

Management of Parapneumonic Effusions

Parapneumonic Effusion

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Introduction

Pleural effusions associated with pneumonia (parapneumonic effusions) are one of the most common causes of exudative pleural effusions in the world.[1] Approximately 20 to 40% of patients hospitalized with pneumonia will have an accompanying pleural effusion.[1] The presence of a pleural effusion is associated with worse outcomes in patients with pneumonia. In one study of patients hospitalized with pneumonia the mortality risk was 6.5 times higher if the patient had bilateral pleural effusion and 3.7 times higher if the effusion was unilateral than if the patient had no pleural effusion.[2] At least part of the increased mortality with parapneumonic effusions is due to mismanagement of the pleural effusion.

The likelihood of developing a pleural effusion with a bacterial pneumonia is dependent upon the organism responsible for the pneumonia. The distribution of organisms responsible for parapneumonic effusions is quite different from the distribution of organisms responsible for pneumonia in general. Organisms responsible for community and hospital acquired pneumonia with complicated parapneumonic effusions also differed considerably in a recent multicenter study from the United Kingdom.[3] For the 336 patients with community acquired pneumonias with parapneumonic effusions in whom the responsible bacteria were identified, the most common organisms were Strept. Milleri group 32%, anaerobes 16%, Strep. pneumoniae 13% and Staph. aueus 11%. For the 60 patients with hospital-acquired pneumonia, the most common organisms were multiple resistant Staph. aureus 28%, other Staph. 18%, Enterobacteriacea 15% and Enterococci 13%.[3] These numbers should be kept in mind when selecting antibiotics for patients with parapneumonic effusions.

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Any patient with pneumonia should be assessed for the possibility of a parapneumonic effusion. Patients with pneumonia have similar symptoms whether or not they have a pleural effusion.[4] All pneumonia patients should have a lateral chest x-ray in addition to the posterioanterior chest x-ray. If both diaphragms are not visible throughout their course, the possibility of a pleural effusion should be assessed with a CT scan, ultrasound or a lateral decubitus radiograph.

There are several pleural fluid findings that are suggestive that a patient will need more invasive therapy (at least tube thoracostomy) for their pleural effusion (Table 1). Therefore, if the patient has more than a minimal pleural effusion, the pleural fluid should be sampled to see if any of the factors in Table 1 are present. The pleural fluid with parapneumonic effusion is an exudate and the differential cell count reveals predominantly neutrophils. If mononuclear cells predominate in the pleural fluid, an alternative diagnosis should be sought.[1] The lower the pH and the glucose and the higher the LDH, the more likely that the patient will need an invasive procedure for their parapneumonic effusion.[1] The low pleural fluid pH and glucose and the higher LDH are more effective at identifying complicated parapneumonic effusions than are procalcitonin, lipopolysaccharide-binding protein, C-reactive protein and triggering receptor express on myeloid cells (sTREM-1).[5]

Table 1. Factors Associated with Poor Prognosis in Patients with Parapneumonic

Effusions (Listed in decreasing order of importance)
1. Pleural fluid is pus
2. Pleural fluid bacterial smears are positive
3. Pleural fluid glucose is less than 60 mg/dl
4. Pleural fluid bacterial cultures are positive
5. Pleural fluid pH is less than 7.20
6. Pleural fluid LDH is more than three times the upper limit of normal
7. Pleural fluid is loculated

