

# Successful Closure of A Bronchopleural Fistula by Intrapleural Administration of Fibrin Sealant: A Case Report With Review of Literature

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## Abstract

**Context:** There are no established guidelines for the proper treatment of patients with bronchopleural fistulas (BPFs). Apart from attempts to close the fistula, emphasis of treatment and management is placed on preventive measures, early administration of antibiotics, drainage of the empyema and aggressive nutritional and rehabilitative support. **Case Report:** A 53-year-old male presented with nausea, vomiting, and dry cough with eventual respiratory failure. He was found to have an empyema of the left hemithorax which was managed with thoracostomy drainage and antibiotics. However, he had persistent air leak through the chest tube due to a BPF. Bronchoscopy failed to localize the involved segment. Application of fibrin glue through the chest tube succeeded in completely sealing the leak. **Conclusion:** To our knowledge, this is the first case report in which fibrin glue was successfully used intrapleurally to close a BPF related to an empyema.

**Keywords:** Bronchopleural fistula, Intrapleural, Fibrin sealant

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## Introduction

A bronchopleural fistula (BPF) is a communication between the pleural space and the bronchial tree.<sup>[1]</sup> Although relatively rare, BPFs contribute to a significant morbidity and mortality and continue to present a challenge to an effective management. Common causes include postoperative complication of pulmonary resection, persistent spontaneous pneumothorax, chemotherapy or radiotherapy for lung cancer, tuberculosis, lung abscess, and empyema.<sup>[1,2]</sup> There is a lack of consensus regarding optimal management with an individualized approach recommended.<sup>[1]</sup> We present the first case of an empyema-related BPF which was

successfully treated by infusing a fibrin sealant through a chest tube.

## Case Presentation

A 53-year-old male presented to the emergency department (ED) with complaint of nausea and a non-bilious vomiting for 2 days associated with cough with purulent sputum and hoarseness of voice for 1 week. He also admitted to generalized malaise and weight loss of around 10 pounds over 1 month. There was no history of fever, dyspnea or abdominal pain. The patient was on methadone for his treatment of heroin dependence. He was an active smoker with a 20-pack-year smoking history. There was no relevant travel history or infectious disease exposure. He worked in a food department loading packages.

On physical examination, the patient was mildly tachycardic with a pulse of 105 bpm and his pulse oximetry showed a saturation of 91% at room air. On head and neck examination, he had a mild icterus with poor overall dentition. Chest auscultation

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revealed decreased breath sounds with decreased vocal resonance on the left infrascapular region. Rest of the examination was unremarkable. Abnormal laboratory findings included serum sodium of 153 mmol/L, white blood cell (WBC) count of 19,000/cu.mm. with 89% polymorphonuclear (PMN) cells, total bilirubin of 4 mg/dl with a direct bilirubin of 1.5 mg/dl. He also had an elevated prothrombin time of 19.6 seconds with an INR of 1.56. Rapid HIV test was negative. Chest radiography showed a homogenous opacity of the left hemithorax. Chest computed tomography (CT) revealed a large loculated left pleural effusion measuring around 9 cm × 12 cm surrounded by a thickened pleural wall suggestive of an empyema [Figure 1].

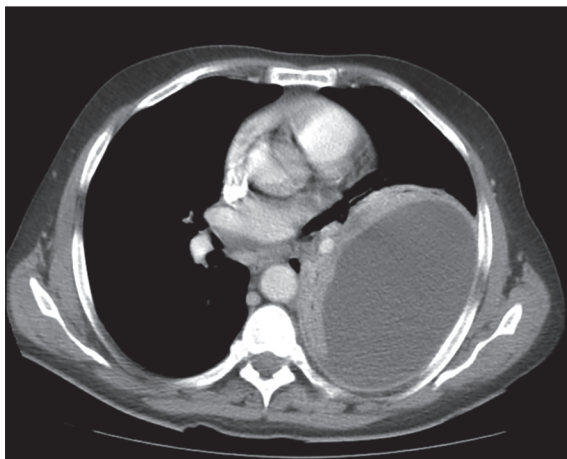
In the emergency department (ED), the patient was started on intravenous fluids and broad spectrum antibiotics (Vancomycin, Cefepime, and Azithromycin) were administered. The patient, however, became increasingly tachypneic and tachycardic. Trachea was intubated and the patient was admitted to the medical intensive care unit (MICU). Because of the high probability of an empyema, a CT guided thoracostomy with a 32 French chest tube was performed. The procedure led to evacuation of a brownish, putrid, and extremely foul-smelling fluid. Pleural fluid analysis showed a pH of 6.88, glucose of 16 mg/dl (serum = 104), total protein of 1.2 g/dl (serum = 5.8), LDH of 13011 IU/L (serum 198) and WBC of 1088/mm<sup>3</sup> with 78% PMNs. Gram stain of the pleural fluid revealed gram positive cocci in chains with the culture ultimately growing *Streptococcus intermedius*. Antibiotic was changed to ampicillin-sulbactam. The patient recovered well from his illness and was successfully extubated on day 10 of admission. The patient, however, continued to have a persistent air leak via the chest tube, leading to a suspicion of a BPF. He was discharged with a Heimlich

