Prenatal and Postnatal Development and also Morphological and Morphometric Indicators of Thymus in Newborns

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ABSTRACT

The thymus is a lymphoepithelial organ located in the mediastinum and reaches its maximum development in youth. While other lymphoid organs develop exclusively from the mesenchyme (mesoderm), the thymus is of dual embryonic origin. Its lymphocytes develop in the bone marrow from cells of mesenchymal origin; they invade the epithelial bud, which has developed from the endoderm of the third and fourth pharyngeal pockets. The thymus is covered with a connective tissue capsule, which is introduced into the parenchyma and divides it into incomplete lobules, so the cortex and medulla of the adjacent lobules are connected to each other.

KEYWORDS: *thymus, thymus gland, immune system, morphology, newborn, fetus, Gassal cells.*

Relevance. One of the important tasks of modern morphology is to determine the norms of a normally functioning immune system. In this regard, studies of the cellular composition of the organs of the immune system and, first of all, its central organ, the thymus, are relevant. Thymus (Latin thymus, thymus gland) is a lymphoepithelial organ of human lymphopoiesis, in which maturation, differentiation and immunological "training" of T-cells of the immune system take place. The thymus also has another name - the thymus gland. The thymus gland is a small organ of pinkish-gray color, soft consistency, its surface is lobular. The thymus gland (thymus) is a huge mystery of medicine, primarily immunology, and in particular pediatrics. In the 20th century, the attitude of scientists to the organ as a generator and regulator of immune reactions, a participant in the production of many populations of immunocompetent cells, etc., was determined [1,2]. The thymus is still considered as a derivative of the immune system, to a greater extent, as its central organ. This organ plays a major role in the antenatal and early postnatal period. It is because of this that the interest of pediatricians in this area of knowledge is associated with a certain understanding of human ontogenesis from birth to old age [3,4]. From the standpoint of a modern overview, the thymus is the central organ of the immune system, which mainly determines cellular and humoral immunity. Thymic factors are involved in the differentiation of thymocytes, which in turn provide antiviral, antifungal, antitumor, antitransplant, anti-tuberculosis and other types of immunity. Powerful cooperation of thymocytes through T-cells-messengers with B-lymphocytes provides adequate humoral (through antibodies) immunity. The entire huge population of lymphocytes integrates and interacts through receptors, cytokines with the histocompatibility system and the microbiome, with the systems of phagocytic mononuclear cells and complement, with cellular formations of barrier organs (skin, mucous membranes, etc.), endocrine and nervous systems. Ultimately, an organically functioning powerful continuum is formed that provides control over the constancy of the internal environment and which is commonly called the body's immune system. To date, the location of the thymus has been studied to a certain extent.

Material and methods. We studied 10 hyperplastic thymuses with a weight significantly exceeding

the norm (on average - 45.5 ± 3.4 g): 5 samples from children aged 1.5 - 8 months who died from fulminant meningococcemia, 5 - from patients aged 2– 5 months who died from SIDS. In both groups there were 4 boys and 1 girl. The comparison was carried out with 5 normal weight thymuses (on average 10.6 ± 0.4 g) from children aged 1 day to 3 months, including 2 boys and 3 girls who died from newborn asphyxia, multiple congenital malformations, congenital bilateral purulent pneumonia with aspiration of amniotic fluid. The degree of enlargement of the thymus gland was assessed on the basis of calculating the value of the thymus index (TI) according to the formula: TI = thymus weight (g) / child's body weight (g) x 100% [5]. Thymus samples were fixed in 10% neutral formalin for 48 hours, then processed according to the generally accepted method [13].

