CHEST

Official publication of the American College of Chest Physicians

A New Classification of Parapneumonic Effusions and Empyema

Richard W. Light

Chest 1995;108;299-301
DOI 10.1378/chest.108.2.299

ISSN:0012-3692

in this issue (see page 341) adds further to the cardiopulmonary advancements in this arena by providing what amounts to a *rapprochement* between the advocates of the quantitative scintigraphic method vs the exercise V_{O_2} approach. In their study, both techniques appear to have merit. While one may quibble with the size of the sample and the inclusion of patients with only mild dysfunction, the findings are in agreement with those of other investigators. Likewise, the physiologic explanation of just how post resectional V_{O_2}max can be predicted by multiplying preoperative V_{O_2}max and the partition of regional lung function via ventilation-perfusion scanning also bears further investigation and explanation.

Perhaps as a devil's advocate, it would be appropriate to suggest that the operability for the lung cancer question is now also somewhat moot. As evidence, I can site the following recent developments: (1) Morice and coworkers[3] and Kearney and associates[4] have broken the "hypercapnia barrier" by successfully resecting lung tissue of patients ostensibly in chronic respiratory failure, (2) video-assisted thoracic surgery (VATS) may further reduce perioperative complications,[5] (3) postoperative analgesia may diminish short-term postoperative dysfunction,[6] (4) lung volume reduction surgery could, if performed in concert with resection, improve rehabilitation,[7] (5) single-lung transplantation, originally performed unsuccessfully in a patient with lung cancer,[8] is now an optional procedure for severe COPD,[9] and (6) some patients may even opt for long-term ventilatory support, if needed, to obtain a cancer cure.

In summary, perhaps the answer to the original question is . . . almost no one.

Gerald N. Olsen, MD, FCCP
Columbia, South Carolina

Assistant Dean for Clinical Curriculum, Pulmonary and Critical Care, University of South Carolina, Columbia.

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A New Classification of Parapneumonic Effusions and Empyema

The optimal management of patients with pleural effusion secondary to a bacterial process in the thoracic cavity will result in patients being restored to their former state of good health in the most expeditious manner with the least invasive measures. In addition to selecting an appropriate antibiotic, the main treatment options are tube thoracostomy (either a small or a large tube), the intrapleural instillation of a thrombolytic agent, videothoracoscopy with the breakdown of adhesions, decortication, or an open drainage procedure.

Pleural effusions due to bacterial infections in the chest have been classified as parapneumonic effusions, complicated parapneumonic effusions, and empyema. A parapneumonic effusion is any pleural effusion secondary to a bacterial infection of the lung, while a complicated parapneumonic effusion is a parapneumonic effusion that requires tube thoracostomy for its resolution. An empyema is pus in the pleural space; pus by definition is thick, purulent appearing fluid. Most empyemas arise from pneumonias, although about one third of patients with empyema have no associated pneumonic process.

Numerous papers have been written about the identification of the patient who will need a tube thoracostomy for the resolution of a pleural effusion.[1,2] The need for tube thoracostomy is dictated by the characteristics of the pleural fluid. Patients who have a low pleural fluid glucose level (<40 mg/dL), a low pleural fluid pH (<7.20), or a positive Gram stain or culture of the pleural fluid are more likely to require tube thoracostomy. Some patients whose pleural fluid meets these criteria, however, recover completely with only the administration of antibiotics.[3,4] In general, I believe that it is preferable to perform too many, rather than too few tube thoracostomies, since the morbidity associated with an unnecessary chest tube is much less than that associated with the delayed insertion of a necessary chest tube.[5]

Not all complicated parapneumonic effusions and empyemas comparably behave.[6] Some patients who

have a low pleural fluid pH or glucose, but nonpurulent pleural fluid can be managed with antibiotics alone.[3,4] In contrast, most patients with pus in their pleural space require thoracoscopy or thoracotomy.[7] The classification outlined in Table 1 was designed to assist the physician in determining how aggressive to be with the initial therapy. This classification is based on the quantity of fluid present, the results of Gram stains and cultures of the pleural fluid, the biochemical characteristics of the pleural fluid, the presence or absence of loculations, and the gross characteristics of the pleural fluid.

A patient has a nonsignificant parapneumonic effusion if the thickness of the fluid on the decubitus chest radiograph is less than 10 mm. In this situation there is no need to perform a diagnostic thoracentesis because these effusions almost always resolve if appropriate antibiotic therapy is initiated.[1] A thoracentesis should be performed if the effusion increases in size during therapy.

Table 1—*Classification and Treatment Scheme for Parapneumonic Effusions and Empyema

Class 1	Small
Nonsignificant Parapneumonic effusion	<10 mm thick on decubitus x-ray No thoracentesis indicated
Class 2	>10 mm thick
Typical Parapneumonic effusion	Glucose >40 mg/dL, pH>7.20 Gram stain and culture negative Antibiotics alone
Class 3	7.00<pH<7.20 and/or LDH>1,000 and glucose>40 mg/dL
Borderline complicated Parapneumonic effusion	Gram stain and culture negative Antibiotics plus serial thoracentesis
Class 4	pH<7.00 and/or glucose <40 mg/dL and/or
Simple complicated Parapneumonic effusion	Gram stain or culture positive Not loculated not frank pus Tube thoracostomy plus antibiotics
Class 5	pH<7.00 and/or glucose <40 mg/dL and/or
Complex complicated Parapneumonic effusion	Gram stain or culture positive Multiloculated Tube thoracostomy plus thrombolytics (Rarely require thoracoscopy or decortication)
Class 6	Frank pus present
Simple empyema	Single locule or free flowing Tube thoracostomy±decortication
Class 7	Frank pus present
Complex empyema	Multiple locules Tube thoracostomy+thrombolytics Often require thoracoscopy or decortication

*Adapted from reference 15.

