Postpneumonectomy empyema (PPE) is an uncommon and devastating complication of pneumonectomy, with substantial morbidity and mortality. The condition is characterized by pleural cavity infection and inflammation. This article focuses on the management of complicated and persistent PPE with a procedure called Eloesser flap placement, a type of open-window thoracostomy.

Mr. F, a 61-year-old former smoker, presented to his primary care provider with right rib pain after falling off his bicycle. A chest x-ray incidentally showed consolidation in the right lower lobe. Positron-emission tomography and computed tomography (CT) scan demonstrated a 15 cm fluodeoxyglucose avid right lower lung mass and fluodeoxyglucose avid right hilar adenopathy. Transbronchial biopsy of the right lower lobe revealed a well-differentiated adenocarcinoma. Mediastinoscopy revealed all mediastinal lymph nodes to be negative for malignancy. Mr. F underwent a right lower lobectomy. Final pathology revealed a 15.5 cm tumor; therefore, he had stage IB non-small cell lung cancer.

Mr. F proceeded with four cycles of adjuvant chemotherapy. A CT scan performed after his chemotherapy and four months postsurgery unexpectedly showed a new right pneumothorax (see Figure 1). He was completely asymptomatic at the time but was admitted to the hospital and a chest tube was placed. Bronchoscopy revealed a bronchopleural fistula at the right lower lobe stump. A bronchopleural fistula is a communication between the pleural space and the large airways of the lungs known as the bronchial tree. The condition is a substantial risk factor for pneumothorax and infection of the associated pleural cavity, given that it provides a pathway of entry for bacterial organisms (Lois & Noppen, 2005). Surgical oncology was consulted but recommended deferring intervention because Mr. F remained asymptomatic.

Figure 1. Chest Scan Before and After Eloesser Flap Placement

Note. The computed tomography scan at left shows a right pneumothorax before Eloesser flap placement. The scan at right demonstrates right posterior 8th, 9th, and 10th rib thoracotomies with right posterior chest wall defect communicating with the right pleural cavity after Eloesser flap placement.

Nine months later, Mr. F became symptomatic with dyspnea on exertion, productive cough, and wheezing. He presented to the emergency department in respiratory distress with a fever of 102°F and cough productive of foul-smelling thick, brown sputum. A CT scan showed an air-fluid level within the pleural space consistent with...
pleural cavity infection, as well as con-tralateral aspiration pneumonia. A chest tube was placed and drained purulent material, consistent with postpneumonec-tomy empyema (PPE). Mr. F was started on antibiotics and discharged home with a Heimlich valve, a small one-way valve used for chest drainage that empties into a flexible collection device and prevents return of fluid or gases into the pleural space. Drainage tubes often provide only a temporary solution for complicated PPE, typically defined as PPE associated with bronchopleural fistula, as in the case of Mr. F. Because a more permanent solution was needed, Mr. F’s surgeon recommended an Eloesser flap, a surgically created open and skin-lined tract in the posterior chest wall that allows chronic external drainage of an empyema.

Mr. F proceeded with Eloesser flap placement, and his flap was shown to be open and draining within the first week postsurgery (see Figure 2). PPE and postoperative skin induration and ery-thema were treated with extended antibi-otic therapy, and drainage was managed with wet-to-dry dressing changes three times daily. By one month postsurgery, the open window was well healed and Eloesser flap care consisted of cleansing in the shower, followed by once daily gauze packing. Mr. F remained free of infectious or respiratory symptoms three months after Eloesser flap placement.

Overview

PPE is an exudative pleural effusion that is characterized by purulent fluid. PPE results from pleuropulmonary inflammation or infection and can progress to a complicated process that includes the development of necrotic, inflammatory, or infectious pleural-space debris that may eventually become fibrinous and form granulation tissue (Molnar, 2007). PPE progresses through three stages if inadequately treated (see Table 1). When pneumonectomy is performed, a residual pleural cavity remains, opening the possibility for infection in the pleural “dead space.” A communicating bronchopleural fistula allows a portal of entry for infectious organisms (Molnar, 2007). Although PPE is uncommon, occurring with only 2%-10% of pneumonectomies, it is caused by bronchopleural fistula in most, if not all, cases (80%-100%) and is associated with a high average mortality rate of 5%-25% (Molnar, 2007).

General and local risk factors predispose patients to PPE (Ng et al., 2005). General risk factors include diabetes, sepsis, poor nutritional status, preoperative anemia, steroids, and chronic obstructive pulmonary disease. Local risk factors include preoperative local radiation therapy, preexistent empyema, completion pneumonectomy, postoperative mechanical ventilation, and prolonged chest-tube drainage (Asamura et al., 1992). Although Mr. F did not have any specific risk factors, he had a lobec-tomy and removal of a very large tumor, which may have increased his risk.

Clinical Features

The clinical presentation and duration of PPE may vary. The interval between pneumonectomy and diagnosis of empyema varies from two weeks to many years, although most occur within six weeks of surgery (Molnar, 2007; Wong & Goldstraw, 1994). Although many present postop-eratively, infections with late onset often originate in or are spread by the blood-stream (Wong & Goldstraw, 1992). Most patients present with low grade pyrexia and leukocytosis (see Table 2). In cases with bronchopleural fistula, expectoration of serosanguinous fluid or pus may cause con-tralateral aspiration pneumonia.

