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MODERN ASPECTS OF DIAGNOSIS AND TREATMENT OF PNEUMONIA IN YOUNG CHILDREN

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ABSTRACT

Pneumonia in children remains one of the most significant and serious medical problems, both in developing and developed countries. On a global scale, pneumonia ranks among the leading causes of hospitalization and mortality in children, especially in early childhood.

ERTA YOSHDAGI BOLALARDA PNEVMONIYA DIAGNOSTIKASI VA DAVOLASHNING ZAMONAVIY JIHATLARI

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ABSTRACT

Bolalardagi pnevmoniya ham rivojlanayotgan, ham rivojlangan mamlakatlarda eng muhim va jiddiy tibbiy muammolardan biri bo'lib qolmoqda. Global miqyosda pnevmoniya bolalarning, ayniqsa erta bolalik davrida kasalxonaga yotqizish va o'limning asosiy sabablaridan biri hisoblanadi.

Children in early childhood are particularly prone to pneumonia due to the immaturity of their immune systems, the characteristics of their mucociliary system, and the structure of their bronchi. In addition, the underdevelopment of the lymphoepithelial pharyngeal ring (resulting in local immune deficiency) and the predominance of type 1 T-helper cell activity over type 2 T-helper cells contribute to the high incidence.

According to the World Health Organization (WHO), pneumonia ranks as one of the top causes of death in 15% of children under the age of 5 worldwide. In 2015, this disease caused the deaths of 920,136 children globally.

In developed countries, pneumonia also occupies a significant place among diseases leading to hospitalization, especially in children with weakened immune systems or chronic illnesses.

Community-acquired pneumonia can have bacterial, viral and fungal causes . Viral pathogens have been identified as the most common aetiology.These include Respiratory Syncytial Virus (RSV), Rhinovirus, Influenza, Parainfluenza, Human Metapneumovirus (hMPV) and Adenovirus. Cytomegalovirus (CMV) related pneumonia also needs to be considered in immunosuppressed patients, particularly those with underlying HIV infection.

Diagnosing pneumonia in children requires a comprehensive approach, including the analysis of clinical data, laboratory tests, and, if necessary, instrumental methods.

Pneumonia in children can be caused by a variety of pathogens, including viruses (e.g., Respiratory Syncytial Virus, influenza, coronavirus), bacteria (e.g., Streptococcus pneumoniae, Haemophilus influenzae), as well as fungi and mycobacteria. One of the factors contributing to the development of pneumonia is the high frequency of respiratory infections, particularly in the fall and winter months, when there is a seasonal peak in incidence.

Diagnosing pneumonia in children can be challenging due to the variety of potential causes and the similarity of symptoms with other respiratory diseases. It is also essential to rule out conditions that may mimic the symptoms of pneumonia, such as bronchiolitis (especially in younger children), asthma, tuberculosis, or a foreign body in the respiratory tract.

A significant factor in the variability of the disease's manifestations is the changing nature of symptoms. Pulmonary infections often follow respiratory illnesses. Risk factors can include prolonged illnesses, a weakened immune system, frequent respiratory infections, lung problems, hereditary abnormalities, or allergic reactions. Typical symptoms of pneumonia, such as fever, cough, shortness of breath, chest pain, and worsening general condition, may develop suddenly or gradually. During physical examination, the doctor assesses the presence of wheezing, crackles, decreased breath sounds, or other abnormal sounds that may indicate lung inflammation. Signs of loss of pulmonary air space or tissue consolidation may also be identified if pneumonia is accompanied by swelling or infiltration. In infants and young children, clinical manifestations may be less specific. For example, in newborns and infants, irritability, refusal to eat, vomiting, lethargy, rapid breathing, the use of accessory respiratory muscles, cyanosis, or pronounced jugular vein pulsation may indicate severe pneumonia. Early detection of the disease is crucial for reducing complications and mortality.

Laboratory tests play an important role in diagnosis: a complete blood count may show signs of inflammation, such as an increase in white blood cells and elevated ESR (erythrocyte sedimentation rate). In the case of bacterial pneumonia, a "left shift" (an increase in the number of band forms) may be observed which suggests leukocytosis .Diagnosing aseptic forms of pneumonia can be challenging. Pneumonia may be caused by viruses or bacteria that are difficult to detect using standard methods. Atypical pathogens such as Mycoplasma pneumoniae and Chlamydia pneumoniae can cause pneumonia with atypical clinical features, which may make diagnosis more challenging.

Clinically, the early identification of the infection type and the selection of the correct treatment will not only ensure a better prognosis, but will also reduce complications, reduce the burden placed on patients, and shorten hospital stays. Recent studies (e.g., Wang Liu et al., 2021) have shown a correlation between elevated red cell distribution width (RDW) levels

and lung diseases, including chronic obstructive pulmonary disease and community-acquired pneumonia.

