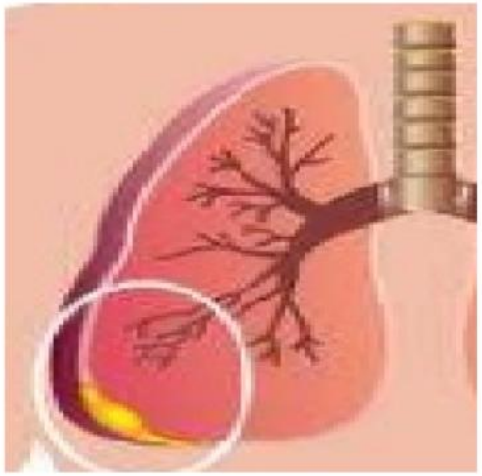
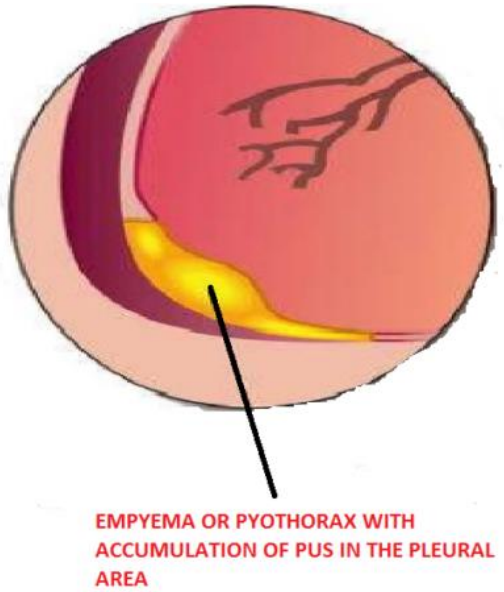
IN THE NAME OF GOD





Empyema (pyothorax or purulent pleuritis)

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Definition & history

- Definition: an accumulation of pus in the pleural space.
- Involvement of the pleural space with pulmonary infections has been recognized since ancient times. Aristotle identified the increased morbidity and mortality associated with empyema and described drainage of empyema fluid with incision.

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Definition & history

- In his 1901 text, The Principles and Practice of Medicine, Sir William Osler, MD, stated that empyema should be treated as an ordinary abscess, "with incision and drainage." Of note, Osler underwent a rib resection for his own post-pneumonic empyema, from which he ultimately expired.

Etiology

- Etiology: 1- pneumonia:
  - ✓Streptococcus pneumoniae (as the primary pathogen),
  - ✓Staphylococcus aureus: most common in developing countries and Asia, in posttraumatic empyema, (Methicillin-resistant S Aureus is a concern in the older age group.),
  - ✓Group A streptococcus (as a complication of an infectious skin disorder),
  - ✓Haemophilus influenzae (vaccination effect?),
  - ✓Gram-negative organisms,
  - ✓Tuberculosis, anaerobes, fungi, viruses, and malignancy are less common causes.
- Because of the use of oral antibiotics before the recognition of the parapneumonic effusion, most specimens cultured are sterile; thus, the relative incidences of the aforementioned organisms are not known.

Etiology

- Etiology: 2- Others:
  - rupture of a lung abscess into the pleural space,
  - contamination introduced from trauma or thoracic surgery,
  - rarely by mediastinitis or the extension of intraabdominal abscesses.
  - One study found that NSAID use during acute viral infection is associated with an increased risk of empyema in children.

Epidemiology

- Bacterial pneumonia with associated pleural empyema is the most common cause of pleural effusion found in the pediatric population.
- Empyema occurs in 5–10% of children with bacterial pneumonia and in up to 86% of children with necrotizing pneumonia.

Epidemiology

- Age: Although rates of bacterial pneumonia have decreased in infants and preschool children, the incidence of parapneumonic effusions has increased most notably in children aged 1-4 years (related to heptavalent pneumococcal vaccine?).

Pathology

- 3 stages: exudative, fibrinopurulent, and organizational.
  1. Exudative stage: fibrinous exudate forms on the pleural surfaces.
  2. Fibrinopurulent stage: fibrinous septa form, causing loculation of the fluid and thickening of the parietal pleura. (Dissemination to lung parenchyma, producing bronchopleural fistulas and pyopneumothorax, or into the abdominal cavity or rarely, through the chest wall: empyema necessitatis).
  3. Organizational stage: fibroblast proliferation (pockets of loculated pus may develop into thick-walled abscess cavities or the lung may collapse and become surrounded by a thick, inelastic envelope-peel).

