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Patomorphology of Early Neonatal Pneumonia in Children with Immuno Deficiency Conditions

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ABSTRACT

Pneumonia in children is one of the leading places in the structure of child mortality. Determines the high level of the overall incidence of the child population recurrent infections lead to impaired functional state of the body can cause a failure to adapt the basic functional systems of the child's body and lead to the development of chronic pathology. The article presents generalized modern data on the pathomorphology of early neonatal pneumonia in children risk factors for pneumonia predisposing factors. Features of cellular and humoral immunity of newborns and young children and immunological changes are given arising against the background of pneumonia.

Keywords:
children; pneumonia; immunity; neonatal; pathomorphology

Introduction

Respiratory diseases are the most representative group in the structure of children's morbidity. Currently, 50-60% of children suffer from this pathology [3,5,9].

Respiratory diseases rank second among the causes of death in children under one year of age and account for 12.4% [1,4,8].

The problem of pneumonia remains one of the most important in neonatal pulmonology [5,8,9]. This is due to its high frequency, severity of the course, a large number and variety of developing complications, a significant level of perinatal losses, as well as a high degree of disability, especially among premature babies. Among the causes of perinatal morbidity and mortality, it continues to occupy the third place and accounts for 10 to 50% of the total infectious pathology of the perinatal period. Neonatal pneumonia is diagnosed in 0.5-1.0% of term infants and in 10-15% of premature infants [4,6,7]. At autopsy, they occur in 38% of stillbirths and in 32% of children who died shortly after birth [2,3,5].

In recent years, according to foreign and domestic literature, the role of chlamydia, mycoplasma and viruses of the herpes family - HGTG types I and II and CMV in the development of intrauterine pneumonia has increased markedly [6].

The neonatal period is one of the most critical in the life of a child, and it is during this period that a serious adaptation of his functional systems, primarily respiration and blood circulation, to extrauterine life takes place. Disturbances in the development of breathing in the early neonatal period in a premature baby are realized in respiratory distress syndrome due to surfactant deficiency [1,8]. In premature babies born earlier than 30 weeks of gestation and who have not received prenatal prophylaxis with steroid hormones, the incidence of RDS is about 65%, in the presence of prenatal prophylaxis - 35% [10]. Thus, it was noted that the lower the birth weight and gestational age of the child, the higher the risk of developing respiratory distress [7,10].

The emergence of neonatal pneumonia is facilitated by the insufficiency of the immunity factors obtained from the mother (transplacental IgG and cytokines; milk IgG and secretory IgA, granulocytes T- and B-lymphocytes, proteins of the complement system, lysozyme, lactoferrin and lactoferricins) and "physiological immunodeficiency" of the newborn, which affects the whole the immune system and, above all, the mechanisms of innate immunity [4,6].

The pathomorphology of neonatal pneumonia is determined by the nature and extent of lung lesions, taking into account clinical and radiological data. Focal pneumonia (bronchopneumonia) is more often observed in young children and currently accounts for 30-40% of the total number of pneumonia. Focal-confluent pneumonia, which accounts for 3-6% of all pneumonia, proceeds more severely. Segmental pneumonia is more common in children

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over the age of 1 year (66%), but it can also be in children in the first months of life. In recent years, croupous pneumonia is rarely diagnosed (1-3% of the total number of pneumonia), mainly in cases of outpatient treatment without antibacterial drugs, due to late diagnosis. Interstitial pneumonia is a rare form and accounts for less than 1% of all pneumonias [4].

The course of the disease is determined in the process of dynamic observation of the patient. Pneumonia is considered acute, the resolution of which is achieved within a period of up to 1.5 months. With adequate therapy, most uncomplicated pneumonias resolve in 2-4 weeks, complicated by 1-2 months. A protracted course is diagnosed when the duration of the pneumonic process is from 1.5 to 6 months.

Purpose of the research

On the basis of a comprehensive study of risk factors, clinical picture, pathogenetic mechanisms and morphological data, establish patterns of formation and develop approaches to early diagnosis and prediction of early neonatal pneumonia in children with immunodeficiency states.

Materials and methods

The study included 107 patients with complicated pneumonia, aged from 1 month to 6 years, who were treated in 2018-2020 in the departments of emergency pediatrics and resuscitation and intensive care of the REPUBLICAN RESEARCH CENTER EMERGENCY CARE (RRCEC).

The examinations included clinical (assessment of epidemiological data, somatic and obstetric anamnesis of the mother, identification of heredity, burden of bronchopulmonary and immunosuppressive pathology) and laboratory (complete blood count, biochemical blood tests, bacteriological smears from the pharynx, chest X-ray and indications of ECG, EchoCG, CT) methods.

Results and Discussion

Group I consisted of 50 full-term newborns with a gestational age of 38-42 weeks, with an average birth weight of 3471.2 ± 510.0 g, a length of 51.2 ± 2.3 cm, a head circumference of 35.0 ± 1.5 cm, chest circumference 33.9 ± 1.5 cm, mass-height coefficient was 67.3 ± 8.0 (M ± σ). Of these, 54.0% were boys, 46.0% girls. Group II included 57 premature babies - gestational age less than 37 weeks, with an average birth weight of 1639.4 ± 427.9 grams, length 41.0 ± 3.7 cm, head circumference 29.6 ± 2.6 cm, chest circumference 25.9 ± 3.3 cm, mass-height coefficient was 39.5 ± 8.0 (M ± σ).

Boys and girls accounted for 59.6% and 40.4%, respectively. Most of the children of group II were born at 30-32 weeks (70.2%), 12.3% of newborns - earlier than 30 weeks and 17.5% of children - at 33-37 weeks of pregnancy. Most of the premature babies (56.1%) had a low body weight at birth (2500-1500 g), 43.9% were born with a very low body weight (1500-1000 g).

