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MODERN METHODS FOR DIAGNOSIS OF PNEUMONIA IN EARLY CHILDREN.

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Abstract:

In most countries of the world, pneumonia is defined as "an acute infectious disease of the pulmonary parenchyma, diagnosed by the syndrome of respiratory distress and/or physical findings, as well as infiltrative changes on the radiograph." This definition assumes the diagnosis of pneumonia only in "X-ray positive" cases of lower respiratory tract infections. This approach allows us to exclude diseases such as bronchitis and bronchiolitis, which in most cases are viral and do not require antibacterial treatment.

Keywords: Pneumonia, diagnosis, treatment

INTRODUCTION:

It should be noted that the recommendations of the World Health Organization (WHO) also allow for the possibility of diagnosing pneumonia only on the basis of clinical data based on the results of examining the child and counting the respiratory rate [3]. This is due to the lack of routine X-ray diagnostics in countries with developing healthcare.

Pneumonia is an acute infectious disease of varying etiology (mainly bacterial), characterized by focal lesions of the lungs with intra-alveolar exudation, which is manifested by varying degrees of intoxication, respiratory disorders, local physical changes in the lungs and the presence of an infiltrative shadow on a chest x-ray

The most important principle from a clinical point of view involves dividing pneumonia into community-acquired (CAP) and nosocomial. Community-acquired (outpatient) pneumonia is pneumonia that developed outside the hospital, incl. diagnosed within the first 48 hours from hospitalization.

Community-acquired pneumonia is an acute infectious disease, so the definition of "acute" before the diagnosis of "pneumonia" is unnecessary.

A special form of pneumonia in the pediatric population is congenital pneumonia, which occurs in the first 24 hours after birth. Due to the peculiarities of etiopathogenesis and treatment of congenital pneumonia, this form of the disease is considered in the relevant clinical recommendations.

CAP in patients with severe immunosuppression (children with HIV infection, congenital immunodeficiencies, receiving chemotherapy and/or immunosuppressive therapy, recipients of donor organ and tissue transplants) differs from the general population in etiology, course and prognosis and are not considered within the framework of these recommendations.

However, the objective difficulties of obtaining biomaterial directly from the site of inflammation, the significant duration of microbiological studies, and the common practice of taking antibacterial drugs before seeking medical help or before carrying out diagnostic measures are the reason for the lack of etiological diagnosis in 50-70% of patients. Bacterial pneumonia in clinical practice is also often classified as "typical", i.e. caused by "typical" bacterial flora, primarily Streptococcus pneumoniae, Haemophilus influenzae, less often Staphylococcus aureus and Streptococcus pyogenes, and "atypical" caused by "atypical" pathogens - Mycoplasma pneumoniae, Chlamydophila pneumoniae, Legionella pneumophila, Bordetella pertussis.

Based on the X-ray picture, focal, focal-confluent, lobar (lobar), segmental, polysegmental and interstitial pneumonia are distinguished.

Based on the severity of the course, mild and severe pneumonia are distinguished. The severity criteria are based on the severity of respiratory failure and the presence of general dangerous signs in the patient. This classification of the severity of pneumonia is recommended by WHO and is considered optimal from the point of view of organizing effective medical care.

The etiological structure of pneumonia in children is very diverse and depends on the age of the child. Data on the etiology of CAP in children vary greatly, which can be explained by the different epidemic conditions in which the studies were conducted, as well as their methodology. The most common causative agents of CAP in children are various bacteria and viruses, but in most cases of CAP the etiology remains unknown. In a prospective multicenter study of 154 hospitalized children with CAP who underwent a thorough etiological search, the pathogen was identified in 79% of children [5]. The bacterial etiology of CAP was established in 60%, of which Streptococcus pneumoniae was isolated in 73%; Mycoplasma

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pneumoniae and Chlamydophila pneumoniae were detected in 14% and 9% of cases, respectively. Viruses were identified in 45% of children. It is noteworthy that 23% of children were diagnosed with viral-bacterial co-infection.

