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Pneumonia In Newborns: Peculiarities Of Etiology, Clinical Aspects, Diagnosis

Babadjanova Xursanoy Melibayevna

Assistant of the Depatment of Pediatrics
Ferghana Medical Institute of Public Health

Abstract Pneumonia in newborns is one of severe pathologies, leading to increased neonatal morbidity and mortality. During the neonatal period pneumonia develops much more frequently than in other age periods. Starting of the spontaneous breathing is one of the most important factors in the child's adaptation to extrauterine existence; intrauterine infections and the development of the inflammatory process - one of the main reasons for the high frequency of respiratory adaptation disorders. The article contains a review of the literature data on the etiology, pathogenesis and diagnosis of pneumonia in newborns.
Keywords: newborn, pneumonia, etiology, clinical manifestations, diagnosis, premature newborns.

Pathology of the respiratory system is one of the main causes of high morbidity and mortality of newborn children [1, 2]. And one of its most severe manifestations is neonatal pneumonia. The relevance of the study of neonatal pneumonia is caused by an increase in the severity and outcome of the disease. Neonatal pneumonia with an extremely severe and "lightning-fast" course began to be registered more and more often, antibiotic-resistant and antibiotic-dependent microorganisms appear, complicating the treatment and prognosis of the disease [3, 4]. The incidence of pneumonia is about 2% among full-term and about 10% among premature infants and reaches 40% in newborns in the intensive care unit on various types of respiratory therapy [5, 6, 7]. In 2007, M.D. Nissen published data that every year in the world from pneumonia from 750,000 to 1.2 million newborns die, which is 10% of the world infant mortality [8].
Congenital pneumonia is a term used to refer to inflammation in the lungs, frolicking in the fetus before birth or within 3 days after birth, in which lung damage is the main form of the disease or part of a generalized infectious process [2]. However, when pneumonia is detected in a child over the age of 48 hours who is in an obstetric or pediatric hospital, it is quite difficult to make a differential diagnosis between congenital and nosocomial pneumonia, since the clinical manifestation often has no specific differences. At the same time, according to N.J. Mathers [9], congenital pneumonia is considered a disease that arose from birth in the presence of a positive test for tracheal aspirate culture during the first 4 hours after delivery.
Some researchers use the term neonatal pneumonia (NP), which combines congenital, aspiration and acquired pneumonia [1, 2, 4].

Etiology of neonatal pneumonia

The etiology and epidemiology of congenital and nosocomial pneumonia differ depending on the population to which the infant belongs, the settings of the clinic, the characteristics of the perinatal period, gestational age and definitions of pneumonia adopted in this region [7]. The predisposition of newborns to the occurrence of infectious complications may be due not only to the characteristics of hospital strains of microorganisms, but also to the state of the immune system of newborn children [10, 11]. Massive and long-term antibiotic therapy performed in neonatal ICU patients negatively affects the biocenosis of the mucous membranes, the formation of local and general immunity of a newborn child [12].

The occurrence of inflammation in the lungs of the fetus and newborn is facilitated by the mother's burdened somatic and obstetric-gynecological anamnesis:

• chronic inflammatory kidney diseases (pyelonephritis), especially if there were exacerbations of the disease during pregnancy;

• untreated chronic focal infection of the genital sphere (salpingoophoritis, colpitis);

• acute infectious diseases of the mother during pregnancy (ARVI, tracheobronchitis, pneumonia);

• pathological course of pregnancy (threat of termination of pregnancy, isthmic-cervical insufficiency of the cervix with suture after 20 weeks of gestation);

• intranatally: premature discharge of amniotic fluid with a long (more than 12 hours) anhydrous period;

• high virulence of infecting agents and inhibition of immunological reactivity in the mother, fetus and newborn are important (against the background of gestosis for more than 4 weeks, chronic fetoplacental insufficiency, chronic intrauterine fetal hypoxia). The etiological structure of pneumonia in newborns differs significantly from other age periods [12].

Cytomegalovirus and herpetic infections are of particular importance in the etiology of neonatal pneumonia in the transplacental pathway of infection [10]. In perinatal infection, an important role is assigned to group B streptococci, E. coli, anaerobic bacteria, chlamydia, mycoplasma, cytomegalovirus, Haemophilus influenzae, Listeria monocytogenes [7, 8]. The postnatal pathway of infection is caused by coagulase-negative staphylococci, Staphylococcus aureus, Pseudomonas aeruginosa, adenoviruses, enteroviruses, cytomegaloviruses, influenza A, B, parainfluenza viruses, RSVIRUSES, candida, E. coli. Analyzing the data of a number of researchers, it should be stated that in modern conditions, the etiology of pneumonia in newborns is polymorphic. Gram-positive flora, especially streptococcus with the prevalence of its pyogenic strain, primarily plays a role in the etiology of the disease [13, 14, 15]. Pneumococcus, which is one of the main etiological factors of community-acquired pneumonia, is observed 3 times less in newborns with congenital pneumonia. From the group of staphylococci, the epidermal strain is most often detected, and it prevails over the golden one [8]. Gram-negative flora with a predominance of enterobacteria takes the second place in the etiostructure of congenital pneumonia [9].

