Community Acquired Pneumonia: ACH Guideline

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Community-Acquired Pneumonia

Key Points

- Community-Acquired Pneumonia (CAP) can be treated effectively in the outpatient setting as long as there is no hypoxia or tachypnea.
- First line treatment in the outpatient setting for CAP is high dose amoxicillin (90mg/kg/day divided 2-3 times a day) for 10 days.
- Room air hypoxia or tachypnea requiring oxygen supplementation are basic admission criteria for CAP.
- First line treatment in the inpatient setting is ampicillin (150-200mg/kg/day divided every 6 hours) for 10 days. This can be transitioned to amoxicillin at the recommended dosing when criteria is met for discharge.
- If atypical pneumonia is suspected, azithromycin should be used for treatment.

Abbreviations

CAP, community-acquired pneumonia; LRTI, lower respiratory tract infection; CRP, C-reactive protein; mg, milligram; kg, kilogram

1. Definition, Epidemiology, Etiology
    a. Definitions
        i. Pneumonia is defined as a lower respiratory tract infection (LRTI) typically associated with fever, respiratory symptoms, and evidence of parenchymal involvement by either physical examination or the presence of infiltrates on chest radiography.
        ii. CAP specifically refers to the clinical signs and symptoms of pneumonia acquired outside of a hospital setting.
    b. Epidemiology
        i. CAP accounts for approximately 2 million outpatient visits annually in the United States.
        ii. In developed countries, the annual incidence of pneumonia is estimated at 33 per 10,000 in children younger than 5 years and 14.5 per 10,000 in children ages 0 to 16 years.
        iii. CAP accounts for approximately 124,000 pediatric hospitalizations annually in the United States.
        iv. The mortality rate is less than 1 per 1000 per year in developed countries.
    c. Clinical Presentation
        i. Children with pneumonia typically present with:
            1. Fever (temperature >38.0℃)
            2. Cough
            3. Tachypnea
                a. Tachypnea becomes less sensitive and specific as age increases, specifically for children > 5 years.

4. Increased work of breathing

ii. Moderate to severe pneumonia can present with signs of respiratory distress such as:
    1. Retractions (intercostal or subcostal)
    2. Grunting
    3. Hypoxemia

iii. Physical exam findings most often include:
    1. Crackles
    2. Wheezes
    3. Decreased breath sounds
    4. In infants, these exam findings can overlap with other lower respiratory tract diseases, such as bronchiolitis.
    5. It should be noted that cough, crackles, retractions, rhonchi, and nasal flaring are highly specific but not sensitive.
        a. Their absence might help rule out the disease.

d. Etiology

The most common pathogens causing pneumonia are viruses and bacteria.

i. Bacterial PNA
    1. Since the introduction of the pneumococcal conjugate vaccine (PCV) and *Haemophilus influenzae* (Hib) vaccines, the prevalence of bacterial pneumonia disease has significantly decreased.
        a. In children who are unvaccinated, *Streptococcus pneumoniae* and *Haemophilus influenzae* must be considered as bacterial pathogens.
    2. Bacterial causes vary based on age but are typically caused by *Streptococcus pneumoniae*, *Mycoplasma pneumoniae*, and *Staphylococcus aureus.*
    3. Special considerations
        a. *Mycoplasma pneumoniae* is more common in school-aged children > 5 years of age.
        b. In neonates, maternal flora, such as group B *streptococcus* and gram-negative bacteria, are common causes that are vertically transmitted.
        c. Community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) should be considered:
            i. in cases of complicated pneumonia with empyema and necrosis.
            ii. In a post-viral setting, especially influenza.
        d. If there is concern for an aspiration event, anaerobes could be a contributing organism.
        e. In children who are immunocompromised, or with underlying conditions such as cystic fibrosis or spinal muscular atrophy, *Pseudomonas aeruginosa* must be considered.

f. Fungal pathogens, such as *Aspergillus fumigatus*, must be considered in immunocompromised individuals.

ii. Viral causes account for approximately 70% of pneumonia cases, with respiratory syncytial virus (RSV), rhinovirus, human metapneumovirus, and adenovirus leading the predominance.

e. Pathophysiology
   i. The respiratory tract is not a sterile environment and is always being exposed to environmental pathogens.
   ii. Pneumonia occurs when there is invasion of certain bacterial pathogens, followed by their proliferation, leading to inflammation of the lung parenchyma.
   iii. Typically, there are a number of local and systemic host defense mechanisms to help prevent the invasion and proliferation of these microorganisms, such as the defense provided by alveolar macrophages. They are responsible for the inflammatory cascade of cytokines and chemokines that produce many of the systemic symptoms associated with pneumonia, such as fever.
   iv. Some individuals are at risk for pneumonia because they are lacking in some form of host defense mechanism. Examples of this include:
      1. Accumulation of secretions – seen in bronchial obstruction and cystic fibrosis.
      2. Impairment of mucociliary clearance – seen in post-viral states and Kartergerner's syndrome.
      3. Humoral and complement-mediated immunity is compromised – seen in immunosuppressed children, diseases such as common variable immunodeficiency (CVID), functional asplenia, and X-linked agammaglobulinemia.
      4. Impaired cough reflex – seen in spinal muscular atrophy (SMA), muscular dystrophy, and traumatic brain injuries.

