

PNEUMONIA

Pneumonia is an inflammation of the paranchyma of the lungs.

It is a significant cause of mortality in childhood throughout the world, particularly in the developing countries, pneumonia is estimated to cause ≈ 3 million deaths, or an estimated 29% of all deaths, among children younger than 5 yr worldwide. The incidence of pneumonia is more than 10-fold higher and the number of childhood-related deaths due to pneumonia ≈ 2000 -fold higher, in developing than in developed countries.

Etiology

pneumonia are caused by microorganisms, noninfectious causes include aspiration of food or gastric acid, foreign bodies, hydrocarbons, and lipoid substances, hypersensitivity reactions, and drug- or radiation-induced pneumonitis. The cause of pneumonia in an individual patient is often difficult to determine because direct culture of lung tissue is invasive and rarely performed.



1. Bacterial or viral cause of pneumonia can be identified in 40-80% of children with community-acquired pneumonia.

Streptococcus pneumoniae (pneumococcus) is the most common bacterial pathogen in children 3 wk to 4 yr of age, whereas *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* are the most frequent pathogens in children 5 yr and older. In addition to pneumococcus, other bacterial causes of pneumonia include group A streptococcus (*Streptococcus pyogenes*) and *Staphylococcus aureus*.

2. Viral pathogens are a prominent cause of lower respiratory tract infections in infants and children <5 yr of age. Viruses are responsible for 45% of the episodes of pneumonia, more common in the fall and winter (influenza virus), and respiratory syncytial virus (RSV) are the major pathogens, especially in children <3 yr of age. Other common viruses causing pneumonia include parainfluenza viruses, adenoviruses, rhinoviruses, and human metapneumovirus.
3. Atypical pneumonias caused by *Mycoplasma pneumoniae* & *Chlamydia pneumoniae* are more prevalent in school aged children & older children.

Specific risk factors for development of pneumonia

1. Lung diseases as asthma or cystic fibrosis.
2. Anatomic problems as tracheoesophageal fistula.
3. Gastroesophageal reflux disease (GERD) with aspiration.
4. Neurologic disorders which interfere with protection of the airways or compromise clearing of the airways.
5. Diseases which alter the immune system as immunodeficiency or hemoglobinopathies.
6. Season (↑in fall & winter).
7. Viral infections of the respiratory tract can predispose to the 2ry bacterial infections by disturbing the normal host defense mechanisms, altering secretions, & modifying bacterial flora.

Recurrent pneumonia

Defined as **2 or more** episodes in a single year or **3 or more** episodes ever, with radiographic clearing between occurrences.

Causes of recurrent pneumonia

1. Aspiration susceptibility : Oropharyngeal incoordination, Vocal cord paralysis, GERD.
2. Immunodeficiency : Congenital & acquired.
3. Congenital cardiac defects : ASD, VSD, PDA.
4. Abnormal secretions or ↓clearance of secretions : Asthma, Cystic fibrosis, Ciliary dyskinesia.
5. Pulmonary anomalies : Sequestrations, Cystic adenomatoid malformation, TEF .
6. Airway compression or obstruction : Foreign body, Vascular ring, Enlarged lymph node, Malignancy.
7. Miscellaneous : e.g. Sickle cell anemia & Sarcoidosis.

Clinical presentations

Viral pneumonias

Viral and bacterial pneumonias are often preceded by several days of symptoms of an upper respiratory tract infection, typically rhinitis and cough. In viral pneumonia, fever is usually present; temperatures are generally lower than in bacterial pneumonia. Tachypnea is the most consistent clinical manifestation of pneumonia. Increased work of breathing accompanied by intercostal, subcostal, and suprasternal retractions, nasal flaring, and use of accessory muscles is common. Severe infection may be accompanied by cyanosis and respiratory fatigue, especially in infants. Auscultation of the chest may reveal crackles and wheezing, but it is often difficult to localize the source of these adventitious sounds in very young children with hyperresonant chests. It is often not possible to distinguish viral pneumonia clinically from disease caused by *Mycoplasma* and other bacterial pathogens.