Clinical manifestation

- Pneumonia phase → an interval if child treated with antibiotic →

empyema phase: Fever, appear more ill, pleuritic chest pain, respiratory distress and, may be abdominal pain and vomiting.

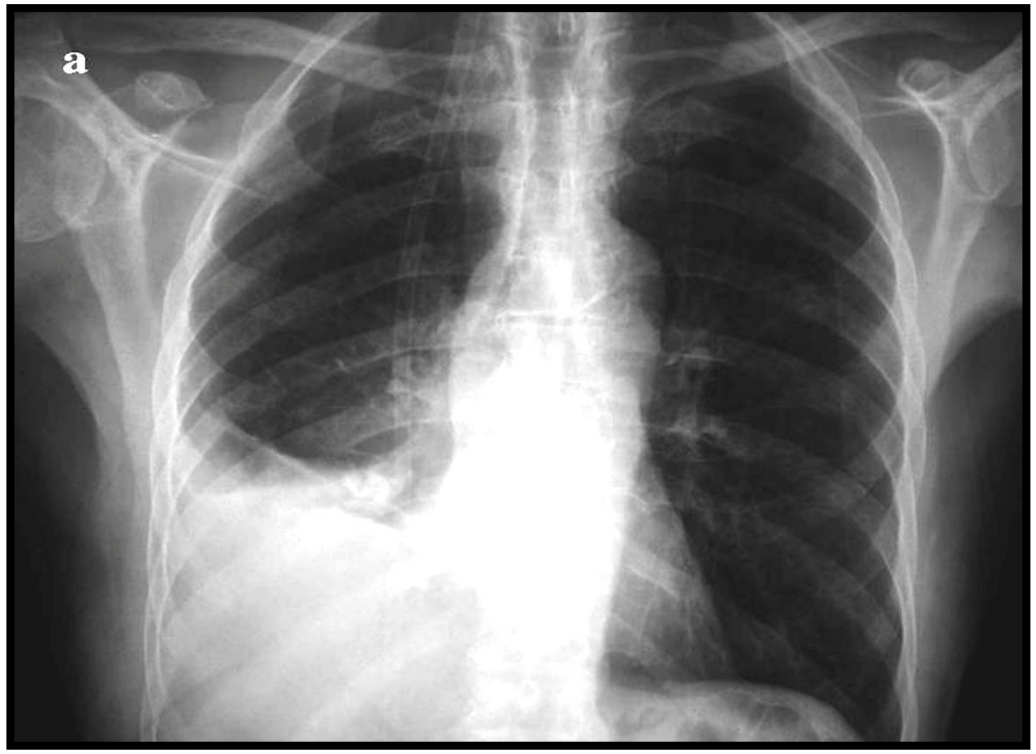
- P/E: Like as serofibrinous pleurisy as seen in the next slide (differentiated only by thoracentesis, which should always be performed when empyema is suspected).

Clinical manifestation

- Auscultation: Crackles, decreased breath sounds, and, possibly, a pleural rub (before a large amount of fluid accumulates).
- Dullness to percussion and decreased breath sounds are likely but difficult to elicit in the younger child, who, because of discomfort, may be less cooperative with the examination.

