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Percutaneous fibrin injection for the successful closure of an iatrogenic bronchopleural fistula following percutaneous lung biopsy

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ABSTRACT

Background: Bronchopleural fistula (BPF) following percutaneous lung mass biopsy is a very rare but challenging complication. We describe percutaneous fibrin injection as safe and successful in the treatment of BPF. Additionally, we present a thorough literature review of the reported treatment options of iatrogenic BPF.

Summary: A 68-year-old man with a lung cancer, COPD, and multiple other comorbidities underwent an image-guided percutaneous biopsy of an enlarging right-upper lobe lung nodule that was complicated by a large iatrogenic right-sided pneumothorax requiring an image-guided placement of a drainage catheter. Four days after the catheter placement, he was diagnosed with a BPF after developing a continuous air leak, pneumomediastinum, and extensive subcutaneous emphysema. Because patient wished to avoid placement of a chest tube, endobronchial interventions, or any other invasive procedures for management of his BPF, he underwent an image-guided, percutaneous fistula closure by injection of fibrin sealant in the fistula tract.

Conclusion: BPF represents a significant challenge requiring a multidisciplinary approach. Percutaneous fibrin injection in the fistula tract represents a less invasive option for patients who have small fistulae, are not operative candidates, or wish to avoid the morbidity of a major surgical interventions.

Keywords: bronchopleural fistula; percutaneous treatment; fibrin sealant

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Introduction:

A bronchopleural fistula [BPF] is a communication between the bronchial tree or the lung parenchyma and the pleural space. Iatrogenic BPF is a rare and challenging complication most commonly [1.5-28%] caused by pulmonary resection surgery [1-3]. Chest tube placement [4], lung ablation [5], or lung biopsy [6] can also be complicated by BPF. Despite its rarity, iatrogenic BPF is associated with increased costs and high morbidity and mortality [7].

In this article, we report on a patient that underwent image-guided percutaneous biopsy of an enlarging right-upper lobe lung mass that was complicated by a bronchopleural-subcutaneous fistula that failed chest tube drainage and resolved after percutaneous injection of a fibrin sealant into the fistula tract. The reported treatment options of iatrogenic BPF are also presented.

Case Description

Our patient is a 68-year-old actively smoking male with multiple comorbidities including severe COPD and right-upper lobe lung cancer treated with radiation therapy 4 years prior. He presented to our medical center to undergo an image-guided percutaneous biopsy of an enlarging right-upper lobe lung nodule. The biopsy procedure was complicated by a large iatrogenic right-sided pneumothorax, that required an image-guided placement of an 8-French drainage catheter [Figure 1] by our Interventional Radiology colleagues. The catheter was attached to a Pleur-evac® Chest Drainage System [Teleflex] with suction at -20 mm Hg. A continuous air leak was observed in the waterseal chamber of the Pleur-evac®. Four days after admission to the hospital, the patient developed increased oxygen requirements and the air leak persisted in the waterseal chamber of the Pleur-evac®. Furthermore, patient developed crepitus over the right chest wall and the right neck. CT scan imaging of the neck and chest showed pneumomediastinum, extensive right-sided subcutaneous emphysema, and a new partially opacified tubular tract extending from the right-upper lobe mass to the anterior chest wall, consistent with a bronchopleural-subcutaneous fistula. [Figure 2]

Because patient wished to avoid placement of a chest tube, endobronchial interventions, or any other invasive procedures for management of the bronchopleural-cutaneous fistula, he then underwent an image-guided, percutaneous fistula closure by our Interventional Radiology team: injection of fibrin sealant in the fistula tract under CT fluoroscopy guidance and local anesthesia.

For this, a 5-French Drainer® Centesis Catheter [Teleflex] was advanced through the subcutaneous tissue into the tract of the bronchopleural-subcutaneous fistula. After 1 mL of fibrin sealant was injected through the inner needle of the Drainer® catheter, the inner needle was removed, and 3 mL of fibrin sealant was injected through the Drainer® catheter into the fistula tract. Post-injection CT images showed narrowing of the pleural tract, the presence of fibrin material within the tract, and presence of a large subcutaneous fibrin plug superficial to the pleural tract. [Figure 3]

Subsequently, the patient's air leak and the right neck and chest wall emphysema resolved, and the drainage catheter was removed. The patient was discharged 6 days after the fistula closure procedure. At a two-month outpatient follow-up visit patient had no evidence of recurrence of the bronchopleural-subcutaneous fistula with a follow-up CT scan of the chest showing healing of BPF and complete resorption of the fibrin glue. [Figure 4]