According to a large-scale population study conducted in the USA in children under 18 years of age hospitalized with a CAP clinic, who had radiological confirmation of CAP and from whom samples were obtained for etiological research (n=2222), viruses were detected in 66.2%: respiratory syncytial virus (RSV) (28.0%), rhinovirus (27.3%) and metapneumovirus (12.8%). It should be noted that RSV was most often isolated in children under 5 years of age compared to older patients (37% vs 8%), a similar situation with adenovirus (15% vs 3%) and metapneumovirus (15% vs 8%). Typical bacterial pathogens - in 7.3% of children: S.pneumoniae - 3.6%, S.aureus - 1.0%, S.pyogenes - 0.7%, M.pneumoniae - 8.0% (mycoplasmas were more often isolated in children over 5 years of age compared with younger children - 19% vs 3%) In another study involving 441 children aged 2 months to 18 years with CAP (13.8% were treated as outpatients, 86.2% were hospitalized) viruses were detected in 55.6%, typical bacterial pathogens in 3.6% of cases, and atypical pathogens in 8.8%.

It should be taken into account that viruses are often (45-80%) isolated from the nasopharynx in children with pneumonia, incl. together with bacterial flora, and in healthy children. Viruses usually act as factors contributing to infection of the lower respiratory tract by bacterial flora. This association may be indicated by more frequent isolation of the virus in patients with CAP than in healthy children. This is observed for influenza viruses, metapneumovirus and RS virus: they are isolated 10 times more often than in healthy people (RR >10). Rhino-, entero- and parainfluenza viruses are detected in CAP as often as in healthy people (no association), while the association with boca- and ("old") coronaviruses was negative.

Respiratory viruses often precede pneumonia in children in the first years of life; with age, their trigger role decreases. The clinical picture of pneumonia itself depends little on the presence of ARVI, with the exception of catarrhal syndrome and influenza intoxication. This makes the term "viral-bacterial pneumonia" unfounded, although signs of viral co-infection should naturally be noted if they are present.

"Pure" viral lesions of the lung are observed with influenza, parainfluenza, RS, adeno-, entero-, rhinovirus and SARS-CoV-2 infections. Unlike bacterial pathogens, viruses primarily affect the interstitium with alveolar edema, fibrin deposition and the formation of hyaline membranes in the absence of alveolar and polynuclear effusion [12]. The SARS-CoV-2 virus also affects the capillaries and branches of the pulmonary arteries with the development of thrombosis, often with the addition of a bacterial infiltrate - incl. as a result of nosocomial infection. The differences between viral and bacterial lung infections gave rise to calling them the term "pneumonitis."

Children in the first months of life

In children in the first months of life, the causative agents of pneumonia can be pathogens acquired in the perinatal period, but the frequency of community-acquired bacterial pathogens (S. pneumoniae, S. aureus, non-typeable strains of H. influenzae) is increasing. S. pneumoniae is the leader in the etiological structure of pneumonia in this age group. S. pneumoniae and S. aureus often cause complicated pneumonia in infants [15]. The spectrum of pathogens of community-acquired pneumonia at this age is determined, among other factors, by incomplete vaccination against pneumococcus and Haemophilus influenzae type B. In this age group, a significant place is also occupied by viruses, primarily RSV, influenza and parainfluenza viruses, adenoviruses and human metapneumovirus. Atypical microorganisms are rare at this age. However, pneumonia caused by B. pertussis can develop in 20% of children who develop whooping cough at this age. The role of such pathogens as U. urealyticum and U. parvum, detected in tracheal aspirates of children with extremely low birth weight and children with bronchopulmonary dysplasia, is discussed [16]. Also, in very rare cases, pneumonia can be caused by C. tracomatis (perinatal infection) [1].

Children 6 months - 5 years

The main etiological factor of LRTI in this age group is viruses [2]. Viruses often act as a factor contributing to bacterial infection.

In the structure of bacterial pneumonia at this age, S. pneumoniae leads, according to various sources, accounting for 21–44% [5, 18]. Other pathogens include H. influenzae type B (an extremely rare cause of CAP in immunized children), S. pyogenes and very rarely S. aureus [19]. In recent years, against the background of mass vaccination against pneumococcal infections, the proportion of mycoplasma pneumonia has been increasing in this age group.

