Use of fibrin glue to treat a persistent pneumothorax with bronchopleural fistula

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Purpose. A case of spontaneous pneumothorax with a subsequent bronchopleural fistula (BPF) treated with endoscopically administered fibrin glue is presented.

Summary. A 76-year-old white man with a history of a benign lung mass and chronic obstructive pulmonary disease was admitted to the hospital with right-sided, anterior, pleuritic chest pain for the past three days and shortness of breath at rest, which worsened during exertion. Initial chest radiograph revealed a right 95% spontaneous tension pneumothorax. A chest tube was immediately placed in the right pleural space, resulting in reinflation of the lung. However, air leaks continued to be present, requiring the need for surgical intervention. The patient required both coronary artery bypass graft surgery and right blebectomy with pleurodesis. Postsurgery, the patient required two pleural chest tubes for the persistence of a BPF. A critical care clinical pharmacist was consulted regarding potential use of an endoscopic fibrin seal. Fiberoptic bronchoscopy was performed, and diffuse bronchiectasis was noted in all right lower respiratory airways. The day after the fibrin sealant was administered, one of the pleural chest tubes was removed because the air leak was significantly reduced in size. The patient was discharged home two days later with a Heimlich chest valve. One week postdischarge, a chest radiograph revealed no pneumothorax.

Conclusion. Use of a fibrin sealant injected through a fiberoptic bronchoscope was effective in reducing an air leak associated with a spontaneous pneumothorax and subsequent BPF.

Index terms: Beriplast; Bronchial fistula; Endoscopy; Geriatrics; Hemostatics; Pneumothorax

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Pulmonary air leaks are a relatively common clinical problem in the United States. Approximately 20,000 new cases of spontaneous pneumothorax occur each year in the United States alone and account for more than $130 billion in health care expenditures.1,2 Men are 4–10 times more likely to suffer pneumothorax than are women. The rate of pneumothorax recurrence exceeds 40% after spontaneous pneumothorax.3 If air leaks continue to be present for more than 24 hours, a bronchopleural fistula (BPF) may develop, which carries a high rate of morbidity and mortality and is associated with prolonged hospital stays.4

Treatment options for pulmonary air leaks most frequently involve the placement of chest tubes large enough to allow sufficient gas flow; however, open thoracotomies are also used in patients with persistent air leaks. We report a case in which fibrin sealant injected endoscopically via a fiberoptic bronchoscope was used in the management of a patient with a BPF.

Case report

A 76-year-old white man was admitted to the hospital with right-sided, anterior, pleuritic chest pain for the past three days and shortness of breath at rest, which worsened during exertion. No fever or cough was noted. The patient’s medical history included a right lung mass, asthma, chronic obstructive pulmonary disease (COPD), and a 90-pack year smoking history. This radiographically stable lung mass was benign on previous bilateral lung biopsy. Home medications included albuterol, ipratropium, and fluticasone–salmeterol inhalers. The patient was also receiving oxygen at home. Upon arrival at the hospital, his vital signs were within normal limits, and his oxygen saturation was 98% on 4 L of oxygen.
via binal cannula. Initial chest radiograph revealed a right 95% spontaneous tension pneumothorax. A right chest tube was placed, which resulted in almost complete expansion of the lung. The patient continued aerosolized home medications and was placed on methylprednisolone 125 mg i.v. every six hours for COPD exacerbation.

On day 2 of hospitalization, a cardiothoracic surgery consult was obtained to evaluate for a thoracotomy. A subsequent computed tomography scan of the thorax revealed bilateral pneumothoraces, approximately 10–15% pneumothorax on the right and left. The left lung appeared to be partially adhered to the pleura, not requiring intervention. Bilateral apical blebs were present on day 3 of hospitalization, and a cardioiology consult was obtained to evaluate for preoperative clearance for blebectomy. A transthoracic echocardiogram was performed. Image quality was limited due to lung interference; however, images appeared normal. A dobutamine–thallium stress test and a coronary angiogram were performed. Significant stenosis was noted in the right coronary artery, with a calcified ostial lesion and moderate stenosis in the left anterior descending artery. Single-vessel coronary artery bypass graft (CABG) surgery was recommended. The patient continued to have a significant air leak in the right chest tube.

One week later, CABG surgery was successfully performed on the right coronary artery. However, subsequent to surgery, three new chest tubes were placed—one in the right pleural space and two in the mediastinal space. On day 17 of hospitalization, all chest tubes (four total) continued to have persistent air leaks. Since the air leaks were not resolving with conservative measures and severe right apical blebs were present, a right thoracotomy with chemical–mechanical pleurodesis and large apical bleb resection (blebectomy) were performed. Multiple blebs were present throughout the lung field but could not be resected. Chemical pleurodesis with aerosolized talcum powder was used. One mediastinal chest tube was pulled on day 20, but the remaining three continued with persistent air leaks. Three days later, the second mediastinal chest tube was removed.

