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HYSTOGENESIS OF LYMPH NODES OF SOME REPRESENTATIVES MAMMALS

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Annotation.
The article is devoted to a review of the literature on the histogenesis of the lymph nodes of some mammalian species. It has been shown that the lymph nodes perform a specific function for them and participate in the immune response, but their development in each species of mammals has its own characteristics in terms of time parameters.

Key words: lymph node, stroma, T-dependent and B-dependent zones, lymphoid cells, stromal cells, monocyte-like cells, follicular-dendritic cells, macrophages, plasmacytes.

Relevance. A number of works highlight the structural regularities of the formation of lymph nodes in the prenatal ontogeny of humans and mice [1, 2, 3]. At the same time, most of them, along with the content of valuable information about the formation of structural and functional zones of the lymph nodes in the embryonic period, do not address the issues of the formation of adaptive reactions of the lymph nodes in postnatal ontogenesis [5, 7, 8].

The works available in this regard were carried out mainly in mice and human fetuses, while the structural and functional features of postnatal development in laboratory rats, which are most often used in the experiment, remain insufficiently elucidated [4, 9, 10].

An analysis of literature data shows that the embryonic development of lymph nodes in mammals, along with general principles, also has some specific differences.

A detailed analysis of the relevant literature was carried out by Yu.I. Borodin and M.R. Sapin [19]. New data on this are contradictory, so it is advisable to cite only data obtained in recent years. Some authors in the process of embryonic development of the thymus gland, lymph nodes and spleen of rats distinguish three stages: a dense primordium; loosening of the stroma; colonization of the stroma by lymphoid cells [12]. Maturation and histochemical activation of stromal cells occurs in stage 2 and precedes the process of colonization of organs by lymphoid cells. Stromal cells of the microenvironment of future T-zones are formed earlier than B-dependent regions [13].

Other authors [14], on the basis of a comparative anatomical study, found that with age, differentiation of groups of lymph nodes occurs. The formation of functionally and morphologically isolated sinuses in them should be considered the first stage in the fragmentation of nodes; the second - division into tissues, into shares; the third is the separation of these lobes into independent nodes, and this occurs not only in early embryogenesis, but also at a later date.

A number of authors in the morphogenesis of the lymph nodes of a human fetus at the age of 5-26 weeks distinguish 3 stages. In the 1st stage, at the site of the future node, there is a lymphatic plexus, into which the connective tissue grows. In the 2nd stage, an immature lymph node is formed. Stage 3 - the appearance of "mature" lymph nodes [13, 14, 16].

Thus, the embryonic development of lymph nodes in humans and some mammals is characterized by different temporal parameters of the formation of structural and functional zones, which is associated

with specific features [16, 19].

An important role in the formation of the lymphoid tissue of the lymph nodes belongs to non-lymphoid cells of the microenvironment, which include IDK and FDC. At present, it is quite fully established that FDC is a cellular component of the stroma of B-dependent zones of lymphoid organs, and IDC serve as a cellular microcircle for T-lymphocytes [40].

In the opinion of most authors, the role of dendritic cells is to capture and retain immune complexes on their surfaces with subsequent transfer of antigens to T-B-lymphocytes [14, 16]. They are characterized by the presence on their surface of receptors for the Fc fragment of immunoglobulins and the C3 component of complement, as well as the ability to stick to glass and plastic.

The question of the origin of these cells in the process of ontogenesis still remains debatable. According to some authors, the dendritic cell originates from reticular cells [15, 18]. Others, based on the existence of antigenic similarity between macrophages and dendritic cells, suggest that these cells belong to monocyte-macrophage cell types [4, 39]. When studying lymph nodes in ontogeny, a number of authors [7, 8, 18] did not reveal FDC in primary follicles. Other authors [7, 19] described a predendritic cell occurring before the development of the follicle. Unlike FDCs, predendritic cells have shorter processes. In the germinal center, the predentritic cells differentiate into FDC.

According to other authors, immature IBCs appear as migrating as migrating elements in the inner zone of the cortex. Then they transform into mature IDCs, the processes of which are in contact with lymphocytes through tight junctions, some of these lymphocytes are also PRKs [48]. In newborn rat pups, the presence of T-lymphocytes and IDC was revealed in the popliteal lymph nodes [49]. FDCs appear later, together with follicle formation, at the 2nd week of postnatal development [50]. These cells are characterized by an irregularly shaped nucleus rich in euchromatin and long branching processes lying between lymphocytes. The processes of two neighboring cells are in contact with each other using interdigitations.

For the functional significance of "dentritic" cells, many researchers use the peroxidase-anti-peroxidase (PAP) complex. After intravenous administration of the PAP complex to 3-week-old rat pups, 2 hours after the injection, it appeared in the primary follicles in the form of shade-brown granules [64, 65]. Based on this, the authors believe that dendritic cells are involved in the transport of immune complexes towards the follicle.

The foregoing allows us to conclude that "dendritic" cells appear before lymph follicles form in the lymph nodes, thereby creating the basis for a cellular microenvironment for future T- and B-dependent zones of the organ. The origin of these cells is still not fully understood. In the postnatal period, the number of dendritic cells with the formation of HC in lymphatic follicles increases and they become heterogeneous [65].

At present, a significant number of works devoted to the study of lymph nodes in postnatal ontogenesis have been published.

