Pneumonia in Children

Description/Etiology

Pneumonia (i.e., inflammation of the pulmonary parenchyma) is a major cause of morbidity and mortality in children, especially in developing countries. (For more information about pneumonia, including in adults, see the series of related Quick Lessons.) Pneumonia in children is primarily caused by viruses (e.g., rhinovirus, human metapneumovirus, adenovirus, parainfluenza, influenza) accounting for approximately one-third of pneumonia cases in children and another one-third from a combination of viruses and bacteria. The other third is caused by bacteria alone. Pneumonia in children caused by fungus occur less often, about one in ten cases. Pneumococcal and Haemophilus influenza type B vaccines have significantly reduced the numbers of bacteria-associated pneumonia occurring in children.

The predominant causes of pneumonia in children vary by age. Respiratory syncytial virus (RSV), adenovirus, and human metapneumovirus more commonly occur among children < 5 years of age than in older children; Mycoplasma pneumonia occur more often in older children than children less than 5 years of age. Bacterial causes of pneumonia in newborns (i.e., 0–30 days old) include organisms present in the maternal genitourinary and gastrointestinal tract flora such as Escherichia coli, Klebsiella pneumoniae, Listeria monocytogenes, and group B Streptococcus.

Fever, cough, and dyspnea are the most common symptoms of pneumonia, although cough is absent in newborns. Crepitus (i.e., fine crackles) or silenced breath sounds can be heard upon auscultation.

Hospitalization is usual for pneumonia in children < 5 years of age; immunocompromised children; children who appear toxic, have respiratory distress (i.e., chest indrawing, hypoxemia, hypercarbia), or require supplemental oxygen; and children with pneumonia for whom outpatient treatment has failed (e.g., no resolution of symptoms after 48 hours of treatment). Chest radiographs are not routinely recommended for children being treated at home. Chest X-rays are used for children who are severely ill, haven’t responded to antimicrobial treatment after 48 hours, or have silenced breath sounds. In developed countries, diagnosis is made based on respiratory manifestations and if necessary (e.g., to determine severity of infection), radiographic findings; pneumonia can be diagnosed based on clinical findings alone.

Treatment includes bed rest, close monitoring, drug therapy (e.g., antimicrobials, analgesics, antipyretics), and in cases of respiratory distress, supplemental oxygen, and mechanical ventilation. Antimicrobials for treatment of pneumonia in children include neuraminidase inhibitors for influenza and antibiotics (e.g., amoxicillin, ampicillin, cefotaxime, azithromycin) for bacterial pneumonia.

Facts and Figures

About 3 million children die from pneumonia each year, worldwide. Most have underlying conditions (e.g., congenital heart disease, chronic lung disease of prematurity, immunosuppression) and most occur in developing nations, although in industrialized countries, pneumonia remains a significant cause of morbidity.

Approximately, 70% of children hospitalized for pneumonia are less than 5 years of age. Globally, pneumonia, along with other lower respiratory infections, is the leading cause
of death in children under 5 years of age. The estimated global incidence of pneumonia in children is 0.28 episodes per
child-year, which is the equivalent of ~ 150 million new episodes annually in children < 5 years of age. Approximately, 90% of
cases of pneumonia in younger children occur in developing countries.

In children younger than 2 years of age, pneumonia accounts for 13% of all infectious illnesses. Approximately, 14–35% of
pneumonia hospitalization in school-aged children and adolescents are caused by *Mycoplasma pneumoniae*. In the United
Kingdom, death associated with pertussis related pneumonia is fifty-nine percent. In developed countries, the incidence of
community-acquired pneumonia (*Streptococcus pneumoniae, H. influenzae, influenza, rhinovirus*) among children younger
than 5 years of age is 0.026 episodes per child-year.

Pneumonia is the leading cause of death in children with AIDS. Opportunistic fungal organisms (e.g., *Cryptococcus,
Pneumocystis*) can cause pneumonia in children with AIDS. Cryptococcosis occurs in about 5–10% of children with AIDS.

**Risk Factors**

Risk factors for pneumonia in children include prematurity, low birth weight, suboptimal breastfeeding, malnutrition, low
socioeconomic status, lack of immunization, day care attendance, immunocompromised status, and certain comorbid conditions
(e.g., cystic fibrosis, asthma, cancer, HIV/AIDS). Environmental factors (e.g., living in crowded or unhygienic homes, parental
smoking, indoor air pollution caused by cooking and heating with wood or dung) can contribute to the child developing
pneumonia. Children with dysphagia, impaired gastrointestinal motility, and/or a gastrostomy tube are at increased risk for
aspiration pneumonia.

**Signs and Symptoms/Clinical Presentation**

Signs and symptoms of pneumonia in children vary with age although the most common symptoms at any age include fever,
cough, and dyspnea although newborns rarely have a cough. Other signs and symptoms include fine crackles or silenced breath
sounds. Cough or difficulty breathing for two weeks or less, rapid breathing (i.e., 50 breaths/min [bpm] in infants 2–11 months
and > 40 bpm in children 12–59 months) and lower chest indrawing indicate a severe form of pneumonia. In addition, crying,
grunting, increased irritability, flared nostrils, lethargy, and refusal to feed are frequently seen in infants and toddlers with
pneumonia. Older children and adolescents can also present with chills, sweating, headache, nasal congestion, ear pain, sore
throat, grunting and/or wheezing, chest retractions when breathing, vomiting, chest and/or abdominal pain, lethargy, and poor
appetite.