When faced with a patient with a parapneumonic effusion, it is important to realize that not all effusions need to be treated in identical manners. The American College of Chest Physicians (ACCP)[6] developed the classification shown in Table 2 to assist the practicing physician in managing patients with pleural effusions. Several comments should be made about this classification. (a) With category 1 effusions, no thoracentesis is indicated and no chemistries or bacteriology are obtained because effusions this small virtually always resolve without difficulty. (b) If the pH is used for the classification it must be measured with a blood gas machine – pH meters and indicator strips are not sufficiently accurate.[7] (c) If a pH measurement is not available, an alternative to the pH is a glucose level of 60 mg/dl. (d) There is nothing magic about a pH measurement of 7.20 or a glucose level of 60 mg/dl– the lower the worse with both measurements. (e) The ACCP recommended that categories 3 and 4 be treated with drainage. Although they stated that therapeutic thoracentesis or chest tube alone is insufficient for most patients with category 3 or 4, many patients are cured with one of these methods.[1] (f) The ACCP recommended that fibrinolytics, thoracoscopy or thoracotomy are acceptable approaches for managing patients with category 3 or 4 without indicating which patient should receive which treatment.[6]

In order to categorize patients who have pleural effusion other than category 1, the pleural fluid must be sampled. There are three possible means to do this: (a) a diagnostic thoracentesis, (b) a therapeutic thoracentesis or (c) the insertion of a small chest tube. Although there are no studies comparing the three methods, I prefer either a therapeutic thoracentesis or the insertion of a small chest tube. The advantage of inserting a small chest tube is that if the fluid continues to be formed, it can be removed as it is formed. The advantage of a therapeutic thoracentesis is that if all of the fluid is removed and if it does not recur, then one need not worry about the pleural fluid. If the fluid recurs, a repeat thoracentesis or a small chest tube should be inserted if the patient has any of the characteristics listed in Table 1.

In most instances when the pleural fluid is loculated with a parapneumonic effusion, the patient will not recover unless the fluid is drained. The loculation is produced by fibrous membranes that partition the pleural space. Frequently when the pleural fluid is loculated, the lung is also encased with a fibrin membrane which prevents the lung from re-expanding. If the pleural fluid is infected, the pleural infection cannot be eradicated unless the fibrin membrane encasing the lung is removed so that the lung can expand and the fill the pleural space. Five procedures have been proposed to remove the loculated

Table 2. Categorizing Risk for Poor Outcome in Patients With PPE

Pleural Space Anatomy		Pleural Fluid Bacteriology		Pleural Fluid Chemistry	Category	Risk of Poor Outcome	Drain-age
A_0 Minimal, free-flowing effusion (<10 mm on lateral decubitus)	AND	B_x culture and gram stain results unknown	AND	C_x pH unknown	1	Very low	No
A_1 Small to moderate free-flowing effusion (>10 mm and < hemithorax)	AND	B_0 negative culture and gram stain	AND	C_0 pH ≥ 7.20	2	Low	No
A_2 Large, free-flowing effusion (≥ hemithorax) loculated effusion, or effusion with thickened parietal pleura	OR	B_1 positive culture and gram stain	OR	C_1 pH < 7.20	3	Moderate	YES
		B_2 pus			4	High	YES

From Colice GL, Curtis A, Deslauriers J, Heffner J, Light RW, Littenberg B, Sahn S, Weinstein RA, Yusen RD. Medical and surgical treatment of parapneumonic effusions: An evidence-based guideline. Chest 2000;118:1158 – 1171.

pleural fluid: the insertion of multiple chest tubes, the intrapleural administration of fibrinolytics, thoracoscopy with the breakdown of fibrin membranes and sometimes decortication, thoracotomy with decortication, and an open drainage procedure. I do not recommend multiple chest tubes because there are frequently multiple locules of the pleural fluid. With thoracoscopy or thoracotomy, the fibrous membrane encasing the lung can also be removed which allows the lung to expand.