Bacterial pneumonia

In adults and older children typically begins suddenly with a shaking chill followed by a high fever, cough, and chest pain. Other symptoms that may be seen include drowsiness with intermittent periods of restlessness; rapid respirations; anxiety; and, occasionally, delirium. Circumoral cyanosis may be observed. In many children, splinting on the affected side to minimize pleuritic pain and improve ventilation is noted; such children may lie on one side with the knees drawn up to the chest.

Physical findings

Depend on the stage of pneumonia.

Early findings may include ↓ breath sounds, scattered crackles & rhonchi on the affected side. with increasing consolidation or with complications as pleural effusion, empyema, or pneumothorax → dullness on percussion & ↓ breath sounds. abdominal distention may be prominent due to gastric dilation from swallowed air &/or ileus. The liver may seem enlarged due to downward displacement of the diaphragm 2ry to hyperinflation of the lungs or superimposed congestive heart failure (CHF). There may be nuchal rigidity (in the absence of meningitis) especially with right upper lobe pneumonia.

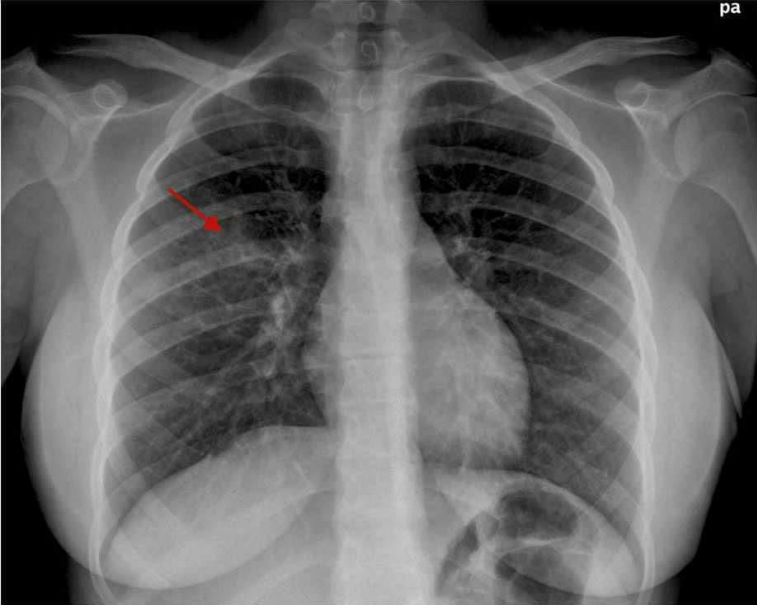
In infants

The clinical patterns are more variable. There may be a prodrome of URTI & ↓ appetite followed by an abrupt onset of fever, restlessness, apprehension, & respiratory distress. These infants appear ill with respiratory distress (grunting, nasal flaring, retractions of the supraclavicular, intercostals, & subcostal areas, tachypnea, tachycardia, air hunger, & often cyanosis). Results of physical examination may be misleading especially in young infants who may have associated GIT disturbances (vomiting, anorexia, diarrhea, & abdominal distention).

- ✓ Rapid progression of symptoms is characteristic in the most severe cases of bacterial pneumonia.

Atypical pneumonia

Often caused by mycoplasma pneumonia or viral infections. The infections tend to start gradually, have minimal or non-productive cough, & have frequent constitutional symptoms as rash, headache, pharyngitis, & GIT symptoms. CXR tend to show patchy, peribronchial infiltrate with only occasional lobar consolidation.



Actas Dermosifiliogr. 2016;107:e47-51

Afebrile infant pneumonia

Caused by Chlamydia trachomatis, CMV, ureaplasma urealyticum, or mycoplasma hominis. Affected infants develop progressive respiratory distress over several days to few weeks associated with failure to thrive (FTT). A maternal history of sexually transmitted disease is common. CXR → bilateral diffuse infiltrate with hyperinflation. There may be eosinophilia & ↑ immunoglobulins (Ig G, A, & M). The causes overlap clinically, although a history of conjunctivitis suggests Chlamydial infection.

