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DIAGNOSIS AND TREATMENT OF COMMUNITY-ACQUIRED PNEUMONIA IN CHILDREN (LITERATURE REVIEW)

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Abstract

Despite the preventive measures implemented in recent years to combat pneumonia among children, an increase in the incidence of upper and lower respiratory tract diseases has been observed in the first and second years of life. This article presents a modern algorithmic approach to the diagnosis and treatment of community-acquired pneumonia (CAP) in pediatric practice.

Keywords

community-acquired pneumonia, pediatrics, children, diagnosis, treatment, antibiotic therapy.

According to recent data, respiratory system diseases continue to occupy a leading position among childhood illnesses despite the achievements made [1, 2]. The anatomical and physiological characteristics of the respiratory organs in early and preschool-age children, combined with immune memory insufficiency, determine the high frequency of respiratory tract infections, including pneumonia [3].

Timely confirmation of the community-acquired pneumonia (CAP) diagnosis in outpatient practice (within the first 3 days of illness) remains inadequate and constitutes less than 50% of all cases. Therefore, the search for new medical technologies and the improvement of approaches—such as early disease detection, elimination of risk factors, and the development of diagnostic and treatment algorithms—remain important tasks facing primary healthcare physicians and the scientific medical community [4, 5].

Etiology of Community-Acquired Pneumonia

At the current stage, CAP is understood as an acute infectious disease of various etiology (predominantly bacterial), manifested by focal lung damage and intraalveolar exudation, accompanied by varying degrees of intoxication, respiratory distress, local physical changes, and infiltrative opacity on chest radiographs. CAP develops outside the hospital setting or within the first 72 hours following hospitalization [6].

In recent years, active investigation of the respiratory tract microbiota during childhood has made it possible to identify fundamental differences in lower respiratory tract infections at various age periods. According to research findings, in children aged 1–3 months, various viruses as well as Escherichia coli, Chlamydia trachomatis, Haemophilus influenzae, and Staphylococcus aureus are the most common pathogens of lower respiratory tract infections. In children from 3 months to 5 years of age, Streptococcus pneumoniae is the most prevalent causative agent of CAP; Haemophilus influenzae, Mycoplasma pneumoniae, and Chlamydophila pneumoniae are also encountered. In children older than 5 years, the role of atypical bacteria (M. pneumoniae, C. pneumoniae) increases significantly, while S. pneumoniae remains the predominant pathogen [3].

One of the distinctive features of the CAP microbiota among lower respiratory tract infections is mixed infection (combinations of S. pneumoniae + atypical bacteria, S. pneumoniae

+ viruses, atypical bacteria + viruses, and S. pneumoniae + atypical bacteria + viruses), which complicates timely nosological diagnosis and the selection of antibiotic therapy. When establishing a diagnosis, the physician must be aware of the importance of differentiating viral respiratory infections of the lower respiratory tract from CAP. It is well established that viral respiratory infections (influenza in particular) constitute a major risk factor for pneumonia. Recent years have seen a growing body of scientific work demonstrating an increasing number of viral pathogenic strains implicated in lung damage (coronavirus, metapneumovirus, etc.). Additionally, the association of these viruses (avian influenza H5N1, swine influenza H1N1) with fungi can lead to severe respiratory syndrome [7, 8].

However, pathological changes in lung tissue caused exclusively by viruses cannot immediately be classified as pneumonia, because the therapeutic approach in such cases differs fundamentally. Viral lung lesions have a clearly interstitial character and are, as a rule, widespread rather than focal and infiltrative as in bacterial pneumonia [7, 8].

Diagnosis of Community-Acquired Pneumonia

Community-acquired pneumonia is pneumonia that develops outside the hospital or within 72 hours after hospitalization (outpatient, at home).

Recent diagnostic data indicate that the diagnostic criteria and algorithm for CAP in patients with suspected pneumonia have not changed. The diagnostic criteria for the disease include collection of the patient's medical history, analysis and assessment of complaints, and a general physical examination. It is important that the physician individually prescribes a set of laboratory and instrumental investigations determined by the patient's age, premorbid status, disease severity, complications, and the setting of treatment [1, 2].

Presenting complaints include fever, loss of appetite, cough, shortness of breath, and chest or abdominal pain. On auscultation and percussion: local dullness of the percussion note, local diminution or bronchial breath sounds, fine moist crackles, and crepitations are heard. Chest radiography reveals pulmonary infiltration (focal, confluent focal, segmental, polysegmental, lobar) and differential diagnosis must be performed with obstructive bronchitis, acute bronchiolitis, and acute bronchitis [1]. Indications for hospitalization include: infants under 6 months of age, severe course of the illness, patients with severe comorbidities, social indications, and absence of effect from antibiotic therapy (ABT) after 48–72 hours [3].

