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Q: Which patients with a parapneumonic effusion need a chest tube?

A: Hospitalized patients with pneumonia who develop a complicated parapneumonic effusion or empyema need to undergo chest tube placement.

WHAT IS PARAPNEUMONIC EFFUSION?

Parapneumonic effusion is a pleural effusion that forms concurrently with bacterial or viral pneumonia. Up to 40% of patients hospitalized with pneumonia develop a parapneumonic effusion.[1] The effusion progresses through a continuum of 3 stages: uncomplicated, complicated, and empyema.

Uncomplicated parapneumonic effusion is an exudative effusion without bacteria or pus that is caused by movement of fluid and neutrophils into the pleural space. Pneumonia itself causes an increase in interstitial fluid and capillary leakage. The effusion becomes complicated as a result of bacteria invading the pleural space, causing a further increase in neutrophils in the pleural fluid. Empyema is defined as the presence of frank pus in the pleural space.

CLINICAL SIGNIFICANCE

According to the US Centers for Disease Control and Prevention, pneumonia accounts for 674,000 emergency department visits each year; of the patients hospitalized, up to 40% develop a parapneumonic effusion.[2] The only study done on rates of death associated with parapneumonic effusion showed that, compared with patients with no effusion, the risk of death was 3.7 times higher with a unilateral effusion and 6.5 times higher with bilateral effusions.[3]

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INITIAL EVALUATION

The initial evaluation of suspected parapneumonic effusion should include chest radiography with lateral or decubitus views, followed by thoracentesis if indicated. If thoracentesis is performed, the fluid should be tested as follows:

- Gram stain
- Appropriate cultures based on clinical scenario (eg, aerobic, anaerobic, fungal)
- Total protein in pleural fluid and serum
- Lactate dehydrogenase (LDH) in pleural fluid and serum
- Glucose
- pH.

CLASSIFICATION OF EFFUSIONS

When pleural fluid is obtained, the total protein and LDH levels are used to categorize the effusion as either transudative or exudative based on the Light criteria.[4] An effusion is confirmed as exudative when 1 of the following 3 criteria is met:

- The ratio of pleural fluid protein to serum protein is greater than 0.5
- The ratio of pleural fluid LDH to serum LDH is greater than 0.6
- The pleural fluid LDH is greater than two-thirds the upper limit of normal for the serum LDH.

Once an effusion is characterized as exudative, the American College of Chest Physicians consensus guidelines are used for further classification and prognostication.[5] The guidelines estimate the risk of poor outcome by dividing the effusions based on their characteristics: the anatomy of the effusion, the bacteriology of the fluid, and the chemistry of the pleural fluid (**Table 1**). Based on these

Categorizing the effusion helps guide treatment

TABLE 1

Parapneumonic effusion: Categories, management, and prognosis

Category	Radiographic appearance	Pleural fluid analysis	Management	Prognosis
Category 1	< 10-mm effusion	No fluid analysis	No drainage needed	Very good
Category 2	> 10-mm effusion and < 50% of the hemithorax	Negative Gram stain and culture pH ≥ 7.2	No drainage needed	Good
Category 3	≥ 50% of the hemithorax, or loculations, or thickened parietal pleura	Positive Gram stain and culture pH < 7.2 Glucose < 60 mg/dL	Complete drainage necessary	Poor
Category 4	≥ 50% of the hemithorax, or loculations, or thickened parietal pleura	Frank pus	Complete drainage necessary	Very poor

Based on information in reference 5.

guidelines, effusions are divided into 4 categories. Category 1 and 2 effusions are considered uncomplicated, category 3 is considered complicated, and category 4 is empyema. The outcomes of interest are prolonged hospitalization, prolonged systemic toxicity, increased ventilator impairment, increased morbidity rate, and increased mortality rate.[5]

Category 1 effusions are defined as free-flowing fluid with a thickness of less than 10 mm on any imaging modality. Thoracentesis for pleural fluid analysis is not required. The prognosis is very good.

Category 2 effusions are defined as free-flowing fluid with a thickness greater than 10 mm and less than 50% of the hemithorax. Thoracentesis is typically done because of the size of the effusion, but Gram stain and culture of the pleural fluid are usually negative, and the pH is at least 7.2. The prognosis is good.

Category 3 effusions are considered complicated because the anatomy of the pleural space becomes altered or because bacteria have invaded the pleural space. The effusion is larger than 50% of the hemithorax or is loculated, or the parietal pleura is thickened. Since the bacteria have invaded the pleural space, Gram stain or culture of pleural fluid may be positive, the pleural fluid pH may be less than 7.2, or the glucose level of the fluid may be less than 60 mg/dL. The prognosis for category 3 is poor.

Category 4 effusions are defined as empyema. The only characteristic that separates this from category 3 is frank pus in the pleural space. The prognosis is very poor.

For some complicated effusions and all empyemas, a small-bore chest tube should be tried first, if possible

TO PLACE A CHEST TUBE OR NOT

For category 1 or 2 effusions, treatment with antibiotics alone is typically enough. Category 3 effusions usually do not respond to antibiotics alone and may require complete drainage of the fluid with or without a chest tube depending on whether loculations are present, as loculations are difficult to drain with a chest tube. Category 4 effusions require both antibiotics and chest tube placement.

WHAT TYPE OF CHEST TUBE?

Studies have shown that small-bore chest tubes (< 20 F) are as efficacious as larger tubes (≥ 20 F) for the treatment of complicated parapneumonic effusion and empyema.[6,7] Studies have also shown that the size of the tube makes no difference in the time needed to drain the effusion, the length of hospital stay, or the complication rate.[8,9] Based on these studies, a small-bore chest tube should be placed first when clinically appropriate. When a chest

tube is placed for empyema, computed tomography should be performed within 24 hours to confirm proper tube placement.

ADVANCED THERAPIES FOR EMPYEMA

Empyema treatment fails when antibiotic coverage is inadequate or when a loculation is not drained appropriately. Options if treatment fails include instillation of fibrinolytics into the pleural space, video-assisted thoracoscopic surgery, and decortication.

The role of fibrinolytics has not been well-established, but fibrinolytics should be considered in loculated effusions or empyema, or if drainage of the effusion slows.[10] Video-assisted thoracoscopic surgery is reserved for effusions that are incompletely drained with a chest tube with or without fibrinolytics; studies have shown shorter hospital length of stay and higher treatment efficacy when this is performed earlier for loculated effusions.[11] Decortication is reserved for symptomatic patients who have a thickened pleura more than 6 months after the initial infection.[12] Timing for each of these procedures is not clearly defined and so must be individualized.

TAKE-AWAY POINTS

- Parapneumonic effusion occurs concurrently with pneumonia and with a high frequency.[1]
- Effusions are associated with an increased risk of death.[3]
- Categorizing the effusion helps guide treatment.
- Chest tubes should be placed for some cases of complicated effusion and for all cases of empyema.
- A small-bore chest tube (< 20 F) should be tried first.

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