Discussion

Iatrogenic BPF is most commonly seen after pulmonary resection, with an incidence ranging from 3-20% after pneumonectomy [8, 9]; significantly lower rates of approximately 0.5% are seen after lobectomy [9]. Other iatrogenic etiologies include chemotherapy, radiation, lung biopsy, lung ablation, and percutaneous chest

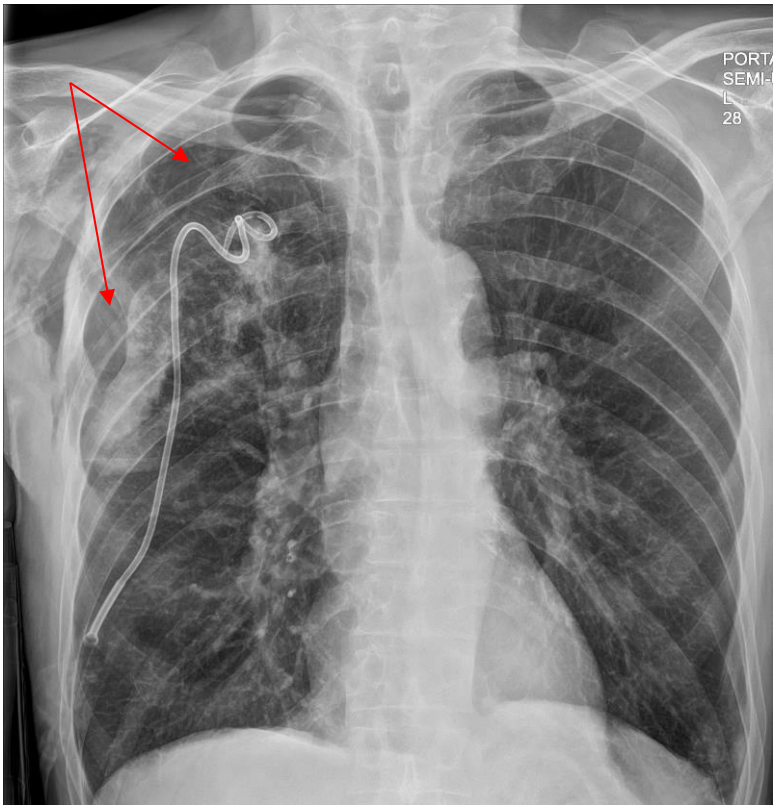

Figure 1. Chest X-ray showing a right-sided pneumothorax [arrows], managed by an 8-French drainage catheter.