**Assessment**

› **Patient History**
  • Ask about travel history since different geographical areas have different level of risk of acquiring certain pathogens (e.g.,
    *Chlamydia psittasi, Histoplasma capsulatum, Coxiella burnetii, Francisella tularensis, Yersinia pestis, M. tuberculosis*)
  • Ask about the child’s immunization status (e.g., pertussis, seasonal influenza, pneumococcal)

› **Physical Findings of Particular Interest**
  • Respiratory crackles, rales, rhonchi, rapid breathing, wheezing, intercostal retractions, fever, cough, flushed skin, and
cyanosis of the skin and/or nail beds can be present
  • For pneumonia caused by an inhaled foreign body, history of a recent choking episode is important in diagnosis

› **Laboratory Tests That May Be Ordered**
  • CBC/differential can show elevated WBCs
  • Erythrocyte sedimentation rate (ESR) can be elevated
  • Blood cultures can be performed
  • Testing of nasopharyngeal secretions and/or nasal swabs by polymerase chain reaction (PCR) and/or immunofluorescence
    can be performed
  • C-reactive protein (CRP) can be elevated, indicating resolving empyema (i.e., pus or fluid in body cavity), but should not
    be used as a basis for diagnosis
  • Cytologic analysis of secretions and Gram stains and smears can identify the causal organism and determine sensitivity to
    antibiotics if the causative agent is bacterial
  • Mantoux skin testing can rule out tuberculosis as the cause of pneumonia
  • Cold agglutinin titer tests can show elevated antibody levels
  • RSV rapid fluorescent antibody stains are useful to identify RSV infection
  • ABGs can indicate acidosis, ↓ PaO₂, and ↑ PaCO₂
  • Pulse oximetry can indicate decreased oxygen saturation
Other Diagnostic Tests/Studies

- Chest X-ray with lateral decubitus views can identify hilar adenopathy, peribronchial thickening, diffuse interstitial infiltrates, hyperinflation, pleural effusion, empyema, pneumatoceles, and/or pulmonary abscess
- Chest ultrasound and/or chest CT scan can show effusion, and in severe cases of pneumonia in children can show necrosis or abscess

Treatment Goals

Promote Optimum Physiologic Status and Reduced Risk of Complications

- Closely monitor vital signs; intake and output; oxygenation; daily weight; electrolytes; sputum production; cardiac, respiratory, fluid, and nutritional status; breath sounds; and pulse oximetry and ABG values. Request referral to a pulmonologist and/or infectious disease specialist if one is not already part of the treatment team
  - Assess for pain, fever, and discomfort, and provide symptomatic relief as ordered
  - Administer prescribed antimicrobial agents as determined by the causative organism and illness severity
  - Follow facility infection control protocols to reduce risk of transmission
- Assist with clearance of secretions using nasotracheal and oral suctioning as needed. Utilize positioning techniques as well as manual or mechanical percussion to help loosen secretions, preferably in conjunction with prescribed breathing treatments. Educate the patient, as developmentally appropriate, and parents about the importance of secretion clearance and regular deep breathing and coughing
  - Assist with tracheal intubation and mechanical ventilation support and provide oxygen for children with progressive dyspnea and/or respiratory failure, as ordered
  - Provide tracheobronchial suctioning or assist with tracheobronchoscropy to help remove effusions, particulates, or plugs, if appropriate, and elevate the child’s head
  - Administer or assist with administration of additional respiratory medications, including nebulized antibiotics, bronchodilators, anti-inflammatory medications, and mucolytics

Provide Emotional Support and Educate

- Provide a quiet, calm environment with frequent rest periods; assess child/parental anxiety and coping ability, provide emotional support, and encourage expression of concerns/feelings. Follow facility protocols regarding encouraging parent participation in patient care, including providing oral care and hydration, and rooming-in. Educate and encourage discussion about pneumonia etiology and pathophysiology, potential complications, treatment risks and benefits, transmission prevention, and individualized prognosis
- Educate about prevention strategies (e.g., pneumococcal conjugate vaccine, *H. influenzae* type B [HiB] vaccine, yearly influenza vaccination)

Food for Thought

- In a randomized, controlled, triple-blind investigation, researchers report that twice daily administration of oral amoxicillin for nonsevere pneumonia in children was found to be as effective as thrice daily administration of oral amoxicillin (Vilas-Boas, et al., 2014)
- Although it is understood that viral pneumonia is prevalent in children, the World Health Organization (WHO) guidelines recommend antibiotic treatment without distinguishing between viral and bacterial pneumonia (Lassi et al., 2014)
- The United States and Canada have a triage system that commonly use pulse oximetry to detect hypoxemia in pediatric patients presenting with symptoms of respiratory symptoms; developing countries see patients on a first-come-first-served basis without any triage criteria.
- The use of pulse oximetry in developing countries can help identify high-risk children with respiratory tract infections sooner which would improve managing the child’s care, eventually leading to a reduction in mortality rates (Hamid et al, 2016)

Red Flags

- Potential complications of pneumonia in children include sepsis, respiratory distress, pulmonary abscess, bronchiectasis (i.e., destruction and widening of the bronchi), constrictive bronchiolitis (i.e., narrowing or obliteration of the bronchioles), persistent empyema, effusions (i.e., fluid leaks into tissues and body cavities), and pneumatocele (i.e., herniation of lung tissue)
What Do I Need to Tell the Patient/Patient’s Family?

› Provide parents with written information on pneumonia, if available, to reinforce verbal education
› Educate parents and older pediatric patients to monitor for signs of increasing respiratory distress and to seek medical attention immediately if these signs develop
› Increase fluid intake, limit activities, and attend scheduled follow-up medical appointments
› Educate parents about the use of nebulized medications, if appropriate, and have them demonstrate their understanding of how to perform nebulizer set up and administer nebulized medication

References