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Aspects of Anemia Related to Factors of the Lymphatic System

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Abstract: Important role in the body's adaptation to adverse endo - and exogenous factors is played by the immune system (is), the importance of which in maintaining immune homeostasis and, consequently, the necessary level of adaptive potential of the body (APO), it is difficult to overestimate. This function is performed in the interaction of various immunocompetent organs, one of which is the lymph nodes (LU), visceral and peripheral (somatic) A new algorithm for studying the functional immunomorphology of lymph nodes is proposed, based on the determination of five parameters at the tissue level and the calculation of three coefficients. The new approach allows us to objectively and accurately assess the structural and functional state of organs both in normal and pathological conditions, which reflects the immune status and the overall level of adaptive potential of the body.

Keywords: lymph nodes, functional immuno-morphology, morphometry, new research algorithm.

At present, she has clarified in detail many features of anatomy and physiology in all structures of the lymphatic system, which now enables clinicians to actively search for ways to correct circulatory disorders and lymph outflow. In modern lymphology, there are many controversial issues regarding the structure of endotheliocytes, basement membrane, lymphatic capillaries and postcapillaries, organization, valves of lymphatic vessels and lymphangions. Until now, there is no clear explanation of the reasons for the different number of lymph nodes in different regions and near organs. Thus, the statement that lymph nodes are characterized by the fact that 5-7 lymphatic vessels enter the lymph node, and only one lymph vessel leaves the lymph node [7] is unfounded. Numerous studies by well-known lymphologists confirm that the number of afferent and efferent lymphatic vessels in the lymph nodes varies from 2 to 8.

Lymph nodes are the most numerous organs of immunogenesis [1]. Their number in an adult is about 460, and the total mass is approximately 1% of body weight (500–1000 g) [6]. This is three to five times the mass of the largest solitary organ of the IS, the spleen.

Lymph nodes perform two main functions — immune and drainage-detoxification [3], which makes it possible to attribute these organs to both the IS and the lymphatic system [11]. The drainage function is performed mainly by the medulla of the LU, the immune one belongs to the cortex, where three separate structural and functional units are distinguished: 1) lymphoid follicles (LF), 2) interfollicular zone, or cortical plateau (CP) and 3) inner cortex, or paracortical zone, paracortex (PC) [2].

The cellular composition of LF is dominated by B-lymphocytes, which, upon antigenic stimulation, undergo blast transformation and subsequent differentiation into plasma cells, forming light (germinal) centers (GC) of LF [8]. In this case, the primary LF turns into a secondary one, which documents the presence of a humoral-type immune response [7].

On the contrary, the population of T-lymphocytes is localized in PC and PC [2,7,9], the expansion of which indicates an increase in the immune response of the cell type [4; one]. A mixed type of immune response is observed with a reactive change in all immunocompetent structures of the LN

[4]. Therefore, the morphological development of these components of the LN parenchyma reflects the level of functional immune activity of these IS organs [14].

The statement [1] that the human connective tissue, all bones, muscles, ligaments, fascia and aponeuroses do not have their own lymphatic drainage, does not correspond to the results of our studies and contradicts the data of other authors [5; 6]. Also controversial is the idea that all lymphatic vessels, with the exception of the thoracic duct, have almost the same diameter [1]. Due to this, it is impossible to determine which generation a particular lymphatic vessel belongs to.

Literature data and our long-term observations refute this information. Thus, the diameter of the lymphatic vessels is extremely variable: in the ventricle it is 67-113 microns, in the small intestine - 27-945, in the liver - 67-1700, in the heart - 67-1080, in the lung - 40-1600, in the ovary - 40 -160, in the periosteum of the ribs - 120-150, in the articular capsule - 40-160, in the peritoneum - 60-180, in the fascia - 25-115, in the aponeurosis - 45-175 microns. [8, 15]

Although lymphology is 400 years old, however, there are still debatable questions on the anatomy of the lymphatic system. TO

For example, in [10] it is noted that lymphatic capillaries begin blindly in the interstitial spaces of all organs and tissues. The exception is the brain and spinal cord, where the function of the lymphatic system is performed to a certain extent by the cerebrospinal fluid system. However, according to our data [5], there are 28 such organs, not 2.

So far, there are no reliable data on the timing of completion of the adaptation of lymphatic capillaries to the action of adverse factors, on the characteristics of their reaction at various tissue and cellular levels, the degree of reversibility of these changes, etc. The solution of controversial issues in the study of the lymphatic system gives excellent results in clinical lymphology. Even now, fundamental studies of the patterns of the structure of the lymphatic system contribute to the successful development of the endolymphotropic direction in the treatment of many diseases. [4;11]

By qualification [12], "blind" lymphatic capillaries are divided into 3 groups: 1st group - capillaries have even contours and mouths are narrowed, clavate and finger-shaped; 2nd group - capillaries are found in the serous integuments with blind processes directed towards the mesothelium (they participate in the resorption of intraperitoneal fluid), the mouths of such capillaries are wide; 3rd group - capillaries have a predominantly spherical shape, they have a narrow mouth. Often found in pathology, edema, hypoxia in the elderly.