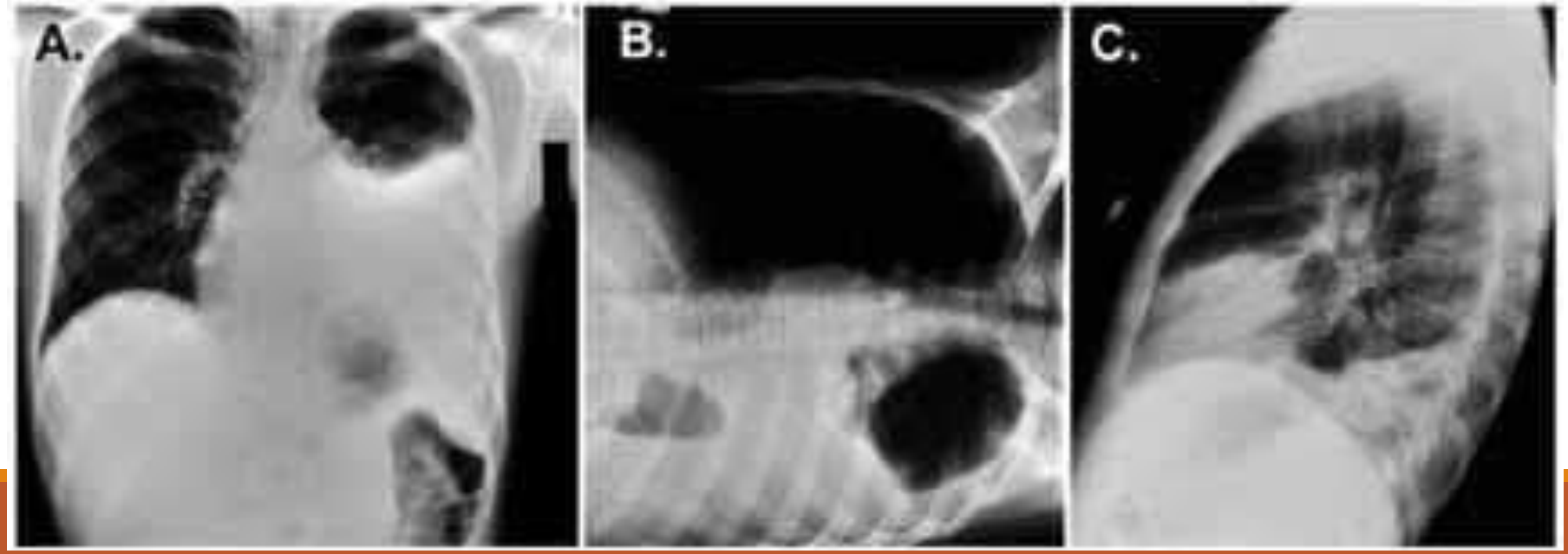
Laboratory data

- CXR: all pleural effusions appear similar, but the absence of a shift of the fluid with a change of position indicates a loculated empyema.
- In cases in which the effusion is moderate, radiography may reveal displacement of the mediastinum to the contralateral hemithorax, as well as scoliosis.



Laboratory data

Radiographic imaging of a parapneumonic effusion may be useful in assessing the stage of the effusion and the type of drainage needed. In Figure A, the left heart border is obscured, and more than 50% of the left hemithorax is filled with an effusion, as evidenced by a fluid meniscus. In Figure B, the effusion is demonstrated to be fluid because it layers out on a decubitus film. In Figure C, the lateral radiograph again demonstrates the fluid meniscus and filling of the posterior sulcus. These findings suggest tube thoracostomy placement may be sufficient to drain this pleural process.