Diagnosis

1. CXR : to confirm the diagnosis & exclude complications as pleural effusion, pneumothorax, or empyema.
In viral pneumonia → hyperinflation + bilateral interstitial infiltrates & peribronchial cuffing.
In bacterial pneumonia → confluent lobar consolidation is typically seen with pneumococcal pneumonia.
The radiographic appearance alone is not diagnostic & CXR cannot reliably distinguish between bacteria & viral pneumonia. Radiographic findings resolve in variable times

according to the causative agents (pneumococcus in 6-8 wk, RSV in 2-3 wk, adenovirus may take 1 yr to resolve). If significant radiological abnormalities persist > 6 wk, there should be a high index of suspicion for a possible underlying problem (e.g. unusual infections, anatomic abnormality, or immunodeficiency).

Follow-up CXR in pneumonia are generally not indicated except in children with pleural effusion, persistent or recurrent signs or symptoms with co morbid conditions (e.g. immunodeficiency).

Viral pneumonias

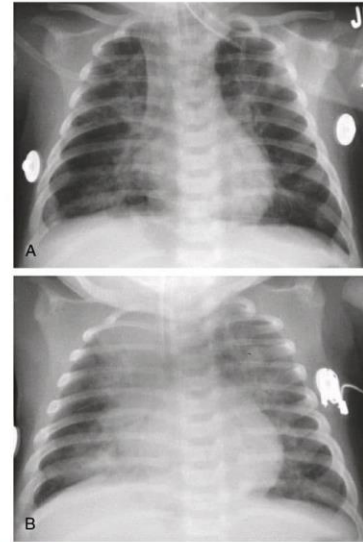


Fig. 428.2 A, Radiographic findings characteristic of respiratory syncytial virus pneumonia in a 6 mo old infant with rapid respirations and fever. Anteroposterior radiograph of the chest shows hyperexpansion of the lungs with bilateral fine air space disease and streaks of density, indicating the presence of both pneumonia and atelectasis. An endotracheal tube is in place. B, One day later, the anteroposterior radiograph of the chest shows increased bilateral pneumonia.

Bacterial pneumonia

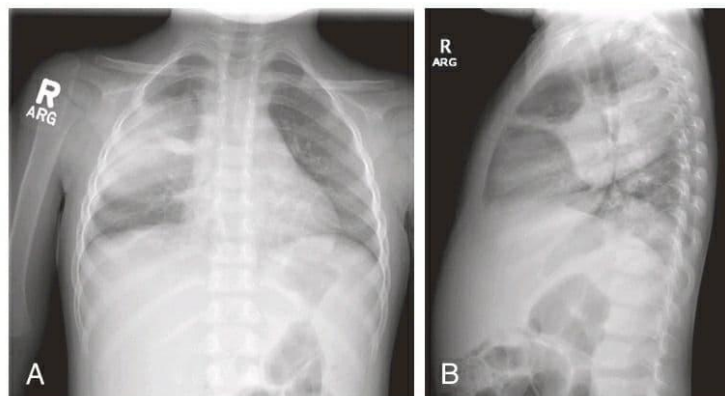
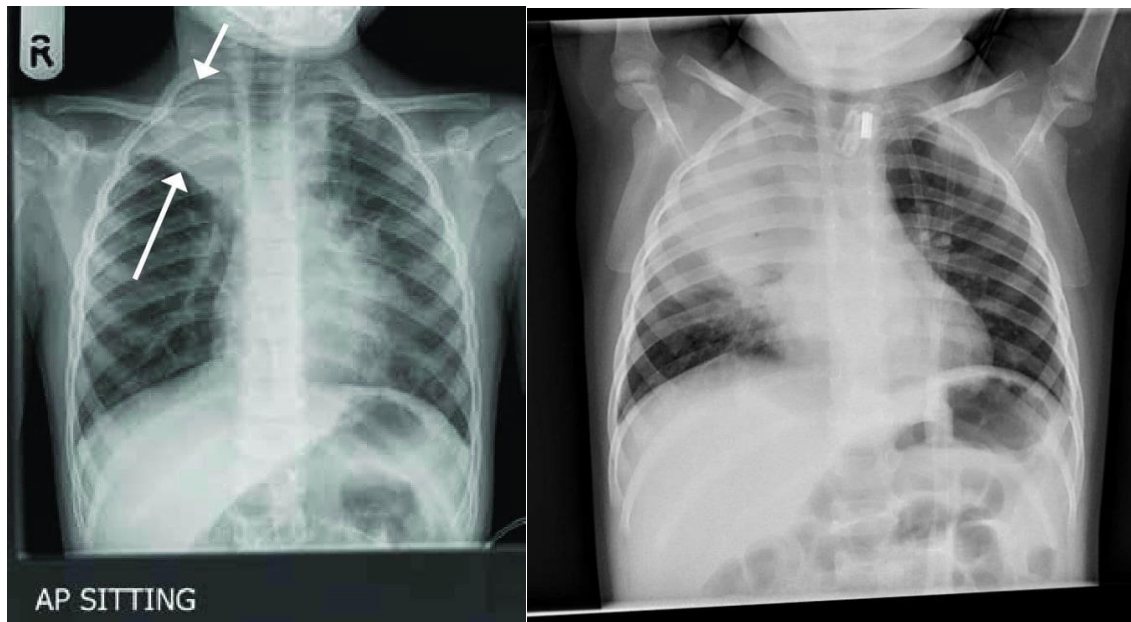