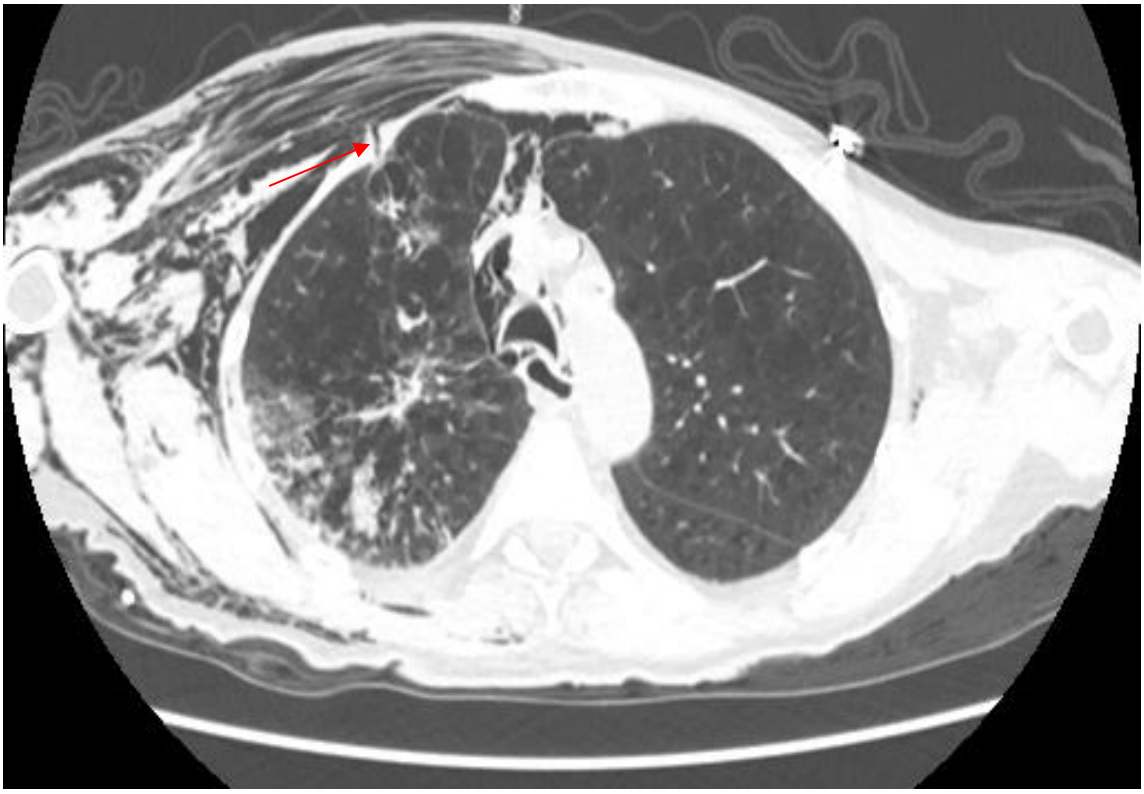

Figure 2. Axial CT scan showing pneumomediastinum, right-sided subcutaneous emphysema, and a partially opacified tubular tract extending from the right-upper lobe mass to the anterior chest wall, consistent with a bronchopleural-subcutaneous fistula [arrow].

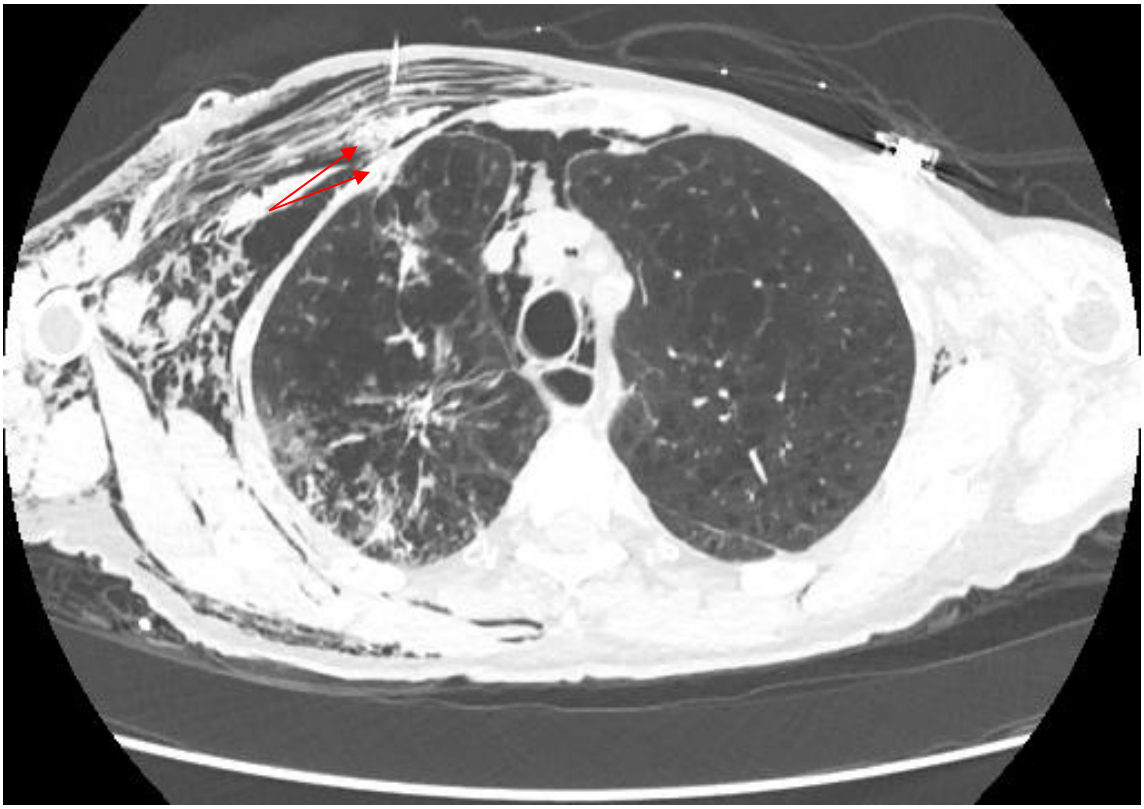

Figure 3. Axial CT scan after the fibrin injection showing narrowing of the pleural tract, the presence of fibrin material within the tract [lower arrow], and presence of a large subcutaneous fibrin plug superficial to the pleural tract [upper arrow].