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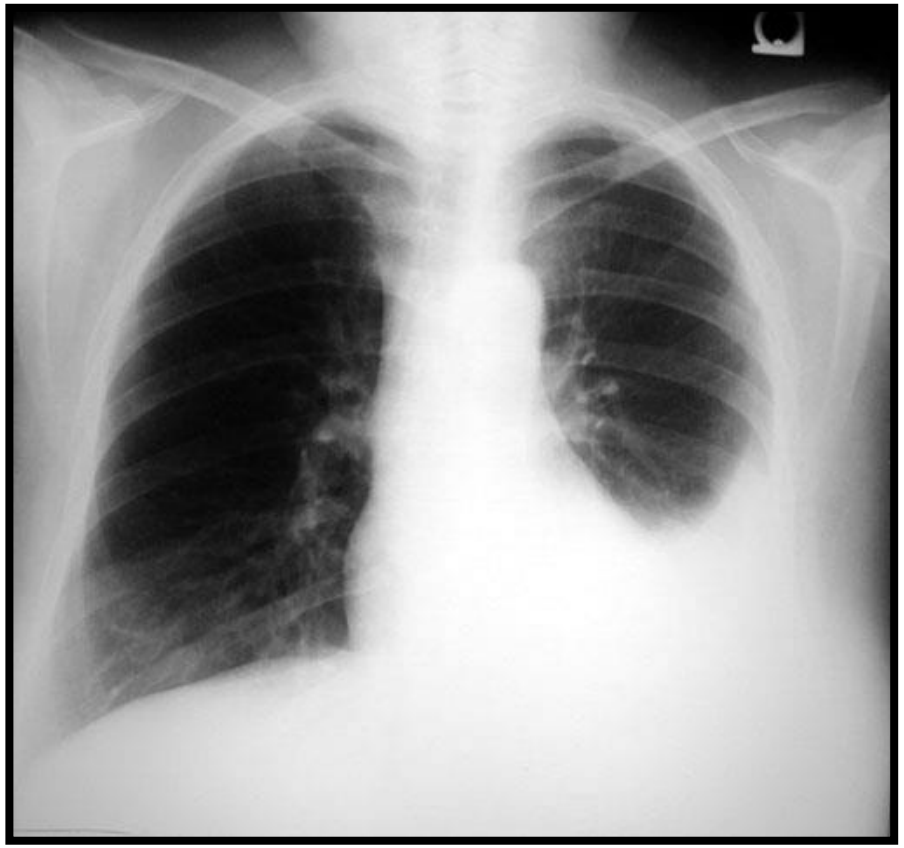
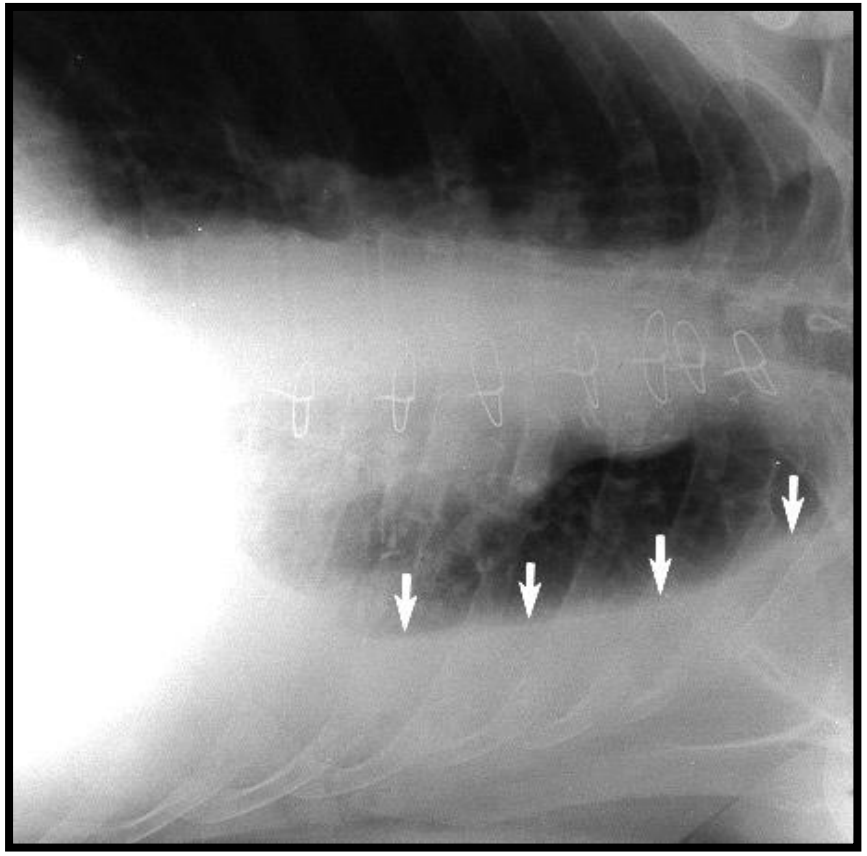