Fig. 209.1 Bacterial pneumonia. "Round" pneumonia caused by *Streptococcus pneumoniae* in 2 yr old girl with a 2-day history of cough, high fever, leukocytosis, and back pain.

Lobar Pneumonia



Staph Pneumonia

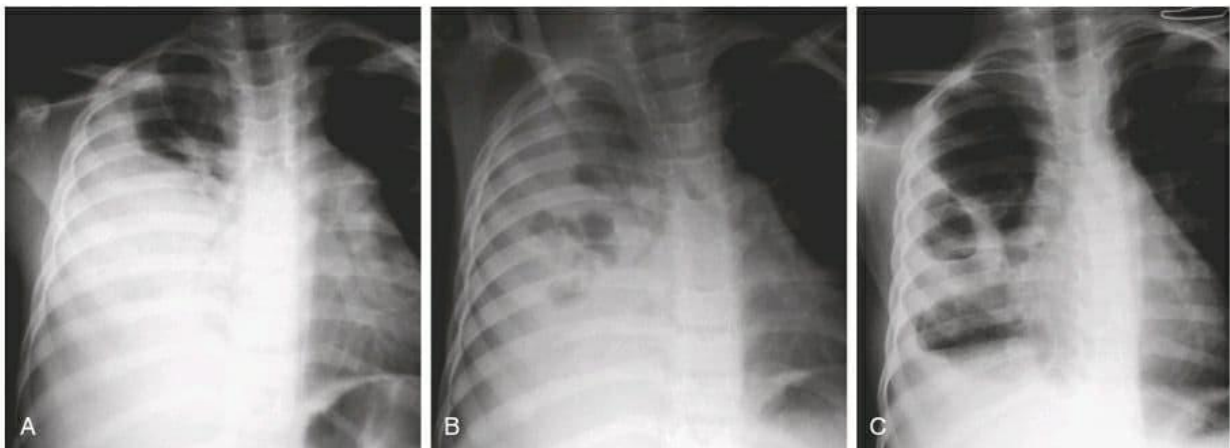


Fig. 208.2 Pneumatocele formation. **A**, *Staphylococcus aureus* pneumonia in 5 yr old child initially demonstrated consolidation of the right middle and lower zones. **B**, Seven days later, multiple lucent areas are noted as pneumatoceles develop. **C**, Two weeks later, significant resolution is evident, with a rather thick-walled pneumatocele persisting in the right midzone associated with significant residual pleural thickening. (From Kuhn JP, Slovis TL, Haller JO: Caffey's pediatric diagnostic imaging, ed 10, Philadelphia, 2004, Mosby, pp 1003–1004.)