There have been many articles attesting to the efficacy of fibrinolytics in the treatment of loculated parapneumonic effusions.[1] The theory behind their use is that the loculations are produced by fibrin membranes and the fibrinolytics could destroy these membranes and facilitate drainage of the pleural fluid. However, a large multicenter, randomized, placebo controlled, double-blind study cast doubt on the effectiveness of fibrinolytics in reducing hospital stays, mortality or the need for surgical intervention.[8] In this study 454 patients were randomized to receive 250,000 IU of streptokinase or saline, twice daily for three days, both in a total volume of 30 ml.[8] In this study the patients receiving placebo had a slightly higher likelihood of surviving without surgery than the patients receiving streptokinase and had nearly identical hospitalization times. In our empyema model in rabbits the intrapleural administration of tissue plasminogen activator (tPA) did not significantly improve the empyema scores.[9]

In view of the above studies, what is the rightful place of fibrinolytics in the management of complicated parapneumonic effusions? It is my recommendation that fibrinolytics should be reserved for patients in centers without access to video assisted thoracic surgery (VATS) and for patients who are not surgical candidates.

What is the future of fibrinolytics in the management of loculated parapneumonic effusions? It is possible that the newer fibrinolytics such as tPA or the combination of a fibrinolytic plus a DNAse may be efficacious. Indeed in our rabbit empyema model the intrapleural administration of the combination of tPA plus a DNAse significantly reduced the empyema scores.[9] Moreover, a large multicenter randomized double blind study has recently been completed that compared the effectiveness of 10 mg tPA, 4 mg DNAse, 10 mg tPA plus 4 mg DNAse and saline in patients with complicated parapneumonic effusions.[10] In this study the combination of tPA and DNAase was significantly more effective in reducing the amount of the hemithorax occupied by pleural fluid than were any of the other three regimens.[10] Indeed as in the previous study, the results with saline and with the two agents individually were virtually identical.[10] Accordingly, if fibrinolytics are used in loculated parapneumonic effusions, it is recommended that they should be combined with DNAse.

Probably the best management of patients with loculated pleural fluid is the performance of VATS with the breakdown of adhesions, the optimal placement of chest tubes and decortication if necessary. When four studies[11-14] with a total of 232 patients are combined, VATS was the definitive procedure in 77% of the patients, the overall mortality rate was 3% and the median time for chest tube drainage after the procedure ranged from 3.3 to 7.1 days. In many of these patients decortication was also performed. In general, patients who require open thoracotomy had their complicated parapneumonic effusion for a longer period before thoracoscopy was attempted.

At the time of VATS it is important to make certain that the lung has completely expanded. If the lung is encased by a fibrous peel, decortication (the removal of the fibrous peel) should be attempted. If this cannot be accomplished by VATS, then a full thoracotomy should be performed in order to do the decortication. In general VATS is preferred to full thoracotomy as the initial procedure since it is associated with a shorter hospitalization and less postoperative pain.

VATS or open thoracotomy should only be performed for pleural sepsis. If the patient has no signs of a systemic infection and has only pleural thickening, neither procedure is indicated as the pleural thickening will improve markedly over time without any intervention.[15,16]

If a patient has an infected pleural space that is not responding to therapy, one therapeutic option is an open drainage procedure. With an open drainage procedure portions of one or more ribs are resected and large tubes are inserted into the empyema cavity. The cavity is then allowed to heal from within. The disadvantage of this procedure is that the median time for the drainage site to heal is several months.[1]

In summary, the possibility of a parapneumonic effusion should be considered anytime that a patient with pneumonia is evaluated. If the diaphragms cannot be seen throughout their entirety on a lateral chest radiograph, the possibility of a parapneumonic effusion should be evaluated with ultrasound, CT scan or lateral decubitus radiographs. If there is more than minimal fluid, the fluid should be sampled preferably with a therapeutic thoracentesis or the insertion of a small chest tube. If the fluid is loculated and cannot be removed, the next step is thoracoscopy. If thoracoscopy does not result in complete expansion of the lung, thoracotomy with decortication should be performed. Fibrinolytics are reserved for those institutions where thoracoscopy is not available or for patients who refuse or cannot tolerate surgery. When fibrinolytics are used, they should be used in combination with DNAse. An open drainage procedure can also be performed on patients who are not surgical candidates.

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