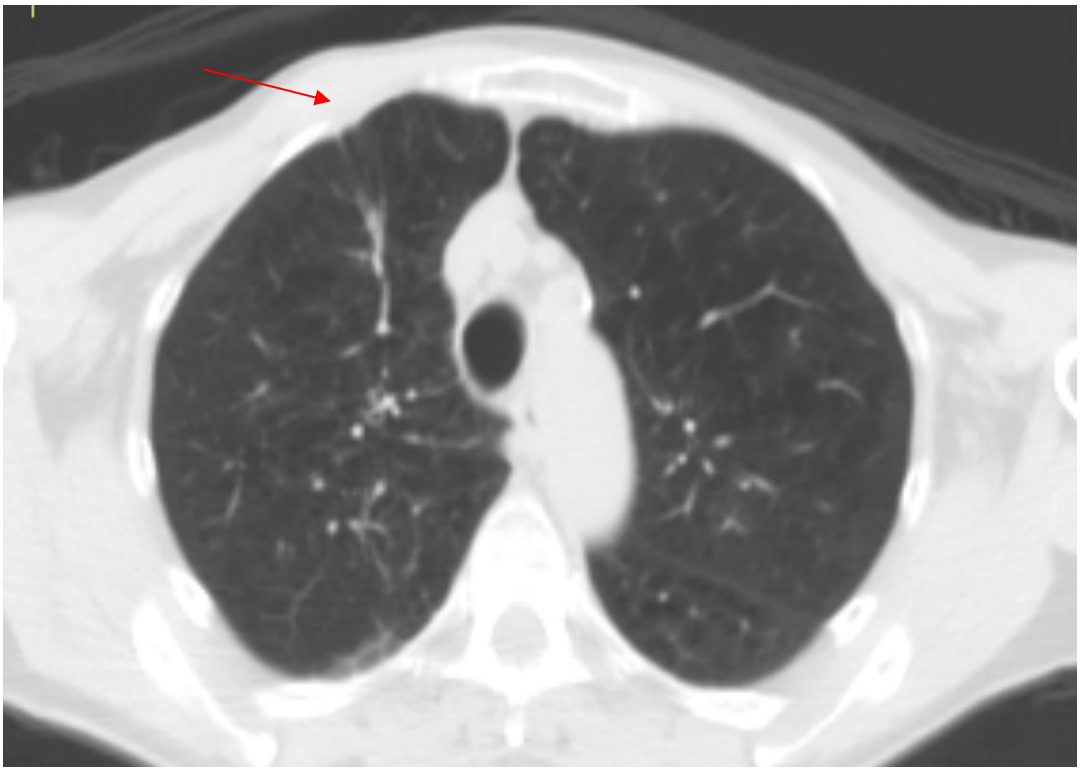

Figure 4. Axial CT scan showing healing of bronchopleural-subcutaneous fistula and complete resorption of the fibrin glue [arrow].

wall and pulmonary procedures [10, 11]. One study suggests that percutaneous interventions involving the periphery of the lung pose the highest risk [10]. Non-iatrogenic etiologies include infections, particularly with resultant necrosis of lung parenchyma, trauma, other necrotizing diseases, persistent spontaneous pneumothorax secondary to ruptured pulmonary blebs, among other conditions [3].

Risk factors for BPF have been evaluated in several studies, with concordant results; risk factors for BPF include tumors in the mainstem bronchi and postoperative mechanical ventilation [8]. Patient-related risk factors include insulin-dependent diabetes mellitus, immune-compromised patients, neoadjuvant therapy, infected lung parenchyma [9, 12]. Other surgery-specific risk factors include problems at the bronchial stump [long stump, devascularization, residual tumor at bronchial margins], and right-sided surgery [9, 12].

There is significant morbidity and mortality associated with BPF. BPF can cause respiratory distress and can result in or exacerbate respiratory failure, in addition to being a significant risk factor for aspiration pneumonia. Indirect morbidity associated with BPF is significant given the prolonged hospitalizations associated with this condition [13]. The mortality rate of BPF varies by study, ranging from 15-40% [14, 15].