chest valve with a plan for close follow-up. However, 3 days after discharge, the patient presented to the ED with an accidental dislodgement of the Heimlich valve. He complained of a pleuritic chest pain and dyspnea on exertion. Chest CT revealed a loculated pneumothorax [Figure 2]. A 28-French chest tube was immediately placed and it was connected to a Pleur-evac drainage system. Significant air leak was again noted confirming a BPF.

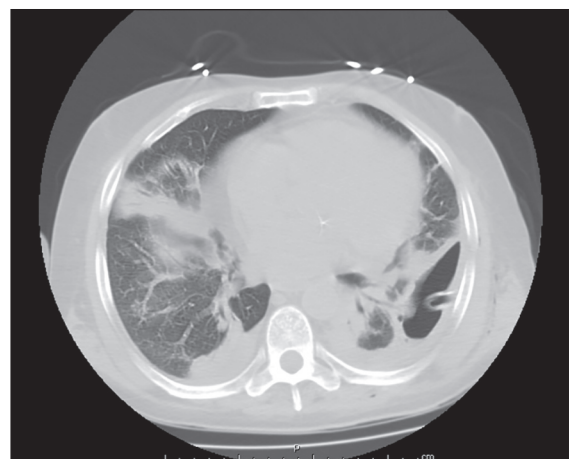
At this time, we decided to attempt bronchoscopic closure of the BPF using fibrin glue. Fibre-optic bronchoscopy was performed in order to localize the culprit segment using balloon inflation. Despite sequentially inflating the balloon in each segment, cessation of air leak could not be achieved. We then decided to attempt the closure of the fistula by administering fibrin glue directly via the chest tube. Tisseel™ was used for this purpose. Two 10 ml Tisseel prefilled syringes were obtained. The two different components in the pre-filled syringe were initially poured into two sterile cups, with one containing 10 ml of the sealer protein solution and the other containing 10 ml of the thrombin solution. The solutions were each diluted with 30 ml of normal saline. The first solution was then infused into the pleural space through the chest tube quickly followed by the second solution. The chest tube was then clamped and the patient was instructed to rotate for a few times. When the clamp was removed after 15 minutes, no air leak was seen. The chest tube was removed the following day and the patient was discharged home. On subsequent visits, a month later, serial radiographs including chest CT scan [Figure 3] were obtained which did not show any pneumothorax. Two months later, the patient is working full time with no residual symptoms.

## Discussion

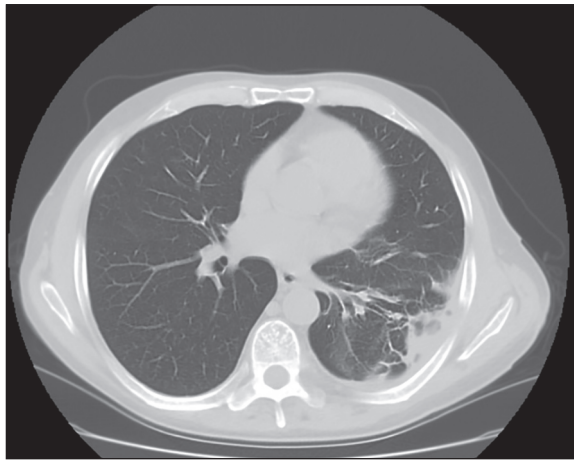
A BPF is a rare albeit challenging problem. Several strategies have been employed to manage the problem