The neutrophil to lymphocyte ratio (NLR) and the platelet to lymphocyte ratio (PLR) reflect the degree of inflammation and the state of immunity. However, it is not clear whether the NLR, PLR, and RDW index can be used to diagnose bacterial pneumonia in children. Thus, this study sought to compare differences in the NLR, PLR, and RDW index values between children with pneumonia caused by mycoplasma infection and children with pneumonia caused by bacteria infection. The correlation coefficients between the NLR, PLR, RDW index, interleukin-6 (IL-6) levels, and procalcitonin (PCT) levels were analysed. Receiver operating characteristic (ROC) curves were used to evaluate the clinical value of the NLR, PLR, and RDW index in the diagnosis of bacterial pneumonia in children. The results of this study can be used to guide the clinical diagnosis and treatment of bacterial infectious pneumonia.

Modern diagnostic approaches, with the development of molecular techniques, have improved the ability to identify pathogens. Clinical tests for microbial agents using bacteriological, serological, or molecular genetic methods, as well as PCR testing, have greatly enhanced the ability to detect specific pathogens (such as Streptococcus pneumoniae, Haemophilus influenzae, Mycoplasma pneumoniae). This allows for a quicker and more accurate selection of appropriate treatment, avoiding incorrect therapy (e.g., antibiotics are ineffective in viral pneumonia).PCR testing is especially valuable when the causative organism is not immediately apparent from clinical examination or chest X-ray results. It also helps reduce the misuse of antibiotics by identifying viral pathogens that do not require antibacterial treatment.

Radiography is the primary imaging method for diagnosing pneumonia. Radiographs may show areas of inflammation (infiltration, consolidated opacity, pleural effusion). X-rays help differentiate pneumonia from other diseases such as bronchitis, asthma, or croup. Magnetic resonance imaging (MRI) of the chest is a promising method in radiological diagnostics, though its role in clinical management and its impact on outcomes require further study. Ultrasound of the chest is used to assess pleural effusion and monitor lung condition if necessary over time. Pulse oximetry, which measures blood oxygen levels, is crucial for diagnosing respiratory failure.

Modern approaches to the treatment of pneumonia in children involve a comprehensive and individualized approach depending on the pathogen, the form of the disease, and the severity of the patient's condition. Key treatment components include antibiotics, antiviral drugs (for viral pneumonia), and oxygen therapy (for severe pneumonia with respiratory failure). Oxygen therapy is vital for maintaining normal blood oxygen levels, especially if pneumonia leads to hypoxia. Other modern treatments may include the use of probiotics to maintain normal gut flora during antibiotic therapy, physiotherapeutic procedures (such as inhalations, chest massage), and other ways to support health.

In cases of suspected pneumonia, antibiotics are typically initiated empirically, particularly if the patient’s condition is severe. If the diagnosis is uncertain in less severe cases, the decision may be delayed until radiographic results are available. For uncomplicated pneumonia, oral antibiotics are preferred, with a transition to parenteral administration if the disease worsens. Indications for antibiotic therapy in children include pronounced

intoxication, persistent high fever for more than 3 days, clinical signs of pneumonia, young age, or prolonged inflammatory processes. In most cases, antibiotics are administered empirically until information about the causative agent is available. The effectiveness of treatment is evaluated based on the improvement of the overall condition and the reduction of fever. If there is no effect (persistent fever, intoxication, or increasing pneumonia on radiographic images), an alternative regimen with a change or addition of another antibacterial drug should be prescribed.

In pediatric practice, the three main groups of antibiotics used to treat pneumonia are:

1. Penicillins and Semi-synthetic Penicillins: Benzathine penicillin is a traditional antibiotic effective against certain bacteria such as streptococci. Semi-synthetic penicillins (such as ampicillin, amoxicillin, amoxiclav) have a broader spectrum of action, covering various gram-positive and gram-negative bacteria. Amoxiclav (a combination of amoxicillin and clavulanic acid) is used to combat bacteria that produce beta-lactamases (enzymes that break down penicillins).

2. Cephalosporins: These have a broad spectrum of action and can be effective against both gram-positive and gram-negative bacteria. Cephalexin (a first-generation cephalosporin) is effective against gram-positive bacteria. Cefuroxime (a second-generation cephalosporin) is effective against various bacteria, including some gram-negative ones. Ceftriaxone and cefoperazone (third-generation cephalosporins) are used for more severe infections, including pneumonia caused by both gram-positive and gram-negative bacteria.

