Features of the Structure, Development and Functioning of The Immune System of The Child's Body

Kodirov Khusan Solievich

Senior teacher of the "Pediatrics" department for the medical faculty of ASMI

ABSTRACT

The development of an individual in ontogenesis occurs in accordance with its inherent genome strategy, i.e. the totality and characteristics of the implementation of genetic information, fixed by previous evolution and inherited from parents. During certain periods, events occur that turn on/off the regulatory mechanisms of certain groups of immune system genes responsible for the morphofunctional formation, unity, effector and regulatory efficiency of nonspecific and specific processes of immunological surveillance and anti-infective immunity.

Keywords: Immune system, children, formation, effect, method, treatment.

INTRODUCTION

Laying and formation of immune system organs. The fetal liver plays an important role in the hematopoiesis of the fetus and, in terms of its function, can be considered an organ of the immune system. In the fetal liver and blood islands of the yolk sac, the first stem cells appear in the 3rd–8th week of embryogenesis. The liver is most important for the development, maturation and differentiation of B cells.

MATERIALS AND METHODS

Bone marrow is formed in the 4th–5th week of embryogenesis and from that time on performs all the functions of the central organ of immunity.

The thymus is formed in the area of the 3rd–4th pharyngeal pouches. Its laying occurs in the 4th–5th week. By the 6th week, the thymus is characterized by an epithelial structure, by the 7th–8th week it is populated with lymphocytes, and by the end of the 12th week its formation is completed.

The spleen also develops at 5–6 weeks. At 5–6 weeks, the formation of lymph nodes and other secondary lymphoid organs occurs. At 9–14 weeks, the tonsils are formed (initially the palatine and pharyngeal tonsils), then the lymphoid nodules of the appendix and lymphoid plaques of the small intestine (14–16 weeks), tongue (24–25 weeks) and tubal tonsils (28–32nd). The formation of lymphoid formations occurs under the epithelium of the digestive tube in the form of an accumulation of epithelium, transforming into reticular tissue. It is into this tissue that lymphoid cells and their precursors are subsequently populated.

RESULTS AND DISCUSSION

Features of the formation of immune system organs in ontogenesis:

a) early formation of immune system organs in embryogenesis;

b) the morphofunctional basis of the organ parenchyma is lymphoid tissue;

c) by the time of birth, the main organs reach maturity sufficient for the development of an adequate adaptive immune response;

d) intensive increase in their mass in childhood and adolescence (especially secondary) (Table 2);
e) pronounced variability (2–3 times) in the mass of lymphoid tissue and the quantitative content of immune system cells (polymorphic and mononuclear phagocytes, lymphocytes) in the population of children and adults;
f) early age-related involution (aging) of lymphoid tissue, especially the thymus, its replacement with connective and adipose tissue.

Preservation of the morphofunctional properties and functions of the organs of the immune system, the balance of its main links is the basis for ensuring the longevity of the individual.

Lymphocytes. During human embryonic development, hematopoietic stem cells initially arise in the yolk sac, then migrate to the embryonic liver, and from there to the thymus and bone marrow. In a 4-month-old fetus, the bone marrow becomes the main site of hematopoiesis. Lymphocytes appear for the first time: in the blood - at 7-8 weeks, in the thymus - at 8 weeks, in the lymph nodes - at 10 weeks, in the spleen - at 11 weeks, in the intestinal mucosa - at 12 weeks. th, in Peyer's patches - at 15–16 weeks.

The content of leukocytes in the fetal blood at the 12th week is 1000 cells/ml, and at the 25th week – 25,000 cells/ml.

Nonspecific mechanisms of the immune system play a primary role in protecting the child's body in the early stages of ontogenesis. They include humoral and cellular factors.

In the embryonic period, the total activity of the fetal complement system along the classical pathway is detected already at 6–8 weeks and is about 60% of that of an adult, and the activity of the alternative pathway is approximately 35–50%. Accordingly, the hemolytic activity of individual components - C1–C9, as well as the factors of the alternative pathway of this system - B, I, P, H is revealed. The liver plays the main role in the biosynthesis of complement components.

The content of fibronectin (a component of the extracellular matrix) in the fetus is 50% of the concentration in adults. It performs an important protective function. When its biosynthesis decreases, children develop respiratory infections, respiratory distress syndrome, bacteremia and sepsis [3].

Biosynthesis of cytokines (interferons and some interleukins) is noted at the 10th week and also accounts for 40–50% of the level in adults.

The phagocytic function of fetal granulocytes is formed by the 12th week of pregnancy and, as a rule, is incomplete. This is due to reduced chemotaxis, as well as imperfect intracellular bactericidal mechanisms.

The system of mononuclear phagocytes (monocytes, macrophages) of the fetus at this time is also functionally inferior.

Pre-B lymphocytes are detected in the fetus in the fetal liver at the 8th week of gestation. Expression of s-IgM by B lymphocytes appears at the 10th week. Fetal B cells express only IgM molecules, without IgD expression. The expression of s-IgA, IgG and IgD is determined from the 11th–12th week of pregnancy. During the same period, increased expression of the CD5 molecule by B lymphocytes is noted [4].

Newborn B lymphocytes differentiate into plasma cells that secrete IgM, but they cannot switch into cells that produce IgG and IgA. This is explained by insufficiently effective help from CD4+ T-helper lymphocytes.

The synthesis of its own specific antibodies of the IgM isotype by plasma cells of the fetus is observed at the 20–24th week of pregnancy; a small amount of IgM and IgA is present in the blood.

The IgG class antibodies contained in the blood of the fetus are of maternal origin and protect the fetus from the range of pathogens to which the mother has developed post-infectious or post-vaccination acquired immunity during her life. Their transport across the placenta (transplacental transfer of antibodies) begins at the 8th week. At concentrations below 0.1 g/l, they circulate in the fetal blood until approximately the 17th–20th week. Then their concentration begins to increase (until the 30th week) and is about 5–10% of the maternal level. These same antibodies form passive immunity,

protecting the child from infection in the first 3–6 months of the postnatal period of life.

CONCLUSION

Thus, the formation of a child's immune system continues for many years and is a complex, multi-stage process. Each period is characterized by certain ontogenetic features, which are based on genomic, functional, structural, neurohumoral changes determined by the age-related development strategy of the organism. Periods of increased sensitivity of the immune system to the action of endo- and exogenous damaging factors (critical periods) determine the manifestation of hereditary variations in the strength of the immune response and immunopathological diathesis. Knowledge of the structural features, development and functioning of the immune system of the child's body is necessary for adequate diagnosis, treatment and prevention of a wide range of childhood diseases.

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