**Figure 1:** Chest CT revealed a large loculated left pleural effusion measuring around 9 × 12 cm surrounded by a thickened pleural wall suggestive of an empyema



**Figure 2:** Chest CT revealed a loculated pneumothorax



**Figure 3:** Repeat chest CT scan after one month did not reveal and evidence of pneumothorax

with variable success. Surgery, direct closure with re-enforcement of pleural, pericardial, intercostal or omental flaps may be necessary.<sup>[3]</sup> As a less invasive option, fibrin glue has been used by several investigators.<sup>[4-10]</sup>

In 1977, Hartmann and Rausch<sup>[4]</sup> first described the closure of a post-operative BPF by endoscopic application of tissue glue. They rapidly injected methyl-2-cyanoacrylate via a teflon catheter through the instrumentation channel of a fibreoptic bronchoscope into a previously localized bronchial segment. In 1983, Roksvaag *et al.*,<sup>[5]</sup> reported injecting 1 ml of N-butyl-2-cyanoacrylate (Histoacryl) through the instrumentation channel of a fibreoptic bronchoscope directly down to the fistula in 2 patients with post-operative BPFs with good results. Jessen and Sharma<sup>[6]</sup> described five patients with various kinds of acute and chronic fistulas where they applied a two-component fibrin sealant directly through a bronchoscope. After one to five application of the fibrin sealant, the fistulas in all the patients healed. Yasuda and colleagues<sup>[7]</sup> described 20 cases of persistent pleuropulmonary fistula after a thoracic surgical procedure treated with fibrin glue injection into the thoracic cavity through a thoracostomy tube. For the treatment, they used three kinds of solutions: solution A—1 g of fibrinogen dissolved in 30-100 ml of normal saline (NS); solution B—2- ml of NS; and solution C—70,000 KIU of aprotinin, 10,000 IU of thrombin, 2 ml of 0.5 mol/L CaCl<sub>2</sub> and 10 ml of NS. The solutions were serially injected through the chest tube after which the tube was clamped, and the patients rotated. The clamp was released after 5-10 minutes. After a mean of 1.6 injections (range 1-4), closure of the pleuropulmonary fistula was achieved in all but 1 patient. One patient experienced tolerable pain and three patients had transient low grade fevers. Samuels and coworkers<sup>[8]</sup> described a case of a post-surgical

BPF, where they injected fibrin glue solutions via 21 g spinal type needles into the airspace under CT guidance, with complete resolution of the BPF. McManigle *et al.*,<sup>[9]</sup> discuss various bronchoscopic techniques in closure of BPFs in their paper. They emphasize that endoscopic closure should not be attempted if the BPF cannot be confidently localized. Kinoshita *et al.*,<sup>[10]</sup> used fibrin glue diluted fourfold with saline solution and/or contrast medium, and performed pleurodesis with the solution in 40 high-risk patients with intractable pneumothoraces and in 13 post-thoracotomy patients with persistent air leak associated with an intrapleural dead space. The air leaks were successfully stopped in all patients of both groups. A recurrence rate of 12.5% was observed in the former group which were successfully treated by repeat glue administration with no further recurrence. Major side effects reported were fever (12.5%) and chest discomfort (4.1%).

In our case, the persistent air leak resulted as a complication of an empyema. After review of all pertinent literature on BPFs, we decided to inject fibrin glue directly into the pleural space based on the method described by Kinoshita *et al.*<sup>[10]</sup> However, unlike their approach, where they infused the fibrin glue via a double lumen chest tube with patients on a fluoroscopy table, we infused the sealant through a regular chest tube at bedside. A CT scan done previously had shown the chest tube to be in the airspace likely formed by the BPF.

We used Tisseel prefilled syringe for the purpose. The syringe comes with two components—a sealer protein solution containing fibrinogen and a synthetic aprotinin (fibrinolysis inhibitor) and a second solution containing thrombin.<sup>[11]</sup> When the two components are mixed at the time of actual administration, a fibrin clot is formed via the cleavage of fibrinogen by thrombin; the whole process occurring within several minutes. The synthetic aprotinin in the first solution delays the degradation of the fibrin clot by the endogenous plasmin. This allows the watertight seal to remain in place for several days, typically 10-14 days.<sup>[11]</sup> The patient tolerated the procedure well and was discharged a day later. We believe, this is the first case report where fibrin glue was successfully used intrapleurally to close a BPF related to an empyema.

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