A 60-year-old man was referred to the thoracic surgery service with a large mass in the right upper lobe of his lung. He had a 4-week history of productive cough and hemoptysis. A chest radiograph was obtained after antibiotic therapy failed to resolve the symptoms. He had no history of weight loss, fevers, or chest pain. He had smoked until 2 years prior and had an 80 pack-year history of cigarette use. A physical examination revealed no bone pain or lymphadenopathy. A CT scan of the chest demonstrated a 9-cm solid mass in the right upper lobe closely adherent to the right hilum. Bronchoscopy with brush biopsy of the mass revealed non-small cell cancer that was confirmed with bronchial washings. A CT scan of the head was negative for metastatic disease.

A cervical mediastinoscopy was negative for metastatic lymphadenopathy and was followed immediately by a right pneumonectomy with mediastinal lymph node dissection. The right mainstem bronchus was closed with staples (TA-30 Autosuture; United States Surgical Corporation; Norwalk, CT) with a leg length of 4.8 mm and a closed height of 2.0 mm. A pleural patch was placed over the staple line. The patient was extubated in the operating room, and he did well in the immediate postoperative period. A new onset of atrial fibrillation was treated with digoxin and was converted to normal sinus rhythm on postoperative day 4. The final pathology revealed moderately differentiated adenocarcinoma (10 cm by 7.5 cm), with negative bronchial margins and one hilar node (station 11) positive. Lymphovascular invasion was identified, as well as multifocal acute necrotizing, organizing pneumonia. After 1 week, a chest radiograph showed a rising fluid level within the right chest cavity, (Fig 1) with a serum WBC count of $10^3/\mu L$.

On postoperative day 9, the patient experienced a sudden onset of tachypnea and dyspnea. He expectorated copious amounts of serosanguinous sputum. A physical examination revealed coarse breath sounds over the left lung and decreased oxygen saturation. An immediate portable roentgenogram of the chest was performed (Fig 2). The WBC count was $31 \times 10^3/\mu L$.

What is the diagnosis?

*From the Departments of Surgery (Dr. Deb) and Cardiothoracic Surgery (Dr. Fonseca), National Naval Medical Center, Bethesda, MD.

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Correspondence to: Peter Fonseca, MD, PhD, FCCP, 505 Couch Ave, Suite 250, St. Louis, MO 63122
Diagnosis: Postpneumonectomy bronchopleural fistula with empyema

The sinking fluid level shown on this patient’s radiograph (Fig 2) is diagnostic of a bronchopleural fistula (BPF). In addition, the sudden onset of increased expectoration (particularly blood tinged) and respiratory distress in any patient who has undergone a recent pulmonary resection should raise suspicion of this diagnosis. Immediate lifesaving treatment consists of positioning the patient with the thoracotomy side in a dependent position and the placement of an intercostal drainage tube. This avoids contamination and drowning of the contralateral lung. Often, Gram’s stain of the pleural fluid will reveal organisms and leukocytes confirming the presence of empyema complicating the BPF, as was present in the case discussed.

A BPF is defined as any communication between a pulmonary airway and the pleural space. Although the incidence of BPF has been reported as high as 25% in the past1–3, current rates reported are 1.3 to 4.8%. There is high mortality associated with this condition (particularly in association with pneumonectomy), ranging between 18% and 50%, to as high as 71.2%.1–3

Fistulas can develop following pulmonary resections, trauma, or spontaneously in patients with underlying pulmonary disease. In the report by Hankins et al1 of 77 patients having a diagnosis of BPF, 49 of 77 patients (64%) had postresection fistulas, and 28 of 77 patients (36%) had spontaneous fistulas. Tuberculosis, bacterial pneumonia, and abscess accounted for the spontaneous cases in their series.4

Postresection BPFs can be classified according to the time of appearance after operation: early fistulas, 1 to 7 days; intermediate fistulas, 8 to 30 days; and late fistulas, > 30 days.5 Most investigators believe that early fistulas are due to technical errors during surgery, whereas intermediate and late fistulas are attributed to the impaired healing of the bronchial stump.

