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Pneumonia is a Common Respiratory Disease in Children

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Annotation: Pneumonia is a leading cause of morbidity and mortality in children younger than the age of 5. Although the majority of deaths attributed to pneumonia in children are mostly in the developing world, the burden of the disease is substantial, and there are significant healthcare-associated costs related to pneumonia in the developed world. This activity reviews the cause, pathophysiology, and presentation of pediatric pneumonia and highlights the role of the interprofessional team in its management.

Key words: streptococci, Klebsiella, Escherichia coli, Streptococcus pneumoniae, Streptococcus pyogenes, fever, cough.

The etiology of pneumonia in the pediatric population can be classified by age-specific versus pathogen-specific organisms. Neonates are at risk for bacterial pathogens present in the birth canal, and this includes organisms such as group B streptococci, Klebsiella, Escherichia coli, and Listeria monocytogenes. Streptococcus pneumoniae, Streptococcus pyogenes, and Staphylococcus aureus can be identified in late-onset neonatal pneumonia. Viruses are the main cause of pneumonia in older infants and toddlers between 30 days and 2 years old. In children 2 to 5 years old, respiratory viruses are also the most common. The rise of cases related to S pneumoniae and H influenzae type B is observed in this age group. Mycoplasma pneumonia frequently occurs in children in the range of 5 to 13 years old however, S pneumoniae is still the most commonly identified organism. Adolescents usually have the same infectious risks as adults. It is important to consider tuberculosis (TB) in immigrants from high-prevalence areas and children with known exposures. Children with chronic diseases are also at risk for specific pathogens. In cystic fibrosis, pneumonia secondary to S aureus and Pseudomonas aeruginosa is ubiquitous. Patients with sickle cell disease are at risk of infection from encapsulated organisms. Children who are immunocompromised should be evaluated for Pneumocystis jirovecii, cytomegalovirus, and fungal species if no other organism is identified. Unvaccinated children are at risk for vaccine-preventable pathogens.

Pneumonia is an invasion of the lower respiratory tract below the larynx by pathogens either by inhalation, aspiration, respiratory epithelium invasion, or hematogenous spread. There are barriers to infection that include anatomical structures (nasal hairs, turbinates, epiglottis, cilia) and humoral and cellular immunity. Once these barriers are breached, infection, either by fomite/droplet spread (mostly viruses) or nasopharyngeal colonization (mostly bacterial), results in inflammation and injury or death of surrounding epithelium and alveoli. This is ultimately accompanied by a migration of inflammatory cells to the site of infection, causing an exudative process, which in turn impairs oxygenation. In the majority of cases, the microbe is not identified, and the most common cause is viral etiology.

There are 4 stages of lobar pneumonia:

- The first stage occurs within 24 hours and is characterized by alveolar edema and vascular congestion. Both bacteria and neutrophils are present.
- Red hepatization is the second stage, and it has the consistency of the liver. The stage is characterized by neutrophils, red blood cells, and desquamated epithelial cells. Fibrin deposits in the alveoli are common.

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- The third stage of gray hepatization stage occurs 2 to 3 days later, and the lung appears dark brown. There is an accumulation of hemosiderin and hemolysis of red cells.
- The fourth stage is the resolution stage, where the cellula infiltrates is resorbed, and the pulmonary architecture is restored. If the healing is not ideal, then it may lead to parapneumonic effusions and pleural adhesions.

The differential diagnosis for pediatric pneumonia includes:

Alveolar proteinosis

Aortic stenosis

Aseptic meningitis

Asphyxiating thoracic dystrophy

Aspiration syndromes

Asthma

Atelectasis

AV septal defect, complete

AV septal defect, unbalanced

Bacteremia

Birth trauma

Treatment should be targeted to a specific pathogen that is suspected based on information obtained from history and physical exam. Supportive and symptomatic management is key and includes supplemental oxygen for hypoxia, antipyretics for fever, and fluids for dehydration. This is especially important for non-infectious pneumonitis and viral pneumonia for which antibiotics are not indicated. Cough suppressants are not recommended. If bacterial pneumonia is suspected, treat empirically with antibiotics, keeping in mind significant history and bacterial pathogens that are common to specific age groups. Neonates should receive ampicillin plus an aminoglycoside or third-generation cephalosporin; however, not ceftriaxone, as it can displace bound bilirubin and lead to kernicterus. Atypical pneumonia is common in infants 1 to 3 months old, and this group should have additional antibiotic coverage with erythromycin or clarithromycin. For infants and children over 3 months old, S pneumoniae is the most common, for which the drug of choice is high-dose oral amoxicillin or another beta-lactam antibiotic. In children older than 5, atypical agents have a more important role, and macrolide antibiotics are usually first-line therapy.

Special attention should be given to children with chronic illnesses, as these might alter choices for antibiotics. Children with sickle cell anemia will need cefotaxime, macrolide, and vancomycin if severely ill. Children with cystic fibrosis will require piperacillin or ceftazidime plus tobramycin. Treat fulminant viral pneumonia as indicated, depending on the virus identified. For Varicella, use acyclovir, and for the respiratory syncytial virus (RSV), use ribavirin for high-risk patients. Patients with human immunodeficiency virus should be treated with sulfamethoxazole/trimethoprim and prednisone, and for cytomegalovirus, ganciclovir, and gamma globulin are the preferred agents. If methicillin-resistant S aureus (MRSA) is suspected, clindamycin or vancomycin may be given.

It is important to have a high index of suspicion for complications, especially in patients returning for repeat evaluation. For patients sent home with symptomatic or supportive management for suspected viral pneumonia, consider a secondary bacterial infection or other diagnoses upon re-evaluation. Children with uncomplicated bacterial infections who fail to respond to treatment within 72 hours should be assessed for complications, including pneumothorax, empyema, or pleural effusion. Other systemic complications of pneumonia include sepsis, dehydration, arthritis, meningitis, and hemolytic uremic syndrome.

Neonates and infants younger than 90 days old should be hospitalized for treatment, in addition to children who are immunocompromised or have other underlying chronic diseases like sickle cell anemia or cystic fibrosis. Children with social factors that preclude access to care have failed outpatient therapy, or present with presumed tuberculosis should also be hospitalized. Admission is often required for patients with respiratory distress and low oxygenation. In most cases, the presence of a parapneumonic effusion requires admission. Children with severe respiratory distress may require chest therapy or even mechanical ventilation. A large pleural effusion requires drainage for diagnostic and therapeutic purposes. In patients with empyema, early video-assisted thoracic surgery (VATS) correlates with decreased mortality, hospital stay, and ionizing radiation from CT scans. It is essential to ensure that clear discharge instructions and return precautions are given to parents or caregivers of children being discharged home in addition to close pediatrician follow-up.

In conclusion, in bronchopneumonia, there is often patch consolidation of one or more lobes. The neutrophilic infiltrate is chiefly around the center of the bronchi. Pediatric pneumonia is often undertreated or missed, leading to high morbidity and mortality. The condition is best managed by an interprofessional team to improve outcomes. The majority of patients are managed by the pediatrician, nurse practitioner, or primary care provider. Patient and caregiver education is vital. Parents need to be told to avoid smoking, and the importance of handwashing cannot be overstated. In addition, all clinicians looking after children should emphasize vaccination against pneumococcus and influenza.

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