One month into the patient’s hospitalization, a BPF was noted, with the two remaining pleural chest tubes continuing to have significant air leaks. A Heimlich chest valve was considered in an effort to facilitate the patient’s discharge home from the hospital. However, before valve placement, the critical care clinical pharmacist was consulted regarding potential use of an endoscopic fibrin seal. Fiberoptic bronchoscopy was performed, and diffuse bronchiectasis was noted in all right lower respiratory airways. Upon inflation of a balloon in the right lower lobe takeoffs, diminution and often complete cessation of the air leak were noted when the lateral basilar segment was occluded. Five milliliters of fibrin sealant or glue was injected into the lateral basilar segment of the right lower lobe. The balloon was inflated to maintain occlusion of the takeoff for two minutes after injection of the fibrin glue. No oxygen desaturation or bleeding occurred during this procedure. The next day, one pleural chest tube was removed due to significant reduction in the air leak. Two days later, a Heimlich chest valve was placed and the patient was discharged home. A chest radiograph conducted seven days postdischarge showed no pneumothorax.

Discussion

The rate of spontaneous pneumothorax and subsequent BPF is 1.5–28% after pulmonary resection.3 Risk factors for these air leaks include acute respiratory distress syndrome, chest trauma, invasive chest procedures, debilitation, malnutrition, dia-

betes, pneumonia, and COPD. While invasive procedures (e.g., chest tubes, open lung surgery, pleurodesis), bronchoscopy, and different coils, glues, and sealants are commonly used to manage pulmonary air leaks, there is no consensus regarding the optimal treatment strategy.

The fiberoptic bronchoscope and balloon are used to visualize and occlude bronchial segments leading to the air leak. Once the fistula has been localized via occlusion with the inflated balloon, sealant material is passed through the distal port into the selected airway, creating a seal and closing the BPF within minutes.4,5 In 1977, the first reports of successful endobronchial management of a BPF were published using tissue glue and a lead shot.6,7 Since then, multiple compounds have been administered through the bronchoscope in an effort to close or seal BPFs, including absolute alcohol, polyethylene glycol, cyanoacrylate glue, fibrin glue, autologous blood, antibiotics, cellulose, and gel foam.4 However, no controlled clinical studies have been conducted to determine the most effective or safest compound. Kinoshita et al.4 used a fibrin glue infusion, diluted fourfold with saline solution or contrast medium, in 40 patients with intractable pneumothoraces and in 13 postthoracotomy patients with persistent air leakage. However, unlike this case study, the glue was infused through a chest tube into the pleural space at the site of the air leak. Air leaks were stopped by glue administration in all patients of both groups. A 12.5% recurrence rate was observed in the intractable pneumothorax group; however, all recurrences were successfully treated with subsequent glue administration. Low rates of fever and chest discomfort were observed.

Our patient experienced a significant reduction in air leak size after the administration of fibrin sealant through a fiberoptic bronchoscope, despite lengthy chest tube trials and
blebectomy. The sealant or glue used—a two-component (fibrinogen and thrombin) biomatrix—offers highly concentrated human fibrinogen to seal the tissue opening. When the two agents are combined at the time of actual administration, a fibrin clot is formed through the cleavage of fibrinogen by thrombin. This fibrin clot forms over the fistula within several minutes of administration. Degradation and absorption of this fibrin glue occur over time via effects of endogenous plasmin. To delay the degradation process, a small amount of aprotinin, an inhibitor of the plasmin enzyme, is added to the sealant. This allows a watertight seal to remain in place as long as possible before degradation, typically 10–14 days. This product is indicated for use as an adjunct to hemostasis in surgeries involving cardiopulmonary bypass and treatment of splenic injuries due to blunt or penetrating trauma to the abdomen, when control of bleeding by conventional surgical techniques is ineffective. It is also indicated for use as an adjunct for the closure of colostomies. Use of the fibrin glue for the closure of a BPF is unlabeled. Case reports have described the successful use of fibrin glue administered via endoscopy for refractory BPFs. However, the majority of these reports are from the 1980s and not readily accessible or familiar to new practitioners.

Conclusion

Use of fibrin sealant injected through a fiberoptic bronchoscope was effective in reducing an air leak associated with spontaneous pneumothorax and subsequent BPF.

References