In outpatient settings, when CAP is suspected in a child, it is sufficient to perform a complete blood count, a plain chest radiograph, and pulse oximetry. When obstructive syndrome is present, assessment of external respiratory function (spirography or bronchophonography) is recommended [4].

Microbiological studies are not routinely recommended in outpatient practice. When hospitalizing children with CAP, assessment of C-reactive protein and procalcitonin levels in the blood is recommended. The latter marker helps to determine the duration of antibiotic courses in severe CAP. Sputum microbiological examination is performed under hospital conditions when there is a likely diagnosis of CAP with a complicated premorbid background.

Microbiological examination is mandatory in severe or complicated pneumonia. In general, the scope of such investigations (cultural respiratory and blood sample testing; polymerase chain reaction [PCR] for atypical bacteria and viruses; rapid tests for pneumococcal infection and viruses) is determined individually and depends not only on the course of CAP but also on the level of the medical institution [3].

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Treatment of Community-Acquired Pneumonia

Treatment of children with CAP is comprehensive and includes adequate ABT (prescription of antimicrobial agents), optimal respiratory support, individual prescription of non-antibacterial medications based on the patient's general condition, and the implementation of modern primary and secondary prevention measures. Timely identification and treatment of exacerbations of chronic diseases and improvement of premorbid background conditions are among the important tasks.

At present, penicillins, cephalosporins, and fluoroquinolones remain the main antibacterial agents in the treatment of pneumonia. However, all fluoroquinolones listed are contraindicated in patients under 18 years of age. Modern international guidelines for the treatment of CAP consider amoxicillin as the drug of first choice. According to the clinical recommendations of the Russian Pediatric Respiratory Society, ABT for CAP is selected individually, taking into account the natural activity of drugs against the likely pathogen, probable resistance, disease severity, and contraindications to certain medications [1, 7].

In clinical practice, particularly in outpatient settings, ABT is selected empirically. Antibacterial agents exert a significant effect on the prognosis of pneumonia; therefore, the use of antibiotics must be initiated immediately—both when a reliable diagnosis is confirmed and when CAP is only suspected.

In all children treated as outpatients without indications for hospitalization, and in patients hospitalized with moderate severity, it is advisable to use oral forms of antibacterial agents. For children hospitalized with severe pneumonia, ABT is usually administered parenterally or by a stepwise approach (parenteral administration for the entire period of infectious toxicosis [3–5 days], followed by a switch to oral forms of the same antibacterial agents) [11, 12].

Evidence-based studies have demonstrated that the efficacy of amoxicillin is not inferior to intravenous benzylpenicillin or ampicillin in severe uncomplicated pneumonia [3, 7].

For ABT in outpatient settings in children, one approach that allows precise dosing according to body weight and age is the enteral route. Dispersible tablets, syrups, and oral suspensions may be used for enteral ABT in children. A significant disadvantage of liquid dosage forms is dosing errors. Dispersible tablets serve as an alternative to liquid dosage forms. The risk of dosing errors with their use is considerably lower, since a dispersible tablet constitutes one suspension dose in tablet form. The dispersible tablet is dissolved in a small amount of water immediately before administration and given to the child in the form of a convenient suspension. Specialists from the World Health Organization and UNICEF (United Nations Children's Fund) consider it advisable to use dispersible tablets more widely in childhood [4].

One important factor influencing the efficacy of ABT is individual dose assignment for each patient. The current standard dose of amoxicillin in pediatrics is 45–60 mg/kg/day, divided into 3 doses. Prescribing amoxicillin at a lower dose is not recommended, as this may lead to treatment failure or increased resistance. The high dose of amoxicillin is 80–90 mg/kg/day, also divided into 3 doses. When there is a risk of S. pneumoniae strains with reduced susceptibility to beta-lactam antibiotics, the following factors are taken into account for dose escalation: antibiotic use within the preceding 3 months, presence of preschool-age children in the household, attendance at childcare facilities or residential institutions, and joint residence of children and adults in long-term care facilities [3, 6].

The use of amoxicillin/clavulanate is recommended only when the patient is at risk of harboring beta-lactamase-producing pathogen strains—for example: virtually all clinical isolates

of S. aureus, certain strains of H. influenzae (no more than 10% of strains), and others. Risk factors for the presence of beta-lactamase-producing strains include: pneumonia during or following influenza (risk of S. aureus), presence of serious comorbidities such as bronchial asthma, diabetes mellitus, and chronic bronchitis, as well as failure of upper respiratory tract infection treatment with amoxicillin [6].