Children over 5 years old and teenagers

M. pneumoniae is the most common etiological agent in this age group, accounting for 14–35% of hospitalizations. An epidemiological feature of M. pneumoniae is the ability to cause outbreaks of URTI infections (including CAP) in organized groups with close contacts (in preschool, school and student

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groups, among military personnel, etc.); familial cases of infection are possible.

S. pneumoniae also plays a significant role, especially in patients with CAP requiring hospitalization. Very rarely, pneumonia in children can be caused by S. pyogenes. Pneumonia caused by S. aureus is usually associated with immunodeficiency states in children [15]. Viral pneumonias are rare, usually proceed relatively mildly [20,21], and are caused by RS viruses, parainfluenza and influenza viruses, adenoviruses and human metapneumovirus.

In children in middle- and low-income countries, B. pertussis is also one of the etiological factors of pneumonia. Risk factors for whooping cough are low vaccination coverage against this infection, incomplete vaccination, underweight, and HIV. CAP caused by C. pneumoniae and L. pneumophila is much less common. To diagnose mild CAP, it is enough to limit yourself to clinical symptoms, chest X-ray, and a general blood test. The diagnosis of pneumonia is reliable in the presence of an infiltrative shadow on a chest x-ray in combination with at least two of the following clinical and laboratory signs: febrile temperature; cough; auscultatory signs of pneumonia; leukocytosis >10–12·109/l and/or band shift of leukocyte formula >10%.
The diagram of the diagnostic search for pneumonia is presented in Figure 1.
In cases of severe pneumonia, it is advisable to include in the standard diagnostic examination methods: Determination of liver enzyme activity; Creatinine and urea levels; C-reactive protein indicator; Procalcitonin concentration, which correlates with the severity of bacteremia and is used to predict the course of the disease; Acid-base status and blood electrolytes; Electrocardiography; Verification of the causative agent by blood culture (positive culture results do not exceed 10-40%), microbiological examination of sputum or secretions from the upper respiratory tract. To clarify the etiology of the disease of "atypical" pathogens, molecular (PCR) and serological research methods are used. An increase in titers of specific antibodies in paired sera taken by more than four times during the acute period and during the period of convalescence (2-4 weeks from the beginning of the acute period) may indicate mycoplasma or chlamydial etiology of pneumonia. This examination method is justified for children over 5 years of age and is most often used for retrospective analysis. Treatment of non-severe CAP is carried out on an outpatient basis; indications for hospitalization of children are: The child's age is less than 2 months, regardless of the severity and extent of the process; Children under 3 years of age with lobar lung damage; Child under 5 years of age with damage to more than one lobe of the lung; Children with a burdened premorbid background: severe encephalopathy of any origin, congenital malformations, chronic diseases of the bronchopulmonary and cardiovascular systems, kidney disease, diabetes mellitus, neoplasms, immunodeficiency states; Children from socially disadvantaged families with poor social and living conditions; Children with complicated forms of pneumonia; In the absence of positive dynamics within 48-72 hours after empirical antibiotic therapy on an outpatient basis.

CONCLUSION:

Taking into account that in the etiological structure of pneumonia pathogens in young children, a significant share (up to 15–20%) is Hemophilus influenzae (type b), the inclusion of vaccination against this infection in the National Vaccination Calendar becomes understandable. In addition, given that the incidence of pneumonia increases significantly during periods of influenza epidemic (both due to bacterial complications and as a result of the development of primary influenza pneumonia), a significant reduction in incidence can also be achieved through annual influenza vaccination. Active implementation of agreed algorithms for the diagnosis and rational treatment of pneumonia into everyday clinical practice will contribute to early verification of the disease in children, adequate treatment and reduction of the risk of complications and adverse outcomes. A significant reserve for reducing morbidity and mortality from pneumonia in children is vaccinating them against pneumococcus, Hib infection and influenza.

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