The rate of complete resolution for BPF through any means has been reported as 57% [14]. Approximately 33% of BPF cases will close without surgical or bronchoscopic management [16]. A 2007 meta-analysis found that bronchoscopic interventions for BPF were successful in 30% of cases [15]. For those with successful management, multiple bronchoscopic interventions were frequently required [15]. Surgical approaches boast a high success rate of 80-95%, though some patients may require multiple procedures [13].

BPF typically presents within the first 3 postoperative/postprocedural months, and is suspected in patients with persistent and/or large air leaks [17]. Clinical symptoms, though nonspecific, include cough, fever, chills, lethargy, anorexia, and respiratory failure [18]. Workup begins with chest x-ray, which will demonstrate a persistent or increased pneumothorax or a decrease in air-fluid level [17]. A 2014 review summarizes the workup for suspected BPF, which begins initially with either imaging or bronchoscopy [17]. Computed tomography [CT] may help to identify the exact location of the fistula, in addition to demonstrating underlying causes or exacerbating factors. CT findings associated with BPF include extraluminal air, increasing air-fluid levels, and fistulous tracts [17]. It is worth noting, however, that imaging evidence of BPF may be noted in the absence of clinical symptoms; these cases are more apt to resolve spontaneously, as noted in a small retrospective study of patients that found imaging evidence of BPF in 53% of patients with empyema or hydropneumothorax, despite only one of twelve patients demonstrating a clinical picture suspicious for BPF [19].

Underlying causes and exacerbating conditions should be managed, if possible. In patients with central fistulas, treatment proceeds with early surgical management, frequently with flap reinforcement [17]. Peripheral BPF management is more focused on patient condition, and can include mechanisms to reduce pleural space and increase the apposition of visceral and parietal pleura [which can be accomplished via pleurodesis, decortication, or open drainage procedures] [17]. There are a variety of more modern and thus less studied methods, which have been described in case reports and retrospective studies but do not have large-scale data to support their use as first-line treatments. The most documented of these options include endobronchial sealants and valves.

Initial management of BPF involves source control for infectious causes, antibiotics, and early drainage with tube thoracostomy, which is typically attempted for 3-5 days [6, 20]. For patients with a prolonged air leak or

suspected/confirmed BPF involving a large central airway, early surgical intervention is performed [6, 20]. Surgical management functions for the principle of closing the fistula, preventing airflow through the fistula, and draining the pleural space [17]. For those in whom operative intervention is deemed the most appropriate option, surgical options include video-assisted thoracoscopic surgery with washout, thoracotomy with temporary or permanent closure, or open window thoracostomy [21]. The goal of surgical management is obliteration of the cavity, which can be achieved with pleurodesis, pedicled or free flap, or thoracoplasty [21].

For patients with smaller fistulas, those with prohibitive operative risk, or those who have failed operative intervention, endobronchial interventions may be attempted [20]. Endobronchial valves have been described for treatment of refractory BPF in several case reports in patients with persistent air leaks [22, 23, 24]. Most cases describe resolution of the BPF, though one described residual discharge [though no air leak] from the site [24]. Though most case reports of endobronchial valves for BPF do not describe timeline for removal, one report of a persistent BPF after lung biopsy reported resolution with endobronchial valve, which was removed after three months without recurrence of the fistula [6].

Other endobronchial interventions include embolization with N-butylcyanoacrylate, which is reported in several studies of early [<30 days post-operatively or post-procedurally] BPF [25, 26]. However, one such case report notes early failure of this method [within 24 hours], which required subsequent successful bronchoscopic metallic coil placement [25]. A retrospective study of patients with BPF after pulmonary resection surgery noted an 80% success rate with endobronchial embolization with the above polymer [26].

By describing the successful treatment of a bronchopleural fistula with percutaneous injection of a fibrin sealant into the fistula tract, we hope that our report contributes to the BPF treatment literature as only a few cases of percutaneous BPF treatment with glue have been described. A small retrospective study noted success with this method, though over half of patients required more than one procedure [27].

Conclusions

Bronchopleural fistulae represent a significant challenge requiring a multidisciplinary approach. Currently, the primary management of bronchopleural fistula is antibiotics and tube thoracostomy, with further interventions determined based on patient factors and response to initial therapy. While large-scale studies of endoscopic and percutaneous interventions are needed to determine the long-term efficacy of these options, they pose a less invasive option for patients who have small fistulae, are not operative candidates, or wish to avoid the morbidity of a major operation.

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