INFLUENCE OF VARIOUS FACTORS ON THE LYMPHOID STRUCTURES OF THE SPLEEN

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ABSTRACT

Starting from puberty, immunological changes in the spleen acquire an involutional character, which affects the palm, lymph nodes and border areas and is manifested by hypoplasia and white pulp delineation. The relative area of the B-zones of the white pulp of the spleen increases, as evidenced by the activation of T - and B-lymphocyte migration. This ensures the stability of the immune state during the initial aging of the body.The periarterial lymphoid junctions expand and stretch significantly with age. By 4-6 months, the total number of lymphoid nodules decreases, which often persist in the subcapsular region. At the age of 6-7 months, the number and size of red pulp sinusoids increases. During puberty, the relative number of lymphoid structures in the spleen begins to decrease.

Relevance of the study: in rats during breastfeeding, there is a gradual increase in the morphofunctional development of the spleen, organometric and morphometric parameters of the white pulp of the organ. By the end of the lactation period (21 days after birth), areas of mature secondary lymph nodes and periarterial lymphatic membranes are formed, which is a symptom of the fact that the body's immune system has reached functional maturity [Katshenko S. A. and Hammual. 2013].

In adolescence, the size of the lymph nodes decreases slightly, while the size of the reproductive centers, on the contrary, increases slightly. Only 10% of lymphoid nodes are found to have reproductive centers. The periarterial lymphoid junctions expand and stretch significantly with age. By 4-6 months, the total number of lymphoid nodules decreases, which often persist in the subcapsular region. At the age of 6-7 months, the number and size of red pulp sinusoids increases. During puberty, the relative number of lymphoid structures in the spleen begins to decrease. [Milichevich N. M. et al., 2011; Arnon T. I.. et al., 2013].

Starting from puberty, immunological changes in the spleen acquire an involutional character, which affects the palm, lymph nodes and border areas and is manifested by hypoplasia and white pulp delineation. The relative area of the V-zones of the white pulp of the spleen increases, as evidenced by the activation of T - and V-lymphocyte migration. This ensures the stability of the immune state during the initial aging of the body [Ryabkina A. I.

and Khammual. 2008; Moroz G. A., Ozerova N. Yu., 2010]. The specific weight of white spleen pulp in newborns is on average 1/7 of the organ size. In infancy, it will be possible to distinguish between periarterial lymphoid junctions and lymph nodes in the white pulp. Lymphoid nodules are unevenly distributed in different parts of the organ. They are more abundant in the peripheral part of the spleen and in small numbers in the central part, where periarterial lymphatic branches are abundant. The lymph nodes of the spleen of newborns do not have reproductive centers. They are formed by the end of the 1st year of life. Then the number of lymph nodes increases and reaches its maximum at the age of 10 years. [Moldavskaya A. A., Dolin A.V., 2009].In the area of the spleen incision, from birth to 4 years of age, there is an increase in the contribution of lymph nodes, a decrease in the amount of red pulp and connective tissue. By the age of 8-10, the proportion of lymphoid tissue decreases. Signs of aging of the limbs are detected from the age of 18. At this age, there is an increase in the volume of connective tissue, destruction of elastic and reticular fibers, fibroblasts, smooth muscle cells, a decrease in the number of fibrocytes, and collagenization of the connective tissue stroma [Alfonsova E. V., 2012].The lymph nodes of the spleen are considered a V-shaped area of white pulp, consisting of a capsule consisting of reticular cells and the sum of T and V lymphocytes, plasmocytes, macrophages. The central artery passes through the lymph node. In the lymph nodes of the spleen, there are 4 indistinguishable areas: the periarterial (pas), reproductive center (km), mantle (MNS) and border (ches) areas. Periarterial lymph nodes (palms) are formed from an elongated-looking accumulation of lymphoid tissue along the pulp artery. The palm is the T-shaped area of the spleen. The mantle sphere surrounds the periarterial sphere and the breeding center and consists of densely packed small V-lymphocytes and a small number of T-lymphocytes, as well as plasmocytes and macrophages. The cells of the mantle region are densely packed and stratified with thick reticular fibers directed in a circle [Schneider D. A. et al., 2011].

