Management of Pleural Space: Effusions and Empyema

Neil A. Christie, MD

KEYWORDS

• Pleural effusion • Pleurodesis • Empyema • Thoracoscopy
• Fibrinolysis

Surgeons are commonly called on to evaluate patients with pleural effusions. This article discusses the normal anatomy, physiology, and pathophysiology of the pleural space. The signs and symptoms of pleural effusions as well as the evaluation of pleural effusions of unknown cause are also reviewed. Although pleural effusions can be seen in a host of medical disorders, the 2 main circumstances that the surgeon is involved with are with malignant pleural effusions and pleural sepsis and therefore the management of theses 2 entities is discussed in detail.

PLEURAL SPACE PHYSIOLOGY

The pleural space lies between the visceral and parietal pleura and consists of 2 opposed pleural surfaces separated by 10 to 20 μm of glycoprotein-rich fluid. The normal volume of pleural fluid is low, at approximately 10 mL (0.1–0.2 mL/kg body weight). Pleural fluid contains few cells under normal circumstances.[1] The normal pleura is a thin translucent membrane and consists of 5 layers: (1) the mesothelium (flattened mesothelial cells joined primarily by tight junctions); (2) submesothelial connective tissue; (3) a superficial elastic layer; (4) a second loose subpleural connective tissue layer rich in arteries, veins, and nerves; (5) a deep fibroelastic layer adherent to the underlying lung parenchyma, chest wall, and diaphragm or mediastinum.[2]

The parietal pleura derives its blood supply from branches of the intercostal arteries. The mediastinal pleura is supplied by the pericardiophrenic artery and the diaphragmatic pleura from the superior phrenic and musculophrenic arteries. The visceral pleura derives most of its blood supply from the bronchial arterial system.[2]

There exist naturally occurring pores, or stomata, in the caudal portion of the parietal pleura and lower mediastinal pleura that are capable of transferring particulate matter

Department of Cardiothoracic Surgery, University of Pittsburgh Medical Center, 5200 Centre Avenue, Suite 715, Pittsburgh, PA 15232, USA
E-mail address: christiena@upmc.edu

Surg Clin N Am 90 (2010) 919–934
doi:10.1016/j.suc.2010.07.003 **surgical.theclinics.com**
0039-6109/10/$ – see front matter

and cells directly into lymphatic channels for removal. Most of the fluid that accumulates abnormally in the pleural space is derived from the lung through the visceral pleura and is absorbed primarily thorough the parietal pleura.[3] In disease states, excess production and/or decreased absorption of lymph is responsible for the generation of effusions.

Evaluation of Pleural Effusions

Causes of effusions are manifold. They can be classified as transudative with a low protein content (found in congestive heart failure, cirrhosis, nephrotic syndrome) or as exudative with a high protein content (found in cancer, infection, pulmonary emboli, pancreatitis, collagen vascular disease, drug-induced conditions, hemothorax, chylothorax).[4]

The clinical scenario is helpful in determining the cause of an effusion. Signs or symptoms of infection, history of malignancy, or associated medical diseases such as cardiac failure or kidney or liver disease can be helpful in determining the cause of an effusion.

Small pleural effusions are asymptomatic. Large pleural effusions can cause dyspnea, cough, and chest discomfort.

Effusions are generally seen on chest radiograph. Small pleural effusions may be evident as blunting of the costophrenic angle. A lateral decubitus film can confirm an effusion to be free flowing. Loculated effusions are harder to diagnose on a standard chest radiograph. Ultrasound can detect a loculated effusion and also determine an appropriate site for thoracentesis. A computed axial tomography (CAT) scan is useful in the evaluation of pleural effusions. It can determine the size and the location of the effusion and it also gives information regarding associated underlying parenchymal and pleural abnormalities.

Thoracentesis is useful to determine the cause of an effusion. Pleural fluid evaluation should include cytologic evaluation, culture, cell count, and differential and simultaneous pleural fluid and serum protein, glucose and lactate dehydrogenase (LDH) levels. Effusions are classified as exudative or transudative based on protein and LDH levels. (Exudate = pleural fluid protein/serum protein >0.5 and pleural fluid LDH/serum LDH >0.6.[4]) Malignant cells on cytologic evaluation indicate an underlying malignancy causing the effusion. Although the specificity of cytologic analysis is high, the sensitivity of a single cytologic evaluation can be as low as 50% and therefore often more invasive procedures may be required to diagnose an underlying malignancy, as discussed later.[5] Presence of an increased white blood cell count in the pleural fluid, particularly with a preponderance of neutrophils, may indicate pleural infection. Low pleural fluid glucose and pH are indicators of active pleural infection and the need for pleural drainage, as discussed in detail later.

A transudative effusion occurs most commonly secondary to congestive heart failure. Transudative effusions are generally managed by medical therapy for the underlying disease. Occasionally another intervention, such as pleurodesis, is required in cases refractory to maximal medical therapy. There are multiple causes for exudative effusions, but they are most commonly due to malignancy, infection, or pulmonary emboli. Overall, the 4 most common causes of pleural effusions in the United States are congestive heart failure, bacterial pneumonia, malignancy, and pulmonary emboli.[4]

Patients in whom a diagnosis of pleural effusion has not been ascertained after thoracentesis and CAT scan should undergo thoracoscopy and bronchosopy. Thoracoscopy allows direct pleural biopsy and also the potential for therapeutic intervention, including evacuation of the effusion either with or without pleurodesis.