Clinical-Morphological and Immunological Diagnostic Aspects of Neonatal Pneumonia in Early Childhood

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ABSTRACT

Neonatal pneumonia (NP) is one of the most severe manifestations of perinatal pathology. In accordance with official statistics, the incidence of pneumonia is about 1% among full-term and about 10% among premature babies, and reaches 40% in newborns in the intensive care unit with various types of respiratory pathology.In recent years, factors of innate immunity, in particular, recognizing receptors, have been actively studied. Toll-like receptors (TLRs) are of great importance in pathogen recognition. The expression profile of receptor and effector molecules of innate immunity at the level of mucous membranes may indicate the functional activity of innate mucosal immunity. So far, the issues about the role of innate immunity factors in the development of neonatal pneumonia remain poorly understood.

Keywords: neonatal pneumonia, children, immunity, clinical and morphological studies

Introduction. Acute pneumonia is currently one of the topical problems of pediatrics. This is due to its widespread prevalence among children and high mortality. According to WHO, about 155 million cases of pneumonia in children are recorded annually in the world, and approximately 1.4 million of them die under the age of five. Thus, this disease is one of the leading causes of child mortality [1].

The frequency of pneumonia as the main cause of deaths varies, according to various sources from 21.6 to 43.9%, in certain regions of the CIS - in even greater limits: 1.55-1.85% per 100 children born in Belarus and the Baltic states, 4.64 -11.6% - in Moldova and Transcaucasia, 10.9 - 21.6% - in Central Asia [4].

Diagnosis is one of the most important objects of standardization in healthcare, the basis for quality management of medical services, documentary evidence of a doctor's professional qualifications.

In classification of pneumonia in the ICD-10, the etiological (microbiological) principle prevails, therefore, with the clarified etiology of pneumonia, when it is considered as the underlying disease, the ICD-10 has the necessary codes. First of all, to determine the pathogen, it is necessary to use the results of intravital microbiological and other modern laboratory research methods [3,7].

The issues related to diagnosis of neonatal pneumonia are challenging. According to sectional data, no more than 25% are recognized in surgical hospitals [4,6]. Among those who died after radical surgery for cancer of the esophagus and cardia of the stomach, pneumonia occurs in 36.8% of cases.

However, such high mortality rates can be misleading, since most patients with neonatal pneumonia (NP) have severe comorbidities, and pneumonia is not the direct cause of death. At the same time, it is very

difficult to determine the so-called attributable lethality, i.e., directly related to NP [1,5].

The presence of many concomitant factors in most patients (previous diseases, previous surgical interventions, complex diagnostic and therapeutic procedures) explains the difficulty (or impossibility) of determining the "contribution" of NP to thanatogenesis in a particular case. However, according to available data, attributable mortality among patients with NP ranges from 1 to 23% [2,4].

Purpose of the research. Conduct a clinical, morphological and immunological study of neonatal pneumonia and develop prognostic and diagnostic criteria for the development of intrauterine and early neonatal pneumonia on the basis of the data obtained.

Materials and research methods. To solve the problem of predicting the risk of developing pneumonia in newborns, it is necessary to determine informative criteria. In this regard, at the first stage of study, we evaluated the anamnestic data of puerperas of newborns with intrauterine and early neonatal pneumonia with the comparison group.

A retrospective analysis of the medical records of 150 newborns with respiratory disorders, selected by copy data method in the period from 2018 to 2020, was carried out.

Examinations included clinical (evaluation of epidemiological data, somatic and obstetric anamnesis of the mother, identification of heredity, aggravation of bronchopulmonary and immunosuppressive pathology) and laboratory (general blood count, biochemical blood tests, bacteriological smears from the pharynx, X-ray of the chest organs and according to ECG indications , EchoCG, CT) methods.

Research results. The clinical examination included the analysis of biological factors (mother's health, characteristics of pregnancy and childbirth) and social anamnesis, assessment of somatic and neurological status.

When observing children, special attention was paid to the examination of the organs of the respiratory system. In the intensive care unit for newborns, continuous cardiorespiratory monitoring, control of the degree of blood oxygen saturation (Sp02), blood pressure, body weight and daily diuresis were carried out.

Daily examination of children was carried out during their stay in the unit of intensive care of newborns and nursing premature babies of stage II.