In rat pups, by the time of birth, the lymph node already contains the primitive cortex and medulla [1, 2, 7]. According to other data, lymphoid formations in the lymph nodes of newborn rats are not detected by light-optical microscopy, but the reticular stroma is well developed [66]. A number of authors, studying the postnatal ontogenesis of mice, obtained similar results, where it is noted that the lymph nodes of newborn mice are not divided into cortical and medulla, their differentiation occurs only on the 7th day of postnatal life [68]. One layer after birth, rounded lymphoid formations are already visible, topographically associated with the afferent lymphatic vessels [69].

The maturation of the lymph nodes is characterized by the formation of lymphatic follicles, followed by the formation of germinal centers in them. In rats, primordial follicles appear in the 2nd week of life. On the 3rd week, secondary (stimulated) follicles first appear [3]. Somewhat different data on the

timing of the appearance of primary and secondary follicles in rats in rabbits were obtained using immunohistochemical methods: the appearance of primary follicles was noted no earlier than on days 18–20, and germinal centers were not found even during 50 days of observation [7] . In mice, primary follicles are formed on the 12th day after birth and, starting from 2 weeks of age, the structure of the lymph node does not differ from those of mature animals [39].

Germinal centers are light zones of lymphatic follicles, consisting mainly of blasts, large and medium-sized B-lymphocytes, most of which do not have surface IgD and are characterized by a high density of peanut agglutinin receptors [63, 65], which is also characteristic of B-cells. memory [7,8]. Along with B-lymphocytes of varying degrees of maturity, single T-cells with surface markers of helpers are found in HC [7, 9, 10]. In addition, among the lymphoblasts, the aforementioned cells of the non-lymphoid series, FDCs, are diffusely located, constituting the stromal microcirculation characteristic only of germinal centers [65]. Antigen retention (AG) by the reticulum is necessary for the development of HC [11].

A number of authors [11, 12, 14], determining the volume of mesenteric, axillary, popliteal, and inguinal lymph nodes in postnatal ontogenesis, found that the most significant changes in volume are observed in the mesenteric lymph nodes, which are larger in newborn mice than other lymph nodes. The increase in the volume of the latter is due to an increase in the number of lymphocytes in the cortex, which is carried out due to the migration of T-lymphocytes and, to a lesser extent, due to the local proliferation of lymphocytes. Small Thy-1 lymphocytes begin to migrate from the thymus to the lymph nodes even before birth. In the postnatal period of development, B-lymphocytes from the bone marrow migrate to the spleen and, to a lesser extent, to the lymph nodes. According to other data [15, 16], an increase in the number of T-lymphocytes, IgG+ cells in the mesenteric lymph nodes compared with similar indicators in the superficial lymph nodes indicates that already in the fetal period, the intestinal contents have a certain effect on the differentiation and proliferation of lymphocytes of the lymph nodes. nodes of the mesenteric group. According to researchers [19], who studied the appearance of B-lymphocytes in mice immunohistochemically during the first 20 days after birth, it was found that the mesenteric lymph nodes in newborn animals are IgM positive cells. After 8 days, a layer of densely packed IgM positive cells was detected in the cortex. The first B-lymphocytes in the lymph nodes are non-dividing migrating cells.

In newborn rat pups in the popliteal lymph nodes, the presence of T-lymphocytes and IDK was revealed [48], while T-helpers make up 10%, T-suppressors 30%. The appearance of B-lymphocytes was noted on the second day after birth, although for other lymphoid organs their presence is typical already at birth [7].

A significant number of works are also devoted to the study of the cellular composition of lymph nodes in postnatal ontogeny [39]. The composition of the mesenteric lymph nodes is highly polymorphic. But in each age group it is more or less homogeneous [49]. So, in all age periods, permanent cellular elements are lymphocytes, reticular cells, macrophages, lymphoblasts. The content of other cellular elements, in particular, granulocytes, in the structural components of the lymph nodes is insignificant and variable. They are more common in the pulp cords, near the sinuses and blood vessels, which indicates the possibility of their entry into the lymph nodes from the blood and lymph [50]. With age, there is a slight decrease in the number of blast cells, the total content of medium and small lymphocytes in all areas of the node changes little, with the exception of lymphatic follicles with HC [64].

Thus, it can be concluded that the postnatal development of the body directly depends on the qualitative and quantitative indicators of neuroimmunoendocrine relationships occurring in the mother's body and the growing organism developing in her womb in the dynamics of pregnancy and lactation [6,

17-25, 30, 33-38, 45 , 51-53, 55-62, 67, 70, 71]. The placenta is the central organ that determines the development of both the body of the newborn, and naturally the formation of its immune, digestive, urinary and other life-supporting systems developing under the direct control of the maternal organism in the prenatal period [2, 4, 5]. And as it was found, the works of most researchers that determine the growth and development of the newborn organism in the period of early postnatal ontogenesis is the mammary gland, the only organ that connects the body of the mother and child [6, 22, 23, 26-32, 36, 41-47, 50, 67, 70]. In addition, it should be noted that the postnatal formation of the structural and functional zones of the lymph nodes is a complex, sequential process and depends on a number of factors. In addition, in different animal species, lymphatic follicles are formed at different times, which depends on the functional orientation of the organ.

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