f. Evaluation and Diagnosis Pneumonia in children can be a challenging diagnosis because the presenting signs and symptoms are nonspecific and can be subtle, and vary depending on the patient's age.

g. In children presenting with mild pneumonia, laboratory analysis and chest radiographs are not needed.
   i. An exam including auscultation of all lung fields should be performed, listening for crackles, crepitations, decreased breath sounds, egophony, or bronchophony.

h. Laboratory
   i. Laboratory analysis is really only helpful in tracking disease severity. WBC counts are not as helpful as biomarkers such as CRP and procalcitonin.
   ii. Peripheral eosinophilia suggests *Chlamydia trachomatis* in infants with pneumonia.
   iii. Blood cultures: should be obtained:

a. In children hospitalized with severe disease
b. In children who fail to demonstrate response despite adequate antibiotic coverage.
c. In children with complicated pneumonia.
d. Not indicated in the outpatient setting, if children appear nontoxic and are fully immunized.

i. Imaging
    i. Chest X-ray
        1. The presence of infiltrates on chest radiograph in a child with fever and respiratory distress confirms the diagnosis of pneumonia.
        2. However, the use of chest radiographs are not necessary for the diagnosis of uncomplicated CAP in the outpatient setting.
        3. In children presenting with moderate to severe pneumonia, a chest radiograph can help assess disease severity and associated complications, such as parapneumonic effusions.
        4. Chest radiographs are recommended for children requiring hospitalization with signs of hypoxemia or respiratory distress.
        5. Repeated chest radiographs are not routinely required in children who are improving.
    ii. Ultrasound
        1. Chest ultrasound is often useful for detecting parapneumonic effusions and empyemas.

2. Management and Treatment Recommendations
    a. Treatment
        i. Antimicrobial therapy is not routinely required for preschool-aged children presenting with CAP, as viral pathogens are responsible for the majority of clinical disease.
        ii. First-line antimicrobial treatment in the outpatient setting for CAP in previously healthy and appropriately immunized children is high dose amoxicillin (90mg/kg/day divided 2-3times per day) for a total of 10 days.
        iii. First-line treatment in the outpatient setting for CAP when atypical pathogens are clinically suspected is azithromycin (10mg/kg/day on day 1, then 5mg/kg/day on days 2-5 in once a day dosing).
        iv. First-line treatment in the inpatient setting for CAP is ampicillin (150-200 mg/kg/day divided every 6 hours) or penicillin G (200,000 to 250,000 U/kg/day every 4-6 hours).
        v. Empiric treatment with a third-generation cephalosporin, such as ceftriaxone (50-100 mg/kg/day divided every 12-24 hours) or cefotaxime (150 mg/kg/day divided every 8 hours) should be considered for hospitalized infants and children who are not fully immunized.

vi. Further investigation should be performed in children whose condition deteriorates after admission or who show no improvement within 48–72 hours.
vii. Children who are immunocompromised or with cystic fibrosis require special considerations in their treatment regimen in addition to coverage for the typical pathogens.
viii. Mucolytics and cough suppressants have no role in the treatment of pneumonia.

b. Management of Parapneumonic Effusions
   i. Children with chronic illness or comorbid conditions are more subject to complications of pneumonia.
   ii. Small and uncomplicated effusions should not routinely be drained as they typically respond well to antibiotic therapy alone.
   iii. Moderate effusions associated with signs of respiratory distress should be drained.
   iv. Large effusions should be drained.
   v. Both chest thoracostomy tube drainage with fibrinolytic therapy and video-assisted thoracoscopic surgery (VATS) have demonstrated to be effective treatments.
      1. VATS should be considered if there is persistence of moderate to large-sized effusions despite 2-3 days of management with a chest tube and fibrinolytic therapy.

c. Disposition
   i. If a child has been admitted for hypoxemia related to their pneumonia, they should be safely weaned off of oxygen with stable oxygen saturations for several hours prior to discharge home.
   ii. If a child has been admitted for respiratory distress or acute respiratory failure related to their pneumonia, they should be safely weaned off of oxygen support with no signs of distress (such as retractions or grunting) for several hours prior to their discharge home.
   iii. Uncomplicated cases of CAP should complete a 10-day course of the appropriate antibiotic (discussed above).
   iv. In cases where there have been complications, such as parapneumonic effusions, the antibiotic course will depend on the adequacy of effusion drainage and resolution, and the patient's clinical response to treatment. Most cases will need to be treated with 2-4 weeks of antibiotic therapy.
   v. Children hospitalized with pneumonia must follow up with their primary care physician after discharge to ensure continued improvement and adherence with the antibiotic regimen prescribed.

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