In the lt proliferation centers of the spleen, B-lymphocytes are located, which mainly proliferate in response to antigen stimulation and differentiate into a plasma cell. [Zaitsev V. B. and hammual. 2011; Afanasyev Yu. I. And et.al 2012; Klimenkova I. V., 2012; Bashina S. I., 2013; Mannapova R. T., Rapiev R. A., 2013; Petrovova E. et al., 2011]

During an immune response, antigens in the blood are captured in the border region and red pulp of the spleen. Then they are transferred by macrophages to the surface of intertwining white pulp cells. Lymphocytes in the bloodstream accumulate mainly in the periarterial lymphatic couplings (T-lymphocytes) and lymph nodes (B-lymphocytes). In the primary immune response, antibody-producing cells first appear in ellipsoid couplings, and then in red pulp. During the secondary immune response, proliferation centers are formed in the lymph nodes, in which clones of V-lymphocytes and memory cells are formed. The separation of V-lymphocytes into plasma cells is completed in the red pulp [Moebius R., Krall G., 2005; Yamate J., 2009; Zhao Yu. et al., 2010; Wang J. et al., 2010].

Purpose of the study: analysis of changes in the lymph nodes of spleen under the influence of various factors.

Materials and methods: the spleen and its parts were fixed in 10% neutralized formalin and after 2-4 hours of washing in running water, dehydration in alcohols and high-concentration chloroform, paraffin blocks were prepared in accordance with generally accepted methods. Paraffin blocks were cut with a thickness of 5-8 microns and stained with hematoxylin–eosin and Van Gieson methods. The structural structures of the spleen preparation were examined morphometrically using an ocular micrometer. The diameter of the periarterial lymph nodes of the spleen, lymph nodes and their multiplication centers, the width of the mantle, border and periarterial regions of the lymph nodes, the relative area of the white pulp and connective tissue elements (relative to the total cross-sectional area) were measured. The measurements were performed in five fields of view of each histological section. The field of view was randomly selected.

To study the cytoarchitectonics of the lymphoid structures of the spleen, the number of cells was counted using a new NLCD-307 microscope (China) with a magnification of 10x100 when immersed in oil. The number of cells was counted using a morphometric attachment mounted on the microscope eyepiece. In lymph nodes that do not have a multiplication center, the total number of lymphocytes in the periarterial lymphatic coupling was determined per unit cross-sectional area.

Results: as a result of the influence of external factors, there is a decrease in the cell density in the lymphoid structures of the white spleen pulp and its comparative size in relation to the red pulp, in which the cell composition changes slightly [Chava, S. V., 2011; Evlakhova, Los Angeles, 2013]. In many literature sources, immune organs (thymus, spleen, lymph nodes, Peyer's disease), rabies vaccine are found in laboratory animals [Kuzin A.V. and Hammoal. 2004], the drug "Immunovak VP-4" [Lebedinskaya O. V. and hammual. 2011], immunomodulators [Razumov A. N. and Hammual. 2010] during the use and long-term consumption of silicon with drinking water [Gordova V. S. and Khammual. 2013], morphological and functional changes are described in detail.

Under the influence of a carcinogen, there is an outbreak of several processes in the body, immune organs, leading to certain changes [Mikhailova M. N. and Hammoal. 2011]. The spleen plays an important role in the formation of immune defense against tumors. Introduction of 1,2-dimethylhydrazine into the body leads to significant morphological and immunohistochemical changes in the white pulp of the spleen. The number of small-diameter lymph nodes increases compared to other nodes of different diameters. The diameter of the lymph nodes and their reproductive centers decreases. 4 months after the end of carcinogenic exposure, more pronounced hypoplasia of lymphoid nodules is recorded compared to the previous period. Lymph nodes are characterized by a significant decrease in the diameter of the breeding centers and the width of the border area. The palm decreases in diameter, the number of V - and T - lymphocytes decreases [Merkulova L. M. and Khammual. 2016].

