Management of pneumonia and pleural effusion in children

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INTRODUCTION

Childhood pneumonia is a public health concern due to its high incidence and potential severity. It is one of the three most common causes of death in children younger than 5 years of age. This acute lung infection, caused mainly by viruses and bacteria, requires an understanding of its manifestations, treatment, and preventive measures. This article aims to review the criteria for diagnosis, hospitalization, and clinical approach, focusing on bacterial pneumonia and common complications.[1] Symptoms include fever, cough, tachypnea, thoracic retractions, crackles, and chest pain. It is difficult to distinguish clinically between bacterial and viral etiologies. One should consider bacterial pneumonia in children presenting with persistent or recurrent fever ≥ 38.5°C over the preceding 48 h with chest wall recession and tachypnea.[2] Differentiating pneumonia from conditions such as asthma and acute bronchiolitis is often a challenge in infants and preschoolers, with the presence of wheezing being a key differential indicator. Wheezing is not often associated with bacterial pneumonia. Common etiologic agents are also *Streptococcus pneumoniae* and *Staphylococcus aureus*.[1]

DIAGNOSIS AND SEVERITY MARKERS

The diagnosis of community-acquired pneumonia (CAP) may be based on clinical presentation. Therefore, chest radiography should not be routinely performed in outpatient settings. Radiography is often indicated in the presence of severity markers, need for hospitalization, or lack of improvement after 48-72 h of treatment.[1] Blood cultures are recommended for hospitalized CAP patients to identify the etiological agent along with swabs for viral detection. Additionally, nonspecific tests such as C-reactive protein levels, procalcitonin, and leukocyte count may suggest bacterial infection when values are extremely high, but have limited value in presuming the etiology of CAP. Finally, polymerase chain reaction can also be used in diagnosing etiological agents.[2]

Inability to drink/eat, incoercible vomiting, convulsions, central cyanosis, lethargy, and oxygen saturation < 90% are predictors of death and should be used as indicators for hospitalization. Moderate and large pleural effusions and multilobar infiltrates are also associated with severe disease.

RECOMMENDED MANAGEMENT

All children require pulse oximetry. In secondary care, children with oxygen saturation < 92% in room air require supplemental oxygen to maintain > 94% saturation. Oxygen can be administered via nasal cannulae. Intravenous fluid replacement may be required if hydration becomes compromised. Clinical trials have shown no benefit from physiotherapy.[3]

Oral antibiotics are safe and effective for children with CAP. Use of intravenous antibiotics in children is recommended if children are unable to tolerate oral fluids (because of vomiting) or have signs of septicemia or complicated pneumonia.

Amoxicillin is the first-line therapy for outpatients. Macrolides can be added at any age if there is no response to first-line therapy. Macrolides should be used if *Mycoplasma pneumoniae* or *Chlamydia pneumoniae* are suspected in atypical presentations or if disease is severe; in this case, an association with another agent is always needed. The first line of intravenous antibiotic therapy is ampicillin or penicillin G. Ampicillin-sulbactam or ceftriaxone may be recommended for severe pneumonia (Chart 1). Vancomycin may also be used in cases of suspected methicillin-resistant *Staphylococcus aureus*.

Complicated pneumonia is a severe illness characterized by local complications (parapneumonic effusion, empyema, necrotizing pneumonia, or lung abscess) or systemic complications (bacteremia). Complicated CAP should be suspected in any child with pneumonia not responding to appropriate antibiotic treatment within 48-72 h. Patients have initial imaging with chest radiography, and ultrasound can also be used to identify pleural fluid.

Complicated pneumonia should be treated with a prolonged course of intravenous antibiotics, and then oral antibiotics.[4] The initial choice of antibiotic is guided by local microbiological knowledge and by subsequent positive cultures, including cultures from pleural fluid.

Most patients may be treated by pleural drainage. Information from pleural space imaging and drainage should guide the decision on whether to administer intrapleural fibrinolytic agents. More extensive surgery (video-assisted thoracoscopic surgery) may be indicated in loculated empyemas.[5]

PREVENTION AND PROGNOSIS

Current treatment guidelines suggest several interventions to prevent CAP. These include frequent hand washing, avoiding tobacco smoke, promoting breastfeeding, reducing exposure to other children,

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Chart 1. Overview of pneumonias: etiologic agents and treatment recommendations.

	Atypical pneumonia	Outpatient pneumonia[a]	Hospitalization due to pneumonia	Complicated pneumonia + pleural effusion[b]	ICU admission due to pneumonia
Possible common etiologic agents	*Mycoplasma pneumoniae*	*Streptococcus pneumoniae*	*Streptococcus pneumoniae* MSSA	*Streptococcus pneumoniae* MSSA	*Streptococcus pneumoniae* MRSA
Antimicrobial treatment options	Azithromycin 10 mg/kg/day single dose for 5 days Clarithromycin 7.5 mg/kg/dose every 12 h for 10 days	Age: from 2 months to 5 years Amoxicillin 50 mg/kg/day every 8 or 12 h for 7 days Age: > 5 years Amoxicillin 50 mg/kg/day every 8 or 12 h for 7 days + Macrolide (erythromycin, clarithromycin, or azithromycin) on suspicion of atypical pneumonia for 7 days	Age: > 2 months Ampicillin or ampicillin-sulbactam 50 mg/kg/dose every 6 h	Cefuroxime i.v. 150 mg/kg divided into 4 doses OR Ceftriaxone i.v. 100 mg/kg divided into 2 doses OR Ampicillin-sulbactam 50 mg/kg/dose every 6 h	Cefuroxime i.v. 150 mg/kg divided into 4 doses OR Ceftriaxone i.v. 100 mg/kg divided into 2 doses OR Ampicillin-sulbactam 50 mg/kg/dose every 6 h MRSA treatment Vancomycin i.v. 15 mg/kg every 6-8 h

MSSA: methicillin-sensitive *Staphylococcus aureus*; and MRSA: methicillin-resistant *Staphylococcus aureus*. [a]Initial treatment is empirical, according to the patient's age group and local epidemiology. Reassessment is recommended within 48-72 h in all cases or earlier if there is clinical worsening. [b]Other interventions are simple drainage and video-assisted thoracoscopic surgery for complicated pleural effusion.

and immunization. Pneumococcal conjugate vaccines have been approved for the prevention of invasive pneumococcal disease in children and are highly effective in reducing disease against the included pneumococcal serotypes.

Several new interventions to prevent respiratory syncytial virus such as long-acting monoclonal antibodies and maternal vaccines potentially have a major impact on the epidemiology of pneumonia.[6] Children should also be vaccinated against other potential causes of pneumonia, including influenza, SARS-CoV-2, *Haemophilus influenzae* type B, pertussis, varicella, and measles.[3]

The clinical course of CAP can be long, especially in patients with necrotizing pneumonia, but complete recovery is the usual outcome.[4,5]

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AUTHOR CONTRIBUTIONS

LMP, MAULC, GABS, and LGBB: literature search and drafting of the manuscript. MCC and LAP: drafting, reviewing, and editing the manuscript. All authors read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

None declared.

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