3. Macrolides: A group of antibiotics that inhibit bacterial protein synthesis, used primarily for infections caused by intracellular microorganisms and certain gram-positive bacteria. Erythromycin is effective against pneumococci, mycoplasma, chlamydia, and others. Rovamycin (Soframycin) has activity against organisms causing pneumonia, including mycoplasma and chlamydia. Azithromycin has a broad spectrum of action and is convenient for use due to its long half-life. The choice of antibiotic depends on the pathogen, the patient's age, and the condition of the immune system.

For fungal pneumonia, depending on the type of fungal infection and the patient's condition, antifungal medications such as fluconazole (Diflucan), which acts against a wide range of fungi including yeasts (e.g., Candida, Cryptococcus), may be used. A more potent antifungal, amphotericin B, is used for life-threatening infections, such as invasive aspergillosis, cryptococcal pneumonia, and other severe fungal infections. The choice between these drugs depends on the type of fungal infection, the severity of the patient's condition, and potential side effects.

Expectorants such as ambroxol, bromhexine, carbocisteine, and acetylcysteine are prescribed to aid in the thinning and expulsion of mucus, helping prevent stagnation and improving lung ventilation. Bronchodilators may be used if the patient experiences bronchospasm or airway obstruction (e.g., in the case of exacerbated chronic bronchitis, asthma, or respiratory failure). Salbutamol, fenoterol, and ipratropium help open the bronchi, ease breathing, and improve airway patency.

For allergic reactions, such as inflammation of the lungs caused by infection or medications, antihistamines (loratadine, cetirizine) and corticosteroids may be prescribed. These help reduce inflammation and swelling of the mucous membranes in the airways.

Vitamins (such as vitamin C and vitamin D) and immune-boosting agents may be prescribed to support the child's overall condition and enhance resistance to infection. Immunomodulators such as echinacea or interferon-based drugs can help activate the immune response.

While antibiotics remain the mainstay of treatment for bacterial pneumonia, Immunomodulatory therapies, such as monoclonal antibodies, are being investigated as adjuncts in the treatment of severe viral pneumonia, particularly in high-risk children infected with viruses like RSV or influenza.Monoclonal antibodies, such as palivizumab for respiratory syncytial virus (RSV), can reduce the severity of infection and prevent complications like bronchiolitis and pneumonia in high-risk pediatric populations. Other monoclonal antibodies are being explored for their potential to reduce inflammation and aid in immune regulation during viral pneumonia.

Corticosteroids and Other Anti-inflammatory Agents:

The role of corticosteroids in the treatment of pneumonia remains controversial, with some studies showing benefit in reducing inflammation and improving oxygenation in severe cases. However, their use should be carefully considered, as steroids can also impair the immune response, making it harder for the body to clear the infection.Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen or paracetamol, may be prescribed to reduce inflammation and alleviate chest pain. In some cases, corticosteroids (e.g., prednisolone) may be used if the inflammation is severe, to reduce airway hyperreactivity. The choice of additional medications depends on the nature of the inflammation, the severity of the disease, and the presence of comorbidities. Treatment always requires an individualized approach and monitoring by a healthcare professional.

Prevention of pneumonia in children includes measures aimed at strengthening the child's immune system, preventing infections, and minimizing risk factors that may contribute to the development of pneumonia. Breastfeeding during the first 6 months helps strengthen the child’s immune system, as breast milk contains antibodies that protect against infections. A balanced diet ensures the child receives sufficient vitamins and minerals to maintain normal immune function. Vitamins A, C, D, zinc, and selenium are particularly important.

Physical activity is also essential for boosting the immune system. Regular exercise helps strengthen the immune system, while outdoor walks, air baths, and other forms of outdoor exposure contribute to overall health. Teaching children proper hygiene, such as regular handwashing and correct coughing and sneezing practices, can reduce the risk of spreading infections.

Limiting exposure to infections through reducing contact with sick individuals is important. Avoiding exposure to people with respiratory infections such as colds, flu, and tuberculosis can help prevent pneumonia. During flu seasons, using masks and other protective measures is advised.

Vaccination is one of the most effective methods of preventing pneumonia in children. Vaccines against pneumococcal infections, influenza, and pertussis, as well as immunization against measles and other infections, significantly reduce pneumonia incidence and mortality. In addition to vaccination, it is important to educate parents about proper child care, preventing respiratory infections, and ensuring access to quality healthcare services.

Timely diagnosis and prevention play a critical role in reducing pneumonia rates in children. Regular pediatric check-ups are essential for early identification of factors that increase the risk of pneumonia. These check-ups not only monitor the child's health but also allow for the early detection of conditions such as asthma and cystic fibrosis, which increase the risk of pneumonia.

Only through the coordinated efforts of healthcare professionals, parents, and the healthcare system can the spread of pneumonia be reduced, improving the health of children worldwide.

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