In hypostatic pneumonia with chronic heart failure, there is a decrease in the relative volume of the white pulp of the spleen and an increase in the red pulp. The density of cell arrangement also decreases, but the cell composition changes slightly [Klimenko N. A. and Hammual. 2009].

In chronic immune inflammation, proliferative processes occur in the white pulp of the spleen. The volume of white pulp increases, the density of cellular elements in the lymph nodes and the periarterial lymphatic mucosa increases. Increased apoptosis and macrophage response in the lymphoid structures of the spleen [Klimenko N. A. and Hammual. 2009].

When a person stimulates the body with standard immunoglobulin once, for a month, in the white pulp of the spleen of white male rats during puberty, a change in the cell density of lymphocytes, plasmocytes, and macrophages occurs. These indicators are significantly increased on the 7th day after exposure to the antigen. Lymph nodes the density of small lymphocytes in the border area reaches a maximum on the 30th day after antigen administration [Gerbut A. O., 2007; Mark F. Cesta., 2006]. On the 2nd day after antigenic stimulation, the number of fat cells first increases sharply, then gradually decreases, and by the 30th it is equal to the standard indicators [Golovasky A. S. and Khammual. 2008; Kasay V. V., Shepitko V. I., 2008].

Katshenko S. A. and Hammoal. (2011) suggested that exposure to cyclosphane at a dose of 200 mg/kg would result in a 37.1% reduction in spleen weight on day 7 of the experiment. Already on the first day of action of this drug, the V-immune response is weakened, which is manifested by an increase in the number of plasmocytes and a decrease in stratification [Shtepa S. Yu., 2008]. The above-mentioned changes in organ-specific parameters of the spleen are also observed under the influence of hydrocortisone [Stasenko E. A., 2008].

When an immunomodulator of bacterial origin PIV (multicomponent Immunovac vaccine) is introduced into the body, an increase and comparison of lymph nodes with large reproduction centers in the spleen is observed. It was found that under the influence of the immunomodulator SPKV (vaccine against staphyloprotein bacillus of blue pus), red pulp hyperemia and its proportion predominate over white pulp. The immunomodulator SV (staphylococcal vaccine), on the other hand, leads to an increase in lymph nodes and lymphatization of the red pulp [Lebedinskaya E. A. and Hammual. 2011].

When an animal is exposed to bisphosphonate "Zometa", an increase in all indicators of spleen structure and hyperfunction is observed. Clearly marked changes occur in the mantle region of the lymph nodes, which indicates the formation of antibodies, activation of humoral immunity. Changes are noticeable on the 7th day of the experiment, reaching a maximum on the 90th day. After the 60th day of recalibration, the values of morphometric parameters approached the control values [Stasenko E. A., 2009].

When gold nanoparticles were administered to rats at a concentration of 57 micrograms / ml, an increase in the number of small and medium-sized lymphocytes in the periarterial and border areas of the lymph nodes of the spleen was recorded on day 15. An increase in the number of immunoblasts and mitotic cells was found in the breeding centers. By day 30, the quantitative indicators remained unchanged with a downward trend. Morphological remodeling of the white pulp of the spleen indicates the activation of the processes of migration, reproduction and stratification of immunocomponent cells [Zlobina O. V. and Hammual. 2018].

Similar processes that indicate the development of an immunological reaction in the body also occur under the influence of toxic doses of sodium selenite, lead cations, and copper [Steika V. A. and Hammoal. 2003; Sizova E. A. and Hammual. 2010; Radtseva G. L., Radtseva Yu. A., 2011].

The introduction of cadmium cations into the body does not cause a general immunological reaction, but it has a direct toxic effect on the spleen tissues [Steika V. A. and Hammual. 2003].