In most cases, children were born from 1 birth (62.0% in group I and 59.6% in group II), from 2 and subsequent births - 38.0% and 40.4%, respectively. Significantly more often premature babies were born by caesarean section (in 71.9% of cases versus 42.0%, $p < 0.01$). Immediately after birth, resuscitation measures were more often required for children of group II (in 17.5% of cases versus 8.0% of newborns in group I). There were no significant differences in Apgar scores at the first and fifth minutes of life in the groups: in group I - 6 [3; 7] and 7 [5; 8] points, in group II - 5 [2; 7] and 7 [4.5; 8] points. All babies required treatment in the intensive care unit, including artificial lung ventilation (ALV). However, in the majority of term infants (84%), the need for mechanical ventilation was no more than 10 days (5 [3; 8.25] days). 58.0% of full-term newborns were on mechanical ventilation up to 5 days of life, 26.0% - within 6-10 days, 16.0% - 11-20 days. Premature babies needed a longer stay on mechanical ventilation (11 [8; 16.5] days ($p < 0.001$)). Mechanical ventilation up to 5 days was carried out in 17.5% of premature infants, within 6-10 days - 33.3%, 11-20 days - 35.1% and more than 20 days - 14.0% of children.

Congenital pneumonia was accompanied by an increase in body temperature in children of group I in 92.0% of cases ($p < 0.001$)), in children of group II - in 56.1% of cases. In newborns in both groups, gray skin, acrocyanosis, marbling and the presence of a venous network were observed (34.0-17.5%, 36.0-61.4% ($p < 0.01$), 8.0- 42.1% ($p < 0.001$) and 6.0-36.8% ($p<0.001$), respectively).

Respiratory symptoms in children of group I were significantly more often characterized by hard breathing (64.0% versus 10.5%, $p<0.001$), the presence of wet wheezing (58.0% versus 12.3%, $p<0.001$) and sputum in 90, 0% of cases, which are significantly more often purulent (44.0% versus 24.6%, $p<0.05$).

At the same time, significantly more often in the II group of children, the auscultatory picture was characterized by weakened breathing (in 89.5% of cases versus 36.0% in group I, $p<0.001$), the presence of crepitant wheezing (84.2% versus 36.0%, respectively, $p<0.001$), sputum in 93.0% of cases. In 59.6% of premature newborns, the

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sputum was slimy; in 24.6% it was purulent. Apnea episodes were observed only in 19.3% of premature infants. Dyspnea and the participation of auxiliary muscles in the act of breathing were found in children of both groups. However, dyspnea was more often observed in patients of group II (56.1% versus 48.0%), the participation of auxiliary muscles in the act of breathing was also more frequently observed in children of group II (91.2% versus 60.0%, $p<0.001$)

During the clinical and morphological study of the material, it was revealed that the state of health of the mother, the course of pregnancy and childbirth play a leading role in the pathogenesis of neonatal pneumonia in newborns. According to our data, in 100% of cases of aspiration pneumonia there was a burdened history of the mother.

A morphological study of the lungs of full-term infants with neonatal pneumonia, in the treatment of which mechanical ventilation was used, revealed the following features: the bronchial epithelium changed from desquamation and flattening (24-48 hours) to metaplasia into a multilayered flat (more than 7 days). In the peribronchial tissue, focal inflammatory changes (6-24 hours) were replaced by sclerosis and necrosis in the group of more than 7 days of life. The exudate of the valveoli and alveolar passages, containing corneous scales, segmented and stab leukocytes (6-24 hours), by the 7th day of life underwent organization with the formation of diffuse sclerosis of the parenchyma. The walls of the alveoli are lined with hyaline membranes. Without the use of mechanical ventilation in the treatment of neonatal pneumonia, these morphological signs were not observed.

In premature infants with aneonatal pneumonia, in the treatment of which mechanical ventilation was used, necrotic changes appeared earlier: in the peribronchial tissue and in the lung parenchyma at the age of more than 2 days, which is associated with the peculiarities of the inflammatory reaction in ontogenesis. Hyaline membranes line the walls of the alveoli in groups with and without mechanical ventilation.

Pathological studies have shown that a feature of the course of modern neonatal pneumonia is an increase in the proliferative processes of inflammation, which is fraught with the development of fibrous pulmonary dysplasia with a difficult prognosis for newborns.

An electron microscopic examination of the lung tissue in neonatal pneumonia in term and premature infants did not reveal the surfactant of the lungs. In term infants without the use of mechanical ventilation, alveolocytes were more intact.

These observations once again confirm that surfactant deficiency takes the leading place in the pathogenesis of hyaline-membranous pneumopathy. Surfactant deficiency is due to insufficient maturity of the surfactant system of the lungs, low secretory activity of type 2 alveolocytes. It is believed that in premature babies in the blood serum, amniotic fluid, in the alveoli there is a special protein factor that destroys the surfactant. There is also a point of view that the disturbance of the surfactant in the onset of HMD is also due to the presence of a surfactant-anti-surfactant immune complex in the plasma of immature children.

Our data of electron microscopic examination indicate that the surfactant of the lungs is absent both in cases with the use of mechanical ventilation, and without, which indirectly confirms the above facts.

Conclusion

In recent years, the number of children with congenital and acquired immunodeficiency states, disorders of local immunity in the bronchopulmonary system has been increasing. The proportion of children with hereditary pathology is increasing. According to Professor Sotnikova, in young children, in 80% of cases, pneumonia develops against the background of immunodeficiency states.

In the light of the above, it seems necessary to study the changes in the immunological status in more detail and develop complex schemes of therapy and rehabilitation that normalize lipid and protein metabolism, stimulate antioxidant protection, and modulate immunological reactivity in children who are sick or have had pneumonia.

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