Although the pathogenesis of the late fistula is attributed to the impaired healing of the bronchial stump, there are multiple factors involved. Extensive dissection around the bronchus (as necessary for lymphadenectomy) may injure the blood supply, leading to ischemia and poor healing. However, limiting the nodal dissection for fear of this result has not been recommended.3 Similarly, the presence of an infectious process such as that caused by underlying empyema within the pleural space can lead to compromised healing and the subsequent breakdown of the stump, as can an excessively long bronchial stump. A multivariate analysis by Asamura et al3 of risk factors in 1,360 patients with lung cancer revealed that patients had a significantly increased risk of postoperative BPF if residual cancer at the bronchial margin, preoperative irradiation, chemotherapy, pneumonectomy, or diabetes were present. In addition, they found a higher prevalence of BPFs in patients with advanced carcinoma (stage III and IV) and in patients undergoing right-sided resections.3

The diagnosis of BPF can usually be made clinically. In patients after pneumonectomy, events such as sudden dyspnea, subcutaneous emphysema, tracheal deviation or mediastinal shift, and the disappearance and/or drop of the fluid level as shown on chest radiograph are diagnostic.6 A drop > 1.5 cm on radiograph is highly indicative of BPF. Following lobectomy, events such as a persistent air leak and purulent drainage from chest tubes, the appearance of a new air fluid level in the pleural cavity, or the presence of loculated intrapleural gas should raise suspicion of BPF. The diagnosis of bronchial dehiscence can be confirmed by fiberoptic bronchoscopy. In the situation of late BPF, chest CT is mandatory to exclude the possibility of recurrent carcinoma. Additionally, the use of an Xe133 ventilation scan can demonstrate BPFs.

The acute management of BPF involves aggressive respiratory support, intercostal tube drainage, and antibiotic therapy. The postoperative patient in distress should be placed with the operated side in the dependent position to prevent the aspiration of pleural contents into the contralateral lung. In the case of early BPF, a reoperation with reclosure of the stump and reinforcement of the closure with pleura or muscle pedicle is usually successful with healing rates of 72%.1 With late-onset BPF, adequate drainage may close small fistulas.

Most late BPFs are associated with empyema and pose a particular challenge to the thoracic surgeon. A 90% mortality rate was noted in one report3 with severe empyema. Appropriate management involves drainage, closure of the fistula, elimination of the empyema cavity, and obliteration of the residual space such that infection will not recur. Adequate drainage and debridement may require an open window thoracostomy as the initial step. Surgical methods of closing late BPFs include transternal reclosure of the bronchial stump,7 myoplasty,8 and thoracoplasty.9 The obliteration of any residual chest cavity space can be accomplished by various techniques, including space-filling operations such as muscle transposition, omentopexy, space collapse with thoracoplasty, or filling the cavity with antibiotic solution (the Clagett procedure).10 Various authors11,12 have reported the endoscopic closure of
smaller fistulas (<5 mm) with the intrabronchial administration of cyanoacrylates or fibrin glue.

The present patient was taken to the operating room for bronchoscopy, which revealed a 5-mm opening of the bronchial stump. The previous thoracotomy incision was then opened, the empyema cavity was debrided, and the bronchial stump was cleaned of all exudate. An intercostal muscle pedicle was then placed over the stump for closure as a myoplasty. Portions of the anterior fifth and sixth ribs were resected, and the anterior portion of the thoracotomy incision was converted into an open window thoracostomy. The chest cavity was packed daily with antibiotic-soaked gauze (cefazolin; 1g/L) for 3 weeks. At this time, the thoracic space was free of infection as determined by culture and granulation tissue observed. The patient’s general condition had improved. A repeat bronchoscopy revealed granulation tissue at the site of the previous fistula, and closure of the BPF was confirmed by ventilation scan. Antibiotics were instilled into the thoracic cavity (ticarcillin/clavulanic acid, 6.2 g/3,000 mL; and bacitracin 1,000,000 U/300,000 mL), with closure of the chest wall defect in layers. Three days after the Clagett procedure, the patient had intractable coughing. A repeat bronchoscopy revealed a loose suture in the region of the fistula closure, and the suture was removed. The coughing ceased, and the patient did well enough postoperatively to return home within the week. He is currently receiving radiation to his brain after the identification of metastatic adenocarcinoma 18 months after pneumonectomy.

References