The effect of various stresses on the rat spleen has been studied quite extensively. In stressed and prognostically resistant rats, after one hour of stress exposure, after 1 hour, on days 3 and 14, a significant decrease in the number of small lymphocytes in the palm, border area, spleen and breeding centers was observed, an increase in the number of destroyed cells and macrophages, compared with in the control group, per unit area, a decrease in cell density was noted. In rats exposed to stress, these signs were clearly manifested [Kapitonova M. Yu. and Hammual. 2011; Dominguez-Zerpe L., Reymendez M., 2001].

Chronic exposure to a strong stressor leads to the development of immunosuppressive changes in the lymphoid tissue of the spleen, which persist in the white pulp of the organ in a much longer term. Quantitative analysis of white spleen pulp showed that damage to the T-cell-dependent part of the immune system persists for at least 3 weeks after the end of stress exposure, while damage to the V-cell-dependent part occurs at an imperceptible level. This is evidenced by the divergence of the immune cell population in post-stress early postnatal ontogenesis [Schaefer E. G., 2011]

The stress effects of systemic gravity overload have a significant impact on the morphofunctional state of rat spleen lymphocytes, changing their adhesive and migration properties, significantly reducing them after 30-fold exposure to hypergravity; this occurs primarily in areas dependent on T-lymphocytes. The number of undifferentiated mitotic cells and macrophages decreases [Morose G. A., 2011].

When large-sized (9g) gravity loads are systematically applied to the spleen of adult rats, structural and functional regeneration of lymphoid tissue occurs, the nature and level of which depends on the frequency of repeated loads. After 10 days of exposure, due to a decrease in the size of lymphoid structures, an increase in the number of mature forms of lymphocytes, an increase in the proportion of cells with a denser distribution of cells, degenerative changes are observed. On the 45th day of exposure, a decrease in morphofunctional signs of lymphoid tissue was detected against the background of hypoxia in the rat spleen. In all areas of the white pulp, an increase in the number of destructive cells is noted [Morose G. A., 2011].

When calcium chloride is consumed with drinking water for 60 days, hyperplastic changes occur in the white pulp of the rat spleen. There is a predominance of the number of primary lymph nodes over secondary ones. Under the influence of calcium, the number of structural formations that are the reproduction center of the white pulp of the spleen decreases by 9%, most of them are lymph nodes (30.6%) with an undeveloped reproduction center. The enrichment of drinking water with calcium leads to a change in the ratio of functional zones of the spleen. There is a significant increase in the area of white pulp and a decrease in the area of red pulp [Melnikova O. V., 2016].

The combined effect of high doses of potassium bicromate and sodium tetraborate reduces the relative weight and mass ratio of the spleen. Increases the red / white pulp index. White pulp reduces the area of the functional zones of the lymph nodes [Umbetov T. J. and Hammual. 2016].

Administration of azathioprine to mice has an immunosuppressive effect on the structure of the spleen, which is manifested by a decrease in the level of proliferative activity and a decrease in the mass of lymphoid structures [Tsirenova D. Z. and Hammual. 2017].

The impact of various factors on the body is manifested by hypo - or hyperfunctions of the spleen. The damaging effect of these factors is manifested by a decrease in the proliferation and stratification of immunocompetent cells, an increase in apoptosis and macrophage activity. Under the influence of chemical or biological factors in the first days of the experiment, there is an increase in cell proliferation and stratification, hyperemia of organs, an increase in the number of LT with reproduction centers or their addition to each other [Makalish T. P., 2013]

When the body is exposed to traumatic factors, morphofunctional changes observed in the white pulp of the spleen can determine the nature and intensity of the immune response of the spleen to this effect. Morphometric verification methods that meet modern requirements of evidence-based medicine and allow us to confirm the results, conclusions, and objectively assess changes in the structural and functional state of white pulp, since the final values of the studied parameters facilitate quantitative and statistical analysis [Volkov V. P., 2015].

It should also be noted that, although there are many modern studies of the morphology of the lymphoid structures of the spleen, including in experimental animals, the issues of microanatomy and microtopography of these components of immune structures, cell composition, are practically not considered. [Kolenko, P. et al., 2010; Breslow, J.M. et al., 2011; Van G. N. et al., 2011]

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