A patient has a typical parapneumonic effusion if the thickness of the pleural fluid is more than 10 mm on the decubitus film and the pleural fluid glucose level is above 40 mg/dL, the pleural fluid pH is above 7.20, the pleural fluid LDH level is below 1,000 IU/L, and the Gram stain and culture are negative. Antibiotic therapy alone is adequate for the treatment of a typical parapneumonic effusion.[1,2] A repeat diagnostic thoracentesis should be performed if the effusion increases in size to make certain that the characteristics of the fluid have not changed.

A patient has a borderline complicated parapneumonic effusion if the pleural fluid pH is between 7.00 and 7.20 or if the pleural fluid LDH is greater than 1,000 IU/L and if the pleural fluid glucose is above 40 mg/dL while the Gram stain and the culture are negative. Most such effusions will resolve with antibiotics alone, but some will require additional therapy.[1,6] I recommend that patients with borderline complicated parapneumonic effusions be managed with daily therapeutic thoracenteses as long as the fluid continues to recur. If the pleural fluid pH falls below 7.00 or if the glucose falls below 40 mg/dL, then tube thoracostomy is indicated. If the pleural fluid is loculated, I recommend that the patient be treated with a small chest tube and intrapleural thrombolytics.

A patient has a simple complicated parapneumonic effusion if the pleural fluid pH is less than 7.00, the pleural fluid glucose is less than 40 mg/dL, the Gram stain is positive or the culture is positive, but the fluid is not loculated and does not appear to be frank pus. The appropriate management of these patients is tube thoracostomy. It appears that such effusions can be managed with relatively small chest tubes (8.3 to 16F) inserted percutaneously.[8,9] The smaller tube has the advantages that its insertion is easier and less painful and its presence is less uncomfortable to the patient.

A patient has a complex complicated parapneumonic effusion if the fluid meets the criteria for a simple complicated parapneumonic effusion but in addition the pleural fluid is loculated. These patients should be treated with tube thoracostomy (a smaller tube is usually adequate), and they should be given a thrombolytic agent intrapleurally. Uncontrolled studies have showed that either streptokinase 250,000 U or urokinase 100,000 U diluted to a total volume of 100 mL administered through the chest tube can facilitate the drainage of loculated effusions.[10-12] The theory behind this therapy is that the thrombolytic agents will dissolve the fibrin membranes that are responsible for the loculation and facilitate drainage of the effusion. If drainage is still inadequate after the thrombolytic therapy, more aggressive therapy should be undertaken. Two primary alternatives are thoracoscopy with the breakdown of adhesions and the optimal positioning of the chest tube[13] or decortication.[14]

A patient has a simple empyema if the pleural fluid is frank pus and if the fluid is free-flowing or is in a single loculus. These patients should be treated with a relatively large (~28F) tube because the thick pus is likely to obstruct a smaller tube. Many patients with simple empyema have a thick peel over the visceral pleura. If a sizeable empyema cavity remains after 7 days of chest tube drainage, consideration should be given to performing a decortication. Decortication is a major thoracic operation requiring a full thoracotomy incision and should not be performed on patients who are markedly debilitated. The mortality rate with decortication is about 10% and the median postoperative stay is about 7 days.[14]

A patient is said to have a complex empyema if the pleural fluid is frank pus and if the fluid is multiloculated. Patients with complex empyemas should initially be managed with large chest tubes and intrapleural thrombolytic therapy. However, most patients will require a decortication.[7] An alternative in patients who need a decortication, but who are debilitated, is an open drainage procedure in which segments of one to three ribs overlying the lower part of the empyema cavity are resected and one or more short, large-bore tubes are inserted into the empyema cavity. The pleural space is irrigated daily with a mildly antiseptic solution and the drainage can be collected in a colostomy bag. The median time for complete healing of the wound with an open drainage procedure is about 6 months.

In summary, the classification shown in Table 1 can be used to guide the initial therapy of the patient with a pleural effusion secondary to an intrathoracic bacterial process. It should be emphasized that there are many questions that remain unanswered regarding the optimal treatment of patients with pleural effusions secondary to bacterial processes in the thoracic cavity. This classification scheme can also be used to stratify patients when comparing different treatment modalities for these pleural effusions.

Richard W. Light, MD, FCCP
Long Beach, California

Professor of Medicine, University of California at Irvine, and Department of Veterans Affairs, Medical Center, Long Beach.

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The Increase in Asthma Prevalence

In recent years there has been considerable progress in both our understanding of the pathogenesis of asthma and its treatment. Despite these advances, there has been an increase in both asthma morbidity and mortality.[1] The basis for this paradox is at present largely unknown.

Between the years 1979 and 1987, asthma hospitalizations among US children increased by 4.5% per year.[2] During a similar time period, the death rate from asthma in the United States increased by 31%.[3] There were also increases in mortality in several other countries, notably in Great Britain and New Zealand.[1] Paralleling the increase in asthma mortality has been an increase in prevalence.[1] Interestingly, asthma mortality and prevalence differ markedly in different parts of the world.[4] At the height of the asthma epidemic in New Zealand, the mortality from asthma in that country exceeded that in the United States by tenfold. Although there is some evidence that epidemics of asthma deaths in Great Britain[5] and New Zealand[6] may have been related to β-agonist use, epidemiologic investigations have failed to provide an explanation for the overall trends in asthma mortality or the worldwide differences in prevalence. This lack of progress can be attributed, at least in part, to methodologic problems inherent in the epidemiologic investigation of asthma.