The clinical symptoms of pneumonia caused by atypical bacteria include: absence of signs of intoxication, severe cough, asymmetric moist crackles, bronchoobstructive syndrome, catarrhal changes of the upper respiratory tract, non-homogeneous opacity without clear borders on radiography, absence of minimal changes in the complete blood count, and positive results of PCR and serodiagnostics. For treatment of this type of pneumonia, the following regimens are prescribed: azithromycin 10 mg/kg once daily for 5 days; josamycin 40–50 mg/kg 2–3 times daily for 4–5 days; clarithromycin 15 mg/kg twice daily for 4–5 days; and midecamycin 20–50 mg/kg 2–3 times daily for 10–14 days.

When conducting ABT, particular attention must be paid to the rapidly developing resistance of S. pneumoniae to 14- and 15-membered macrolides (clarithromycin, azithromycin). In recent years, this indicator has risen to 20–30% in the Russian Federation and among Central Asian states [17]. Therefore, macrolides should not be used as initial therapy in outpatient practice [2, 3, 9].

The question of the optimal duration of ABT in CAP remains debatable, as the heterogeneity of factors influencing the physician's decision on course duration (age of the child, presence or absence of comorbidities, severity, treatment course, complications including allergic predisposition, and others) implies an individualized approach [5]. Most specialists emphasize that the duration of antibiotic use should not exceed 7–10 days in uncomplicated CAP in the majority of children. The criterion for ABT efficacy is regression of clinical symptoms (sustained reduction of body temperature to 37.2 °C or normalization for at least 2 consecutive days, absence of signs of intoxication and respiratory failure, and a clear trend toward normalization of the complete blood count — leukocytes < 10×10^9/L, neutrophils < 80%, band forms < 6%) [2].

Other therapeutic directions include: oxygen therapy (when saturation falls below 92–94%); infusion therapy administered orally in children and parenterally in severely ill patients; antiviral agents are not routinely used (administered within the first 3 days only in severe viral pneumonia); glucocorticosteroid hormones as adjuvant therapy in severe cases; antipyretics on demand. Mucoactive preparations are used for non-productive cough; bronchodilators for obstructive syndrome; antihistamines in allergic conditions; and probiotics in the presence of gastrointestinal disease [8].

Dispensary Monitoring of Community-Acquired Pneumonia

Children who have had CAP should be under dispensary monitoring by a pediatrician or family physician for 1 year. The number of examinations during the year is conducted according to the child's age: children under 3 months — twice monthly during the first 6 months, then once monthly up to 1 year of age; 3–12 months — once monthly; 1–3 years — once every 1.5 months; over 3 years — once quarterly [7].

During physician visits, in addition to general examination and analysis of respiratory organ findings, mandatory complex complete blood count and, as indicated, assessment of external respiratory function are included. Radiographic examination is advisable twice yearly. Consultation with a pulmonologist and computed tomography of the lungs are performed as indicated.

Special attention must be paid to preventive measures aimed at preventing intercurrent respiratory infections of the upper and lower respiratory tract. Non-specific measures include adherence to principles of a healthy lifestyle and regular physical activity appropriate to the child's age and individual characteristics.

In children with frequent respiratory infections in whom there is a risk of recurrence, planned use of medications is advisable (interferon inducers, bacterial lysates, clinical homeopathic preparations, physiotherapy exercises combined with breathing gymnastics, massage, and others). The preventive medication schedule for the entire period of medical surveillance is developed by the district pediatric (family) physician together with a pulmonologist [3, 5].

The set of specific preventive measures for the disease includes mandatory vaccination against pneumococcal infection according to the national immunization calendar [5, 6]. If a child due for scheduled vaccination falls ill with a respiratory (or other) disease, vaccination is permitted one month after recovery, based on the decision of the immunological committee.

Conclusion

The accumulation of new clinical data and research results on lower respiratory tract infections, deepening of understanding of the respiratory microbiota and disease risk factors, and the development of diagnostic and treatment algorithms have determined the continuous revision of existing clinical guidelines and recommendations. The availability of ABT algorithms enables family physicians (general practitioners) to optimize the selection of antimicrobial agents and to formulate a comprehensive CAP treatment regimen. This, in turn, improves the quality of medical care provided to children with lower respiratory tract infections.

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