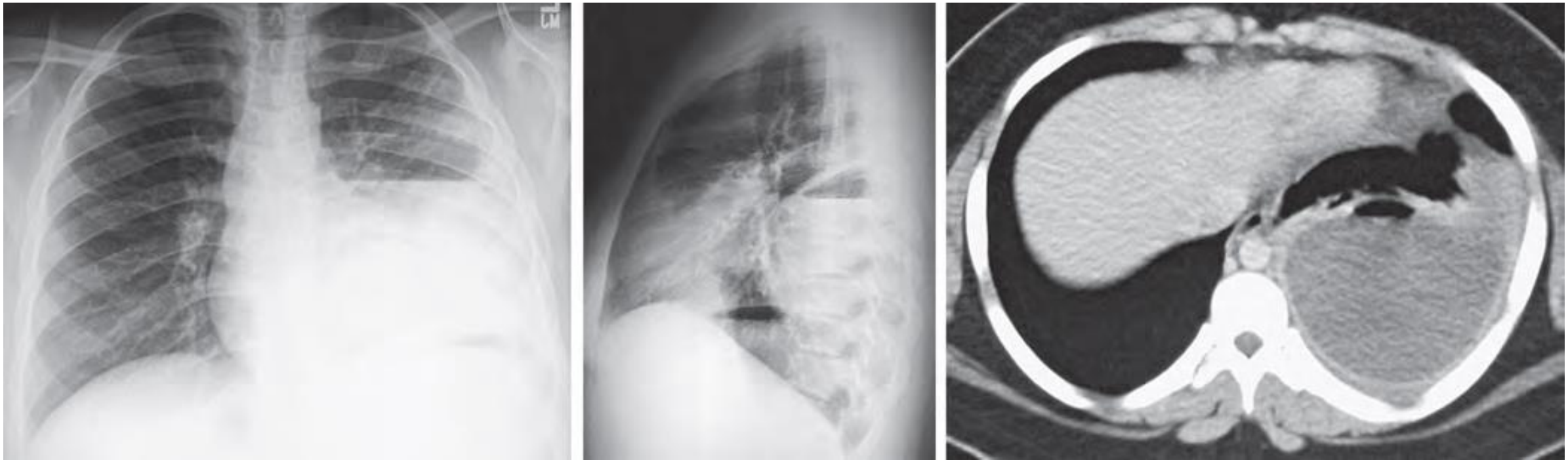
Laboratory data

- Sonography: a lenticular shape may indicate the presence of loculated fluid. Ultrasonography that reveals the absence of loculations suggests that effective treatment can be achieved without surgical intervention.
- CT scan: in patients with complex fluid collections, chest CT imaging has emerged as the study of choice. Chest CT imaging can be used to detect and define pleural fluid and image the airways, guide interventional procedures, and discriminate between pleural fluid and chest consolidation.

Laboratory data

Laboratory data

- Loculated hydropneumothorax



Laboratory data

- Thoracentesis: The effusion is an empyema if: bacteria are present on Gram staining, the pH is <7.20, and there are >100,000 neutrophils/μL, glucose level <60 mg/dL, and lactate dehydrogenase (LDH) >1000 units/L. The organism can be identified in up to 60% of cases.
- Blood cultures may be positive and have a higher yield than cultures of the pleural fluid.
- Leukocytosis and an elevated sedimentation rate may be found.

Laboratory data

- Pleural fluid polymerase chain reaction (PCR), latex agglutination (or counter immunoelectrophoresis [CIE] for specific bacteria) may be helpful if the cause of the infection cannot be ascertained from stain or culture results.
- Cytokine analyses of pleural fluid have been performed in experimental settings and may prove to add prognostic value on the degree of inflammation present and may be beneficial in determining treatment course in the near future.

Differential Diagnoses

- Pleural Effusion
- Heart Failure, Congestive
- Hemothorax
- Pediatric Nephrotic Syndrome
- Pulmonary Infarction

Complications

- The effusion may organize into a thick “peel,” which may restrict lung expansion and may be associated with persistent fever and temporary scoliosis.
- Fibrothorax, a complication reported in the adult literature, is rarely observed in pediatric patients.

Complications

- local complications: bronchopleural fistulas and pyopneumothorax (common in staphylococcal infections), pericarditis, pulmonary abscesses, peritonitis from extension through the diaphragm, and osteomyelitis of the ribs.
- Systemic or septic complications: meningitis, arthritis, osteomyelitis, septicemia (often in H. influenzae and pneumococcal infections).

Treatment

- The aim of empyema treatment is to sterilize pleural fluid and restore normal lung function.
- Treatment includes systemic antibiotics and thoracentesis and chest tube drainage initially with a fibrinolytic agent; if no improvement occurs, VATS is indicated. Open decortication is indicated if fibrinolysis and VATS are ineffective.

