, the number of reports on cases successfully healed by bronchoscopic closure of the fistula has been increasing.<sup>3)</sup>

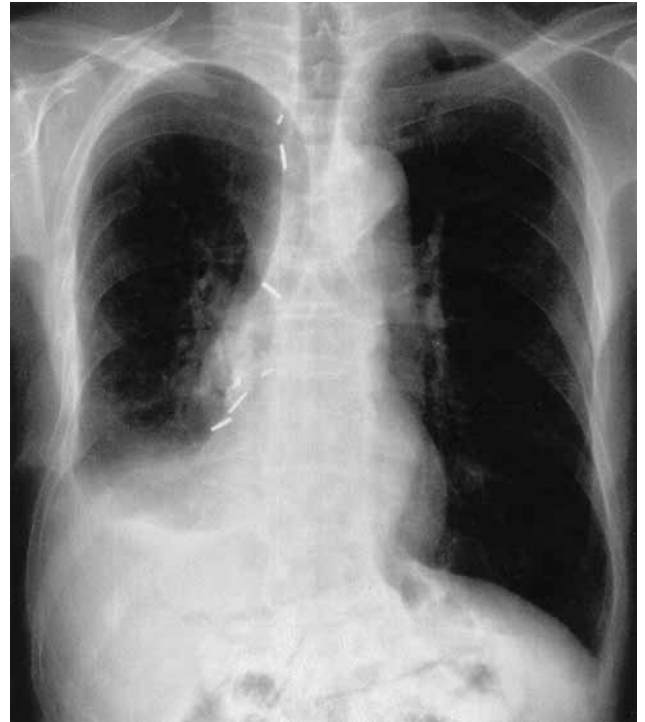
Several reports showed that occlusion with adhesives such as fibrin glue allowed successful bronchoscopic closure of bronchial fistula.<sup>4)</sup> Ikushima et al.<sup>5)</sup> and Glover et al.<sup>6)</sup> reported that infusion of fibrin glue into a bronchial fistula (5 mm in diameter in the former report and 4 mm in the latter report) under a bronchoscopic guide cured



**Fig. 4.** Bronchoscopic findings (after occlusion). The bronchial fistula at the lateral edge of the stump has been closed by the embolus.

the fistula. However, the diameter of the bronchial fistula was small (about 2 mm) in many of the reported cases of successful treatment with fibrin glue. If a bronchial fistula larger than about 2 mm is treated with occlusion using fibrin glue alone, the embolus created is highly likely to be blown away by coughing, and this treatment is unlikely to succeed. The same can also occur even in cases where the bronchial fistula is below 2 mm in size.

To resolve this problem and to allow more reliable occlusion, Watanabe et al. devised a technique by which metallic coils are inserted into the bronchial fistula prior to infusion of fibrin glue, so that the coils serve as the core for fibrin glue. They applied this coil occlusion method to the 4 bronchi of 2 patients. However, in all of these bronchi, the fibrin clot created as the embolus of the fistula was expectorated in a few days, leaving only coils in place and requiring as much as 1.5-2 months for the fistula to be completely filled with granulation tissue. In this respect, some investigators recommended occlusion using metallic coils alone without being combined with fibrin glue.<sup>7,8)</sup> Our technique resembles the technique reported by Watanabe et al. in that it uses metallic coils serving as the core for fibrin glue. However, our technique has modified the way by which an embolus is created by the fibrin glue. According to the technique reported by Watanabe et al., fluid A and B of fibrin glue are



**Fig. 5.** Chest X-ray (after occlusion). Aspiration pneumonia has been resolved.

sprayed into fistula in an alternating fashion. With their technique, the fibrin clot did not adequately capture the coils serving as the core of embolus, resulting in the likelihood of the fibrin clot to be blown away by coughing. With our technique, on the other hand, small bean-sized pieces of Surgicell cotton, pre-soaked in fluid A or B of fibrin glue, are held with biopsy forceps through the biopsy channel of a bronchoscope inserted into the bronchial fistula. That is, several pieces of cotton containing fluid A and the same number of cotton pieces containing fluid B are pushed by the biopsy forceps into the fistula in an alternating fashion. As a result, the fibrin clot was firmly united with the coils, leading to reliable closure of the bronchial fistula.

Bronchoscopic occlusion of the bronchial fistula using adhesives is usually performed under local anesthesia without involving tracheostomy. With our technique, however, Surgicell cotton pre-soaked in fibrin glue is held with biopsy forceps and inserted into the fistula and this manipulation needs to be repeated for several times, changing fluid A with fluid B in an alternating fashion. If the bronchoscope is inserted and withdrawn each time Surgicell cotton is held and inserted without involving tracheostomy, the patient may be exposed to high stress and can develop coughing. However, if tracheostomy is

performed for respiratory management prior to bronchoscopic occlusion, like in the present case, repeated insertion and withdrawal of the bronchoscope will not cause stress to the patient and will not induce coughing, thus allowing prevention of postoperative pectoration of the embolus created to close the fistula. Therefore, in cases of postoperative bronchial stump fistula, tracheostomy allows not only effective respiratory management (sputum aspiration, mechanical ventilation, etc.) but also easy closure of the fistula through the tracheostomy, as observed in the present case. It seems therefore advisable to perform tracheostomy soon after the onset of postoperative bronchial stump fistula.

Our technique is well indicated in cases where the bronchial fistula is within 3 mm in size. If the bronchial fistula is larger than 3 mm, it will be indicated for filling with greater omentum<sup>9)</sup> or with muscular flap.<sup>10)</sup> Greater omentum is rich in blood vessels, can stimulate vascularization and possesses self-cleaning activity. Because of these features, greater omentum seems to provide the best filling material.<sup>11)</sup> Our technique is relatively noninvasive and simple to perform. It deserves to be tried before selecting surgical treatment even in a case where a large bronchial fistula is present. Particularly for patients in poor general condition, our technique seems to serve as a therapy of first choice.

Once it develops, a bronchial stump fistula is often difficult to treat. It is therefore essential to take measures to prevent its onset. Risk factors for bronchial fistula include advanced age, compromised respiratory function, preoperative radiotherapy or chemotherapy, some underlying diseases (such as diabetes mellitus and asthma), and use of steroids.<sup>12)</sup> The incidence of bronchial fistula is particularly high if pneumonectomy or middle and lower lobectomy of the right lung is performed in patients with these risk factors. Therefore, when performing lung resection for these patients (high risk group for bronchial fistula), it is essential to take preventive measures (covering the stump with intercostal muscle flap, etc.) during surgery and to administer adequate nutritional management after surgery.

## Conclusion

A patient with SCC of the right lung developed a bronchial stump fistula 4 days after middle and lower lobectomy of the right lung. We performed bronchoscopic occlusion of the bronchial fistula via a tracheostomy in this case, and obtained favorable results. Our technique of

occluding a bronchial fistula uses metallic coils and Surgicell cotton pre-soaked in fibrin glue which are inserted via a tracheostomy into the fistula. This technique, allowing more reliable closure of a bronchial fistula than previous techniques, has been presented in this paper, with reference to the literature.

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