In modern conditions, when new technical means are widely used (ultrasound, computed tomography, endoscopy, laparoscopy, radionuclide diagnostics, etc.), accurate data are needed on the individual parameters of the size of the lymph nodes, their shape, syntopy with arteries, veins, nerves, ducts of glands, lymphatic collectors, trunks and ducts.

In recent years, some authors [13;14] have raised the issue of a lymphatic postcapillary [15], identified a “lymphatic postcapillary” in the initial section of a lymphatic vessel, which has a valve, unlike lymphatic capillaries. The valve in the lymphatic postcapillary is formed by a fold consisting of endotheliocytes without connective tissue [14]. It is argued that the presence of connective tissue is a prerequisite for the valve, and the protrusion of endothelial cells into the lumen of the lymphatic capillary is not a prerequisite for isolating a new structural formation in the form of a “lymphatic postcapillary” on this basis.

We do not share the opinion found in the literature that lymphatic postcapillaries have elements of smooth muscles [2], and we did not find myocytes in the thickness of the walls of postcapillaries. According to our data, smooth myocytes are found starting from the lymphatic vessels [8-11].

We cannot agree with the statement [16] that: Lymph is a liquid that is contained in the blood and provides oxygen and nutrients to the cells. Having received toxins in return, the lymph is removed from the tissues into the veins and lymphatic vessels. However, the lymphatic vessels are extremely fragile:

they are subject to internal ruptures, and can also be easily damaged as a result of external influence,

which leads to disruption of the flow of lymphatic fluid. The lymphatic fluid is rich in protein and quite thick.

It is generally accepted now that lymph is a liquid located in the lumen of the lymphatic channel. Lymph (from Latin - pure, transparent spring water, moisture) is a biological fluid of complex composition and function, located in the lumen of lymphatic capillaries, lacunae, networks, post-capillaries, vessels, collectors, nodes, trunks and ducts. Do not identify tissue, intercellular and other types of fluids (cerebrospinal, cavitary, synovial, etc.) with lymph. Thus, according to [11], "In a closed circulatory system, blood is not a liquid medium surrounding cells. This role is performed by the tissue (intercellular) fluid - lymph. Small vessels (lymphatic capillaries) with walls of a single-layer epithelium open directly into the intercellular space and lymphatic vessels, from here it is divided into tissue lymph and vascular. [13] Notes that "... lymphatic fluid circulates in the intercellular gaps, which brings nutrient material for the cells of the Malpighian layer and carries away the products of cell metabolism from the epidermis." In such cases, it is advisable to consult qualified lymphologists.

For a clear idea of what lymph is and how it is formed, knowledge of the theories of lymph formation is necessary [12]. At the same time, it should be taken into account that the presence of many such theories indicates the complexity and laboriousness of studying this issue and the need for a comprehensive analysis of different theories, which, in fact, are complementary and enriching each other.

Starting from 2015, mythology has revealed that there are lymphatic capillaries and vessels in the human dura mater and brain. Until that time, it was written everywhere that in the brain and spinal cord and in their membranes there are no elements of the lymphatic channel.

A group of scientists from Finland and the USA asserts the existence of lymphatic capillaries and vessels in the dura mater (DM) of mice, humans and monkeys.

Daniel Reich (Md.) used MRI to visualize the lymphatic vessels (LV) in the dura mater. The author used staining and showed the presence of lymphatic vessels in the DM. CSF from the brain goes to the cervical lymph nodes (here is a link to these discoveries: ne.Zimpho, 2018, No. 2, p. 9).

A sensation in 2015 was the publication in the journal Nature of a study by Jonathan Kipnis and co-authors on the structural and functional characteristics of the lymphatic vessels of the central nervous system.

These structures have all the molecular features of lymphatic endothelial cells, are capable of carrying immune cells from the cerebrospinal fluid, and are connected to the deep cervical lymph nodes. The unique arrangement of these vessels may have prevented their discovery to date, thus contributing to the long held concept of the lack of a lymphatic vasculature in the central nervous system.

Conclusion. Currently, there are controversial and variable issues in the field of lymphology. The question is not clear why lymphatic capillaries do not exist in all organs. There are big discrepancies about the structure of the lymphatic capillaries (closedness, openness, lymphatics, prelymphatics, etc.). It is not established how many regional lymph nodes are needed for each organ, etc.

Thus, the proposed new morphometric approach to the study of LN functional immunomorphology allows an objective and accurate assessment of the structural and functional state of the organ both in normal and pathological conditions, which reflects the immune status and the overall level of APO.

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