Treatment: Antibiotics

- If empyema is diagnosed early, antibiotic treatment plus thoracentesis achieves a complete cure.
- No clinical studies have effectively contrasted antibiotic treatment without drainage to currently available drainage techniques.

Treatment: Antibiotics

- The selection of antibiotic: base the choice on the most common pathogens that cause pneumonia within the patient's age range and geographic location: Staphylococcus, S. pneumoniae, and H. influenzae. In the patient who is debilitated or neurologically impaired, consider coverage for anaerobic infection.

Treatment: Antibiotics

- Most antibiotics cross the pleural space and are thus safe to use, with the exception of aminoglycosides (due to their inactivation in low pH environments).
- Appropriate empirical agents for empyema include β-lactam with β-lactamase inhibitors (e.g., amoxicillin-clavulanate or piperacillin-tazobactam) and carbapenems (e.g., imipenem or meropenem).

Treatment: Antibiotics

- Duration: Clinical response in empyema is slow, and systemic antibiotics may be needed for up to 4 wk (the patient receives 10-14 days of intravenous antibiotics and receives treatment until he or she is afebrile, off supplemental oxygen, and appropriately responds to therapy. Continuation of oral antibiotics may be recommended for 1-3 weeks after discharge but is not required for less complicated infections).
- Instillation of antibiotics into the pleural cavity does not improve results.

Treatment: Antibiotics

Numerous studies have demonstrated resolution of the radiographic abnormalities by 3-6 months following therapy, with few to no symptoms reported at follow-up examination.

Treatment

- Closed-chest tube drainage with fibrolytics if: 1- pus is obtained by thoracentesis, 2- pleural fluid septation is detected on radiographic studies (followed by VATS if there is no improvement).
  - Closed-chest tube drainage is controlled by an underwater seal or continuous suction; sometimes more than 1 tube is required to drain loculated areas. Closed drainage is usually continued for 5-7 days. Remove the tube when the lung re-expands and drainage ceases.

Treatment

- Multiple aspirations of the pleural cavity should not be attempted. Clinical resolution is not hastened by chest physical therapy used as an adjunct to standard treatment in children hospitalized with acute pneumonia.

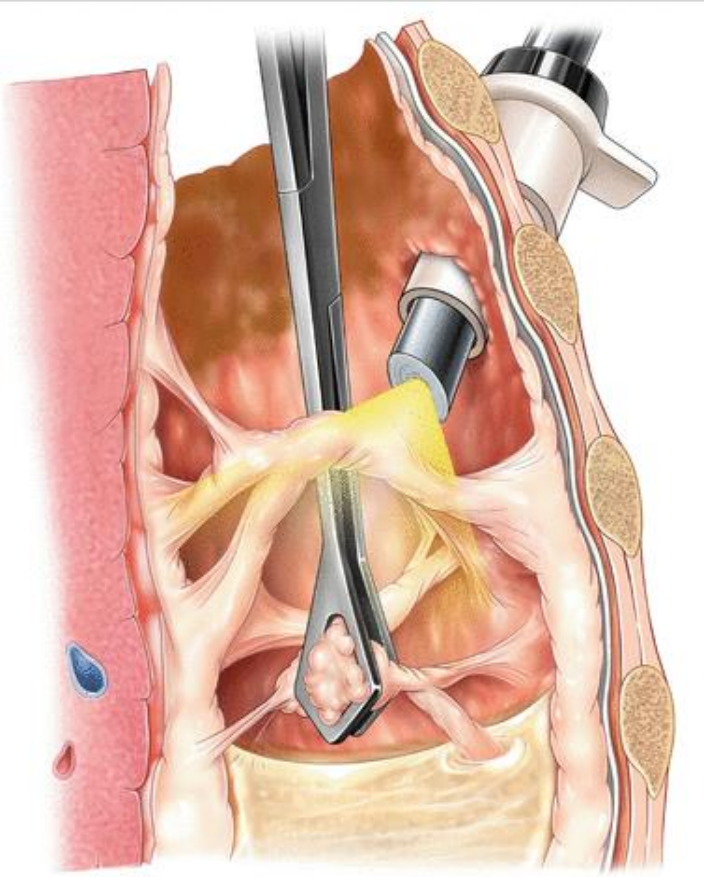
- Advantage of instillation of fibrinolytic agents into the pleural cavity via the chest tube: promotes drainage, decreases the length of time a chest tube is in place, decreases fever, lessens need for surgical intervention, and shortens hospitalization.