Research results. The thymus is laid by the end of the first month of intrauterine development [7,8]. It is formed from pairs III and IV of branchial pockets. In the fetus, the thymus at the time of its birth is the largest and only fully structurally and functionally formed lymphoid organ in the body. From the 21st week, the thymus is clearly visualized according to the results of sonography, and, finally, by the 24th week, the thymopoiesis function becomes full. From 21 to 36 weeks of gestation, the monthly thymus gland increases by 1.7-1.9 times. Starting from week 37, the rate of its growth slows down. After this week, the increase occurs no more than 1.3 times. When studying the predominance of the size of one of the lobes of the Thymus over the other, it was noted that the thymus is more often asymmetric (76.74%) than symmetric (23.26%). Dominance in size of the right lobe is 80.23% for males and 75.58% for females. It should be emphasized that in healthy newborns, the thymus is fully formed, well functioning and fully active, regardless of the activity of this organ in their mothers [9,10,11,13]. The thymus gland of the newborn makes up 0.5% of the body weight. This is about 10-15 grams. While the spleen is 11 grams and the heart is 24 grams. According to some morphologists, the greatest growth of the Thymus is observed during the first year of a child's life, and the maximum organ weight relative to body weight is noted at 2-4 years. The absolute maximum mass of the Thymus is observed during puberty, after which the organ decreases. In this case, the glandular tissue of the Thymus is replaced by adipose tissue [9,14]. The size and mass of the thymus often undergo age-related changes and, moreover, vary greatly within the same age. In the period 32 - 36 weeks of the fetus, the length of the Thymus in the male is approximately 49 - 50 mm. The female sex is 43 - 44 mm. Also, the width in the period 32 - 36 weeks in males is 39 - 40 mm, in females 38 - 39 mm. For newborns, these numbers are slightly different. The length of the thymus in the male is 75 - 76 mm, in the female 76 - 77 mm. Also, the width for a newborn male is 41 - 41.5 mm, for a female 40 - 40.5 mm. The mass of Thymus in newborns ranges from 7 grams to 9.5 grams. The shape of this gland can be different, but it is mostly leaf-shaped. And we can recognize this by percentages: leaf-shaped (68.8%); cylindrical (9.6%); pyramidal (conical) (7.2%); and less often bean-shaped, oval-shaped. The distribution of fetuses and newborns by the number of lobes of the Thymus gland occurs in different ways. We have established the forms of individual anatomical variability of the Thymus in fetuses and newborns, taking into account the somatotype. According to the number of lobes, 3 types of thymus are distinguished: monocotyledonous prevails in the brachymorphic body type (5.81%), it is found more often in boys than in girls. In people of the brachymorphic body type, transverse dimensions prevail, the muscles are well developed, they are not very tall. The heart is located transversely due to the high-standing diaphragm. In brachymorphic ones, the lungs are shorter and wider, the loops of the small intestine are located mainly horizontally. Dicotyledonous prevails in the mesomorphic body type, is more common in boys than girls. The mesomorphic type is a sports body type with a tendency to engage in active sports. The mesomorphic type is characterized by an increased level of testosterone and a fast metabolism against a background of good appetite, all this allows them to quickly gain muscle. Most professional athletes are mesomorphs. The tripartite predominates with the dolichomorphic body type, it is found equally often in both boys and girls. People of the dolichomorphic body type are distinguished by the

predominance of longitudinal dimensions, have relatively longer limbs, poorly developed muscles and a thin layer of subcutaneous fat, narrow bones. Their diaphragm is located lower, so the lungs are longer, and the heart is almost vertical. On the right and left edges, both phrenic nerves, respectively, are adjacent to the Thymus in both fetuses and newborns. In fetuses of 32 weeks from top to bottom, the thymus occupies a space from 3 - 4 tracheal cartilage to the level of 3 ribs. In fetuses of 38 weeks from 4 - 5 tracheal cartilage to 3 - 4 ribs. In newborns, the thymus occupies a space from 4 - 5 tracheal cartilage to 4 - 5 ribs, or to the anterior transverse groove of the heart, or to the right ear of the heart, or to the anterior surface of the right ventricle. The anterior surface of the cervical part of the thymus is adjacent to the posterior surface of the sterno-thyroid and sterno-hyoid muscles. The anterior surface of the chest part at the top is adjacent to the posterior surface of the sternum handle, to the posterior surface of the sternocostal joints and the sternoclavicular joint. The mediastinal pleura covers up to 1/2 of the lower anterior surface of the thymus and its lateral edges. The posterior surface of the upper third of the thymus is often adjacent to the trachea. The lateral edges of the organ go deep under the anterior edges of the lungs. The relevance of the topic lies in the fact that all these studies of the structure of the Thymus in different periods of ontogenesis are of interest to scientists. Thymus in childhood is more often described in infectious diseases, especially of the gastrointestinal tract, with severe confluent pneumonia, with meningoencephalitis, with sepsis, local suppurative processes, malignant tumors, cachexia of various origins. From the above, it follows that the pathogenesis of this gland is complex and is currently not fully disclosed. It is assumed that this is more often a manifestation of the adaptation syndrome in response to stress. Leading importance is attributed to reactive shifts in the hypothalamic-pituitary-adrenal system, an increasing amount of glucocorticoids in the blood, with a decrease in the production of biologically active substances. The process, as a rule, is not unambiguous in all lobules of the Thymus, but more often corresponds to the degree of maturity of the organ at the time of the onset of the stress factor. In particular, scientists regard the fact of an increase in Thymus as a result of a compensatory reaction (i.e., a variant of the norm and a natural phenomenon in response to the influence of stress factors), and in some cases, as borderline states, accompanied by morphofunctional immaturity of organs and systems. Undoubtedly, data on the morphology of the Thymus at the early stages of ontogenesis are of great practical importance due to the fact that this organ is responsible for the regulation of immune functions. Morphological and morphometric studies of the organs of the immune system in health and disease at different stages of ontogenesis is an urgent problem of modern immunology.

Output. The structure of the Thymus, depending on the size and number of lobes, as well as gender, age, is different. There are 3 main forms of Thymus: leaf-shaped, cylindrical, pyramidal (cone-shaped). According to the number of lobes, 3 types of Thymus were identified: monocotyledonous, dicotyledonous, and tripartite. In the newborn period, only one organ is a representative of the immune system Thymus, which is a fully formed organ. Studying the Thymus, we can easily use new directions in the treatment of certain diseases of the immune system, promote optimal conservative treatment, rational planning and performance of surgical interventions, as well as the development of new methods for the prevention and diagnosis of diseases associated with dysfunction of the Thymus.

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