The combined bacterial-bacterial flora is also noted in the etiostructure. Moreover, according to a number of authors, the same microorganisms predominate as in monoinfections. With microbial associations, Enterobacteria are also sown more often. So, mainly there is a combination of enterobacteria with hemolytic Streptococcus, Staphylococcus aureus, Pseudomonas aeruginosa. With a combined infection of Enterobacter with Pseudomonas aeruginosa, contamination is not excluded. Most researchers also consider it to be a contamination infection that develops well in wet environments of neonatal intensive care units [7, 8]. With ELISA in the blood of newborn children with pneumonia, Ig class G is mainly detected for CMV and HSV, and in isolated cases – for mycoplasmas and chlamydia. Since mycoplasma and chlamydia do not pass the placental barrier, infection occurs intranatally when the fetus passes through the birth canal. And infection with CMV

and HSV occurs in the antenatal period, since Ig class G are detected immediately after the birth of a child [10, 11]. Neonatal infections in premature infants are of particular medical and social importance. Their early infections are represented by bacteremia, pneumonia, meningitis, infection of the urinary system, they are characterized by a severe course and mortality from them reaches 40%, which is 3 times higher than that of premature newborns in the absence of infection. Their main pathogens are group B streptococci and Escherichia coli [12]. Late neonatal infections in premature infants, including pneumonia, are usually caused by nosocomial flora. At the same time, the main pathogens are coagulase–negative staphylococci (about 50% of infections), Staphylococcus aureus, enterococci, E. coli, Klebsiella spp., Pseudomonas spp., fungi. The risk of infection is inversely proportional to gestational age and birth weight and is directly proportional to the severity of the newborn's condition [8,12]. According to the results of a Russian study, the incidence of ventilator-associated pneumonia in premature infants who were on a ventilator was 45.8%, and in children who were in nursing units – 19.2%, and it was shown that the duration of a ventilator increases the risk of developing pneumonia [6]. The microbiological study of the endotracheal aspirate and the material from the mucosa of the posterior pharyngeal wall showed that the microflora isolated from the endotracheal aspirate and from the posterior pharyngeal wall is almost identical. All microorganisms isolated from endotracheal aspirate and material from the posterior pharyngeal wall were typical representatives of nosocomial flora. P. aeruginosa and K. pneumoniae were the most frequently distinguished. Gram-negative enterobacteria and anaerobes were rarely isolated [8].

Clinical manifestations of pneumonia

Speaking about the clinic and diagnosis of neonatal pneumonia, it should be emphasized that early clinical symptoms may be nonspecific [13, 14]. Often children are born in a critical condition requiring resuscitation. It is very important to assess the anamnesis and identify infectious factors in it [16, 17].

Since disorders in the formation of respiratory function at birth can be of a post-asphyxiant and post-respiratory nature, but the genesis of these pathological syndromes may be due to infectious pathology. Depending on the time and circumstances of the penetration of the infectious agent into the lungs of the fetus and newborn, the following variants of congenital pneumonia are distinguished, the etiology of which may be different:

• congenital transplacental pneumonia (the pathogen penetrates from the mother to the fetus hematogenically through the placenta or aspiration-bronchogenic infection from amniotic fluid); • congenital intranatal pneumonia is caused by pathogens that have penetrated into the lungs during childbirth also by aspiration of infected amniotic fluid or contamination during the passage of the child through the infected birth canal of the mother; According to the literature, there are two variants in the clinical course of congenital intranatal pneumonia:

• The first option: the newborn is born in asphyxia, and during resuscitation, there is no positive dynamics due to the inflammatory process in the lungs, and the child needs a ventilator;

• The second option occurs with a "light" interval, when clinical symptoms of pneumonia appear 3-5 hours after the birth of a newborn. Predisposing factors affecting the immunological reactivity of the body play an important role in the development of congenital pneumonia of newborns [16, 18]. Prolonged intrauterine hypoxia causes lung damage, reduces the drainage functions of the airways, leads to a deficiency and insufficient activity of pulmonary macrophages, which is a favorable background for the development of pneumonia. In the clinical picture, there may be such manifestations of pneumonia in a newborn as cyanosis, central nervous system depression or, on the contrary, excitability, violation of temperature control, etc. From the respiratory organs, tachypnea, apnea, inflating of the wings of the nose, chest retraction, "grunting" breathing, an increase in

manifestations of respiratory failure are possible. Cough may be absent or weakly expressed, although foamy discharge from the mouth is possible. Hemodynamic disorders, gray skin color, jaundice, hemorrhagic manifestations and other symptoms may occur [13].