Diagnosis

PPE is not diagnosable by a single test, but rather a combination of clinical, labora-tory, and radiologic findings. Pleural fluid may show frank pus with or without identi-fiable bacterial organisms in concert with other diagnostic findings (Molnar, 2007) (see Table 3). Of note, in 47%-56% of cases, detectable causative organisms are not found in pleural fluid, and blood cultures are positive in only 10% of patients (Wey-ant, 2007). Pleural fluid C-reactive protein levels higher than 100 mg/L have 100% sensitivity and 91% specificity for post-pneumonectomy empyema, and serum C-reactive protein also may be elevated (Icard et al., 1994). In addition to chest x-ray and CT findings, CIs of the chest demon-strate fistula communication and can distinguish a hydro pneumothorax (air and fluid in the pleural space) from an infec-tion (Brant & Helms, 2007). Bronchoscopy also should be performed to determine the

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Note. Based on information from Molnar, 2007.
Management

PPE is a complicated disease that typically requires multistage management (Molnar, 2007; Reyes et al., 2010). Goals of management are to (a) completely evacuate the content of the infected pleural space, (b) eliminate the presence of the pleural dead space to prevent recurrent infection, (c) control or eliminate any causative organisms, and (d) provide supportive care to enable patient recovery (Molnar, 2007).

Decision making regarding management of PPE is guided by the general condition of the patient and the stage of PPE. At the onset of PPE, most patients are treated nonsurgically by thoracentesis, catheter drainage, or chest tubes. However, these treatments are associated with moderate-to-high failure rates of up to 65% (Molnar, 2007). Therefore, for refractory and more advanced cases of PPE, management will progress to more complicated procedures such as open or video-assisted thoracic surgery debridement or to more aggressive surgical procedures such as open-window thoracostomy, thoracoplasty (i.e., reconstructive thoracic surgery), and multistep combined surgical procedures (Molnar, 2007; Reyes et al., 2010).

One type of open-window thoracostomy is the Eloesser flap. The primary indication for the Eloesser flap procedure is a bronchopleural fistula–associated PPE that is ineffectively or suboptimally treated by external drainage devices (Molnar, 2007; Reyes et al., 2010). The flap is helpful particularly in debilitated patients who cannot tolerate more aggressive surgeries such as open debridement and thoracoplasty. In 1935, Leo Eloesser designed the operation to unroof and externalize the empyema cavity at its most dependent point (Molnar, 2007; Reyes et al., 2010). An Eloesser flap is a U-shaped flap, surgically constructed, located inferiorly on the posterior chest wall. Rib resection allows the flap to be inverted into the thoracic cavity, permitting passive drainage of the empyema (Netscher & Baumholtz, 2009; Thourani, Lancaster, Mansour, & Miller, 2003). If PPE resolves and pleural infection is eradicated fully, the bronchopleural fistula and Eloesser flap may be closed eventually by using a combination of skin grafts and muscle flaps (Eerola, Virkkula, & Varstela, 1988; Reyes et al., 2010).

Conclusions and Nursing Implications

Although a rare postsurgical complication of pneumonectomy, PPE is associated with high morbidity and mortality, partially because of high associated rates of sepsis (Molnar, 2007). Early diagnosis and prompt management may allow less invasive management and substantially improve outcomes (Molnar, 2007). Therefore, nurses should assess for signs and symptoms of PPE. Even with prompt diagnosis and management, many PPEs will require multistage and progressively complex management. One option for refractory or complicated PPEs is the Eloesser flap. Nurses play a critical role in the postoperative care and long-term management of Eloesser flaps, including patient and family education and promotion of self-management (Ng et al., 2005). In the immediate postoperative period, extended antibiotic therapy, often for several weeks, is needed to effectively clear the pleural cavity of infection (Molnar, 2007), and nurses play a key role in promoting adherence to the full antibiotic course. In addition, nurses must attend to pain management and aggressive pulmonary toilet, promotion, and management of drainage from the pleural cavity, as well as wound care with regular packing of the pleural cavity and promotion of infection control. In addition, attention should be given to maintaining skin integrity; a moisture barrier can be applied to the surrounding skin to protect from exudates. A wound care specialist could be consulted if complications arise. Teaching patients and family members to do the same also is an integral nursing responsibility, given the extended, if not permanent, duration presence and size of a bronchopleural fistula and to evaluate for tumor recurrence (Lois & Noppen, 2005).
of Eloesser flaps. In one series, the median time from placement to closure of open window thoracostomies was 454 days, and closure was achieved in only 22% of patients (Reyes et al., 2010). The overall goal of nursing care is to promote preservation or improvement of pulmonary function and to reduce disability. Proactive nursing assessment and care is paramount in assisting with prompt diagnosis and management of PPE, particularly when caring for patients who experience complex surgical procedures such as the Eloesser flap.

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References


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