2. WBC count may be useful in differentiating viral from bacterial pneumonia. In viral pneumonia → WBC count may be normal or ↑ but usually not $> 20,000/\text{mm}^3$ with a lymphocyte predominance. In bacterial pneumonia → WBC count is often \uparrow ($15,000 - 40,000/\text{mm}^3$) with a granulocyte predominance.
3. The definitive diagnosis of a viral infection rests on the isolation of the virus or the detection of the viral antigen in the respiratory tract secretions. Tissue cultures require 5 - 10 days. Serologic techniques may be used to diagnose a recent viral infection but

generally require testing of the acute & convalescent serum samples for ↑antibodies to a specific viral agent (epidemiologic tool).

4. The definitive diagnosis of a bacterial infection requires isolation of the organism from the blood ($\leq 10\%$ with bacterial pneumonia), from the pleural fluid (60-85%), or from lungs. Sputum culture is of no value (due to carrier states in healthy children, e.g. staphylococcus aureus or H. influenza).
5. In mycoplasma pneumonia → ↑cold agglutinin titers $> 1:64$ is found in 50% of cases but it is not specific (may ↑with other infection as influenza viral infection).
6. In group A streptococcus pneumonia → ↑ASO titer.

Treatment

Treatment of suspected bacterial pneumonia is based on the presumptive cause and the age and clinical appearance of the child. For mildly ill children who do not require hospitalization, amoxicillin is recommended. In communities with a high percentage of penicillin-resistant pneumococci, high doses of amoxicillin (80-90 mg/kg/24 hr) should be prescribed. Therapeutic alternatives include cefuroxime axetil and amoxicillin/clavulanate. For school-aged children and in children in whom infection with *M. pneumoniae* or *C. pneumoniae* is suggested, a macrolide antibiotic such as azithromycin is an appropriate choice. In adolescents, a respiratory fluoroquinolone (levofloxacin, moxifloxacin, gemifloxacin) may be considered as an alternative.

If viral pneumonia is suspected, it is reasonable to withhold antibiotic therapy, especially for those patients who are mildly ill, have clinical evidence suggesting viral infection, and are in no respiratory distress. Up to 30% of patients with known viral infection may have coexisting bacterial pathogens. Therefore, if the decision is made to withhold antibiotic therapy on the basis of presumptive diagnosis of a viral infection, deterioration in clinical status should signal the possibility of superimposed bacterial infection, and antibiotic therapy should be initiated.

Indications for hospital management

1. Age < 6 mo
2. Sick cell anemia with acute chest syndrome
3. Multiple lobe involvement
4. Immunocompromised state
5. Toxic appearance
6. Moderate to severe respiratory distress
7. Requirement for supplemental oxygen
8. Dehydration
9. Vomiting or inability to tolerate oral fluids or medications

10.No response to appropriate oral antibiotic therapy

11.Social factors (e.g., inability of caregivers to administer medications at home or follow up appropriately)

Hospital management

1. Close observation :

Frequent monitoring of the degree of respiratory distress is essential. The respiratory rate, retractions, grunting, color, & level of consciousness should be recorded every 1-2 hr.

2. O2 therapy :

The presence of respiratory distress is an indication of O2 therapy. The method of administration depends on the age & patient tolerance (infants →head box, older children →O2 mask or nasal prongs). O2 concentration depends on the degree of respiratory distress & the level of PaO2. Practically, 40-60% O2 concentration is usually sufficient & the subsequent changes will depends on the course of the illness. O2 should be used continuously & should be withdrawn gradually.

3. Antibiotics :

The empiric treatment of suspected bacterial pneumonia in a hospitalized child requires an approach based on the clinical manifestations at the time of presentation. Parenteral cefotaxime or ceftriaxone is the mainstay of therapy when bacterial pneumonia is suggested. If clinical features suggest staphylococcal pneumonia (pneumatoceles, empyema), initial antimicrobial therapy should also include vancomycin or clindamycin.

4. IV fluid :

In infants with moderate-severe respiratory distress, oral feeding is hazardous & may →serious complications. Maintenance IV fluid is usually needed during the 1st2-3 days to provide an adequate fluid intake. If the patient is still having a significant distress, NG tube feeding should be gradually replace the IV fluid. Oral feeding can be resumed in patients with minimal or no distress.