A standard laboratory and instrumental examination of all children was carried out, including clinical blood and urine tests, biochemical and immunological blood tests, blood tests for markers of intrauterine infections, X-ray examination of the chest organs, electrocardiogram registration, electroencephalography, ultrasound examinations (of the brain, heart, organs of the abdominal cavity). The microbial spectrum of the tracheal aspirate was studied with the determination of the sensitivity of isolated flora to antibacterial drugs. In children with life expectancy from 0 to 3 days (69.1% of the number of deaths), macroscopic analysis of lung tissue showed no specific signs of pneumonia. In children aged 5 to 15 days, against the background of moderate compensatory emphysema in the anterior sections of the lungs, the presence of small and confluent foci of tissue compaction of a grayish-red hue was noted, while in 57 cases the lung lesion was bilateral, small- or large-focal (figure). In 6 children aged 5 to 15 days, a picture of typical pleuropneumonia was noted.

The microscopic picture of the lung tissue in the vast majority of children, regardless of the period of death, was characterized by severe circulatory disorders in the form of congestive plethora of capillaries and venules, erythrocyte stasis, diapedetic hemorrhages, uneven perivasal edema of the stroma. Also, the presence of many neutrophilic polymorphonuclear leukocytes in the lumen of the alveoli and alveolar septa was revealed in these children (89.4%).

Neutrophil infiltration was abundant in 58.5% of cases, focal - in 41.5% of cases. In the lung tissue of 20 deceased children, erythrocytes (21.3%) were found in the lumen

of bronchioles and alveoli, which is explained by a pathogenetic relationship with generalized hypoxic syndrome [1]. In 14.9% of cases, the presence of alveolar macrophages was noted, in 7.4% of cases - cells of the lymphoid series. At the same time, in 36.1% of children, parietal hyaline membranes were detected in the alveoli, resulting from damage to the alveolar epithelium, combined with impaired capillary permeability and exudation of fibrin into the lumen of the alveoli [3].

Fibrin strands were revealed in the lumen of alveolar structures in 7 cases (7.4%), mainly in children with pleuropneumonia. Desquamative-dystrophic changes in the epithelium of the bronchi and pneumocytes were found in 20 cases (21.3%). Infiltration was combined with widespread atelectasis in 21.3% of cases.

According to the composition of tracheal aspirates, in case of respiratory disorders in premature newborns in the early neonatal period, congenital pneumonia was characterized by the most morphologically expressive changes: the presence of viral and bacterial flora, signs of death of alveolar epithelium cells, mainly in the form of necrobiosis and necrosis (2 times more often than in children with RDS, $p<0.05$), as well as a significant increase in the average number of polymorphonuclear leukocytes in the field of view (by 4.6 times compared with children with RDS, $p<0.01$). The vast majority of leukocytes had incomplete phagocytosis or were destroyed, which reflects the inability of the body of very preterm infants to respond with a full leukocyte reaction to infection. And it can also indicate lack of cellular immunity in the lungs, associated with both physiological and pathological immaturity of the immune system due to its dyschronous development under conditions of intrauterine infection.

This is also confirmed by the fact that lymphocytes and macrophages were found only in single smears in patients with congenital and neonatal pneumonia, while, according to the literature, with the development of inflammatory process in the lungs against the background of unchanged local immunity, a significant increase in the number of these cellular elements is observed.

With RDS, there was a predominance of unchanged alveolocytes (1.8 times more than with congenital pneumonia, $p<0.02$); the death of respiratory epithelium cells was carried out mainly by apoptosis (3.2 times more often than in congenital pneumonia, $p<0.05$), that is, it was genetically programmed. The composition of tracheal aspirates in children with subsequently developed neonatal pneumonia occupied an intermediate position between congenital pneumonia and RDS.

When performing a mathematical analysis, a significant ($p<0.05$) positive correlation was found between the content of surfactant protein B ($r = 0.44$) and Clara cell protein ($r = 0.64$) in the blood and the average number of leukocytes in smears of tracheal aspirates in newborns with congenital pneumonia, which confirms the presence of inflammatory process in the lung tissue. Cytological examination of tracheal aspirates in very preterm infants in the early neonatal period can be used as a simple non-invasive additional method that allows differential diagnosis of infectious and non-infectious respiratory disorders.

Conclusion: In newborns, the mechanism of innate immunity provide the main protection against pathogens, and it can be assumed that changes in the innate immunity system are one of the reasons for the risk of developing infectious pathology. In recent years, much attention has been paid to the identification of immunological prognostic markers of neonatal pneumonia.

Therefore, it is relevant to further search and introduce into clinical practice accurate, highly specific, available in hospitals, highly informative and prognostically significant diagnostic methods that have the ability to identify the probable risk of developing neonatal pneumonia, as well as their varieties, at the preclinical stage.

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