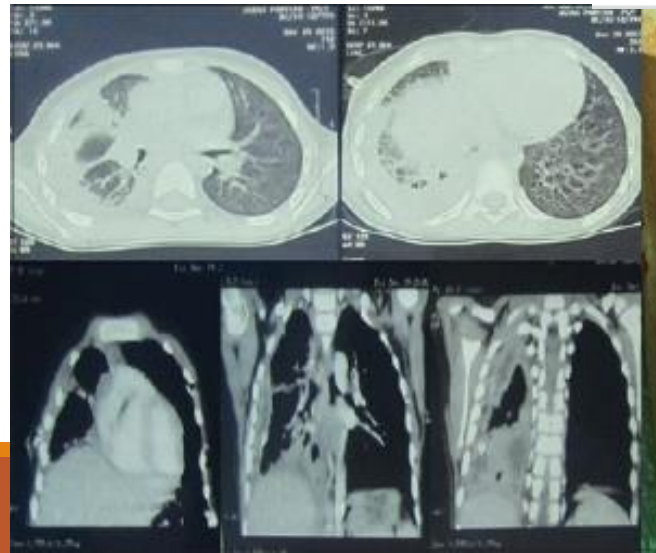
Treatment

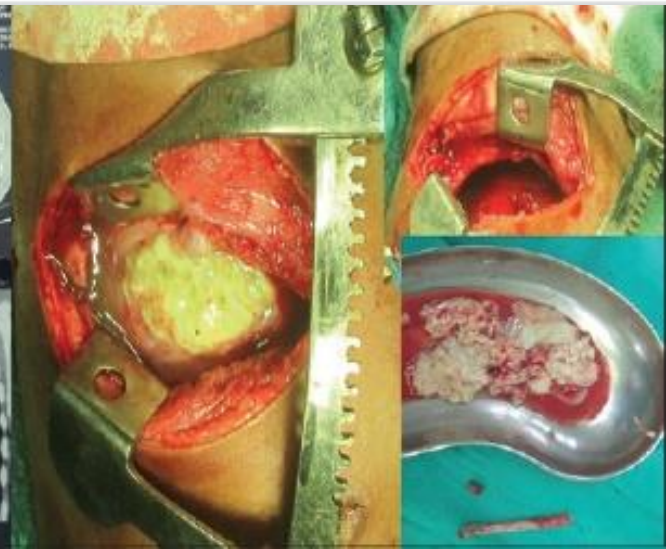
- The optimal fibrinolytic drug and dosages have not been determined: Streptokinase 15,000 units/kg in 50 mL of 0.9% saline, urokinase 40,000 units in 40 mL saline, and **alteplase (tPA)** 4 mg in 40 mL of saline have been used in the pediatric population.
- The combination of fibrinolytic therapy with DNAse is superior to the use of fibrinolytics alone to promote chest tube drainage.
- Risks: There is a risk of anaphylaxis with streptokinase, and all 3 drugs can be associated with hemorrhage and other complications.

Treatment

- VATS (Video-assisted thoracoscopic surgery): In the child who remains febrile and dyspneic for more than 72 hr after initiation of therapy with intravenous antibiotics and thoracostomy tube drainage, surgical decortication via VATS or, less often, open thoracoton may speed recovery.







Treatment

- The definitive approach is thoracotomy drainage with mechanical release of the pleural peel and lysis of adhesions. Studies of decortication and debridement report 95% effectiveness for empyemas in the fibrinopurulent stage.
- Pneumatoceles: attempt to surgery or aspiration if: 1- they reach sufficient size to cause respiratory compromise or 2- become secondarily infected.

F/U

- Obtain follow-up radiographs and pulmonary function tests to determine prognosis of patients with empyema and to confirm resolution of pleural and parenchymal changes.
- Consider a follow-up chest CT scan after the radiography findings clear.

Prognosis

- The long-term clinical prognosis for adequately treated empyema is excellent, and follow-up pulmonary function studies suggest that residual restrictive disease is uncommon, with or without surgical intervention.


HAVE A NICE DAY.