4. Complication:

○ Pleural effusion & empyema :

Pleural effusion most often occur with pneumococcal pneumonia. Patients respond poorly to treatment of pneumonia & develop worsening respiratory distress & chest pain or discomfort. CXR shows the presence of fluid in the pleural space, a finding that can be confirmed on U/S. Most effusions can be treated conservatively as they are small sterile

parapneumonic collections of straw colored fluid. Some clinicians advocate a tap of the pleural fluid to assess its consistency & for diagnostic purposes. Closed intercostals drainage (underwater seal) is indicated in massive or moderate effusion & the tube is left in place until complete drainage & complete expansion of the collapsed lung which is usually achieved within 2-5 days. If the fluid proves to be frankly infected then an empyema has occurred with active infection in the pleural space. Staphylococcus aureus & streptococcus pneumonia are the most common causes of empyema. The treatment of empyema depends on its stage weather it is exudative, fibrinopurulent, or organizing. Imaging studies including U/S & CT- scan are helpful in determining the stage of empyema. The mainstays of treatment include antibiotics therapy & drainage with tube thoracostomy. Newer approaches include fibrinolytic therapy & selected thoracoscopy to debride, lyse adhesions, & drain the loculaed areas of pus. Early diagnosis & treatment may obviate the need for thoracotomy & open debridement.

- **Respiratory failure :**

Fortunately, most cases of pneumonia with respiratory failure respond to management & recover completely in 7-10 days. In severe cases of bronchopneumonia in infants, assisted mechanical ventilation may be live-saving. The clinical criteria to initiate mechanical ventilation are cyanosis (in spite of 60% O₂) or progressive deterioration of the level of consciousness. On the laboratory level, O₂ saturation < 90% or PaO₂ < 50 mmHg (with 60% O₂) or PaCO₂ > 60 mmHg are indications for mechanical ventilation. When facilities for intensive care are notavailable, manual ventilation with bag & mask is an alternative.

- **Congestive heart failure (CHF) :**

Myocarditis & CHF may occur especially in infants with severe bacterial bronchopneumonia. Treatment include digoxin & diuretics. The fluid intake should be ↓about 20-30%.

- **Paralytic ileus :**

severe pneumonia is the commonest cause of reflux ileus in infants which →vomiting & abdominal distention. Plain abdominal X-rays in erect position → multiple fluid levels. The patient should be kept on maintenance IV fluid with complete rest of the GIT. The condition usually subsides within few days & gradual oral feeding can be resumed.

Typically, patients with uncomplicated community-acquired bacterial pneumonia respond to therapy with improvement in clinical symptoms (fever, cough, tachypnea, chest pain) within 48–96 hr of initiation of antibiotics. Radiographic evidence of improvement substantially lags

behind clinical improvement. A number of factors must be considered when a patient does not improve on appropriate antibiotic therapy

slowly resolving pneumonia:

- (1) complications, such as empyema;
- (2) bacterial resistance;
- (3) nonbacterial etiologies such as viruses and aspiration of foreign bodies or food;
- (4) bronchial obstruction from endobronchial lesions, foreign body, or mucous plugs;
- (5) pre-existing diseases such as immunodeficiencies, ciliary dyskinesia, cystic fibrosis, pulmonary sequestration, or cystic adenomatoid malformation; and
- (6) other noninfectious causes (including bronchiolitis obliterans, hypersensitivity pneumonitis, eosinophilic pneumonia, aspiration, and Wegener granulomatosis). A repeat chest x-ray is the 1st step in determining the reason for delay in response to treatment.

Complications

usually due to direct spread of bacterial infections within the thoracic cavity (e.g. pleural effusion, empyema, & pericarditis) or due to bacterial hematological spread which is rare (e.g. meningitis, suppurative arthritis, osteomyelitis).

Prevention

that vaccination has reduced the incidence of pneumonia hospitalizations. the 13-valent pneumococcal conjugate vaccine (PCV13) ,influenza vaccine recommendations to include all children >6 mo of age might be expected to affect pneumonia hospitalization rates