Auscultation against the background of weakened breathing, wet wheezing and / or crepitation are often heard.

Diagnosis of neonatal pneumonia

However, all the described clinical manifestations are nonspecific and can be observed in newborns against the background of respiratory distress syndrome, and often in combination with intrauterine respiratory infection [19, 20].

Therefore, X-ray and laboratory examinations are of great importance in diagnostics [19]. The radiological picture of pneumonia is determined by the type of tissue infiltration and the stage of inflammation [20].

Types of infiltration:

• the alveolar type of infiltration is observed when the air-containing alveoli are filled with inflammatory exudate (air-space consolidation, compaction, consolidation of air-containing spaces).

• interstitial type of infiltration – observed when the interalveolar spaces are filled with exudate, while the alveoli contain air (ground-glass opacity, a symptom of frosted glass).

Stages of pneumonia:

1. The stage of infiltration (the first week of the disease). Shading of the lung tissue without clear contours and boundaries, which, as a rule, is localized in the peripheral parts of the segments, lobes. In certain areas, shading may be limited by intersegmental or inter-lobe partitions, interstitial reactions are detected in adjacent segments.

2. The stage of resorption (the second week of the disease). The extent and intensity of infiltration decrease, it is possible to visualize lobular shading and focal shadows of various sizes in combination with areas of lung tissue of normal or increased pneumatization against the background of increased pulmonary pattern due to the interstitial component.

3. The stage of interstitial changes (end of the second – beginning of the third week). There are no infiltrative changes, and interstitial changes are detected at the site of infiltration in the form of peribronchial changes, mesh deformation of the pulmonary pattern, heaviness. According to the National Neonatology Guidelines, the diagnosis of congenital pneumonia can be confirmed if at least one main or three (or more) auxiliary diagnostic signs are identified [1] (Antonov, E.N. Baibarina, 2003):

Main:

• focal infiltrative shadows on the chest X-ray (during X-ray examination in the first three days of life in 30% of cases may be absent);

• seeding of identical microflora in mother and child (provided that the material is taken on the first day of life);

• with aspiration syndrome, the development of pneumonia during the first three days of life (this criterion is applicable in cases where aspiration occurred intranatally and was confirmed by suction of the contents from the trachea immediately after the birth of the child).

Auxiliary diagnostic criteria:

• leukocytosis of more than 21×109 / l (in combination with a shift of the leukocyte formula to the left of more than 11% or without it) in the general blood test on the first day of life;

• negative dynamics in the general blood test on the 2nd-3rd day of life;

• increased bronchovascular pattern during X-ray examination (in combination with a local decrease in transparency lung fields or without it) in the first three days of life;
• the presence of infectious diseases in the mother;
• the presence of other purulent-inflammatory diseases in the child in the first three days of life;
• the presence of purulent sputum during the first intubation of the trachea in the first three days of life;
• an increase in the size of the liver in the first day of life (more than 2.5 cm along the sredneklyuchny line; for children with a body weight of less than 1500 g – more than 2 cm), sometimes in combination with the availability for palpation of the spleen (in the absence of hemolytic disease of newborns);
• thrombocytopenia less than 170×109/l;
• concentration of immunoglobulin M in blood serum more than 21 mg% on the first day of life; • presence of fluid in the pleural cavities from the first day of life;
• inflammatory changes detected during histological examination of the placenta.

In neonatology in bacterial infections, a large diagnostic role is assigned to the determination of C-reactive protein [9, 13, 14]. According to the observation of N.N. Volodin et al. (2001), determination of the concentration of acute phase proteins in blood serum in dynamics may have not only diagnostic, but also prognostic value. Thus, an increase in the level of C-reactive protein over 6 mg/l is an early sign of bacterial infection in full-term infants, whereas a similar pattern between its concentration in the blood of premature infants and the presence of infectious pathology in them has not been clearly proven [18, 19].

The procalcitonin test (PCT) has recently been considered a sensitive marker of an inflammatory reaction. An increase in the level of PCT in the blood serum in newborns of more than 0.5 ng/ml determines a high probability of an infectious process [18, 19, 20].

Conclusion

The etiological structure of pneumonia in newborns is represented by a wide range of pathogens. A wide range of microorganisms and a severe course of the disease are associated with an immunodeficiency condition in newborns. The clinical picture of neonatal pneumonia depends on the gestational age of the child and is rarely characterized by classical clinical and radiological signs. Early clinical manifestations of pneumonia in newborns are nonspecific and are determined on the basis of a violation of the general condition. All this will make it possible to optimally stop the inflammatory process of the respiratory tract, reduce the time of artificial ventilation of the lungs and prevent the development of complications in newborns.

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