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MODERN CONCEPTS OF THE STRUCTURE AND FUNCTION OF PEYER'S PATCHES (literature review)

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✓ ***Resume***

The article is devoted to a review of native and foreign literature on the structure and functioning of Peyer's patches. Also, a comparative analysis of information on macroscopic and microscopic, morphological and morphometric parameters of these patches in rats in postnatal ontogenesis was carried out.

Key words: immune system, small intestine, Peyer's patches

СОВРЕМЕННЫЕ ПРЕДСТАВЛЕНИЯ О СТРУКТУРЕ И ФУНКЦИИ ПЕЙЕРОВЫХ БЛЯШЕК (обзор литературы)

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✓ ***Резюме***

Статья посвящена обзору отечественной и зарубежной литературы по строению и функционированию Пейеровых бляшек. Также, проведен сравнительный анализ информации о макро и микроскопических, морфологических и морфометрических показателей этих бляшек у крыс в постнатальном онтогенезе.

Ключевые слова: иммунная система, тонкая кишка, Пейеровые бляшки

ПЕЙЕР ПИЛАКЧАЛАРИНИНГ ТУЗИЛИШИ ВА ВАЗИФАЛАРИ ТЎҒРИСИДА ЗАМОНАВИЙ ҚАРАШЛАР (адабиётлар шарҳи)

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✓ ***Резюме***

Мақола пейер пилакчаларининг тузилиши ва вазифалари ҳақидаги маҳаллий ва чет эл адабиётларининг шарҳига бағишланган. Шунингдек, постнатал онтогенезда каламушларда бу пилакчаларнинг макро ва микроскопик, морфологик ва морфометрик кўраткичлари тўғрисидаги маълумотларнинг қиёсий таҳлили ўтказилган.

Калит сўзлар: иммун тизим, ингичка ичак, Пейер пилакчалари

Relevance

The immune system is of key importance in the mammalian body and is one of the most sensitive systems that reacts with lightning speed to contact with various exogenous and endogenous factors at the earliest stages of their impact. It is she who helps to go through "natural selection" defending against new infectious diseases that cause epidemics and pandemics, and affects the future of mankind. Defending against these threats depends on how the body can maximize the potential of its complex immune system.

The constant impact of pathogenic substances on the body leads to a violation of the immune status and the emergence of many diseases, and since any, even a short, infectious disease is a manifestation of a temporary failure of protection, the problems of immunity disturbance concern all inhabitants of the planet [3,17].

The fundamental property of immunity is that no part of our body is cut off from its observation. For this reason, although the immune system may seem less essential than an organ such as the heart or liver, collectively, the immune system consumes enormous resources, producing a large number of cells on which its successful functioning depends [33].

For example, in the skin there are Langerhans cells, in the liver there are Kupffer cells, adenoids of the nasopharynx, etc. One of such

improvisations of the immune system is the lymphoid tissue associated with the mucous membrane or the immune system of the mucous membranes (ISSS). It develops due to the action of microorganisms and antigens, after their absorption into the blood, regulated by the gastrointestinal barrier, in postnatal ontogenesis [9, 30]. As part of the ISSO, a distinction is made between lymphoid tissue organized in a certain way and lymphocytes located freely or forming clusters of several cells.

The aim of the study is to analyze literature data on the structure and function of Peyer's patches.

Material and methods

We used information sources devoted to the development of ISS in postnatal ontogenesis and materials related to the structure and functioning of Peyer's patches.

Discussions

Aggregated lymphoid follicles were first described by Marco Aurelio Severino in 1645 in Italy. They were named Peyer's plaques after they were described in detail by the Swiss pathologist Johann Konrad Peyer in 1677 [29].

It is now more than obvious that Peyer's patches are organized lymphoid structures that are of particular importance for the initiation of intestinal immune responses. Their precursors are found in the fetus at the 16th week of antenatal development, differentiation into separate T and B cells occurs before the 19th week of antenatal development. They are well developed already at the 5th month of intrauterine life and continue to develop after the birth of the child [22,32].

According to [19], lymphoid plaques of the small intestine of rats, which are universal experimental animals, are laid on the 19th day of prenatal development, and in newborn rat pups they have the appearance of a small rounded or oval spot visible from the serous membrane of the intestine. There are 4 stages of development of lymphoid plaques: 1-6 days - stage I; 7-14 days - stage II; 15-21 days - stage III; 22-30 days - IV stage.

The first plaque is found, as a rule, in the distal duodenum, the last - in the ileocecal angle from the ileum [15].

After isolating the visible lymphoid nodules and determining their mass, [1] found that in sexually mature animals it ranges from 3 to 52 μg (on average 29.6 ± 1.5 μg). The total mass of tissue aggregated into lymphoid nodules averages 704.5 ± 15 μg. The sizes of the nodules are (6.1 ± 1.8x6.5 ± 1) cmx10-1.

Macroscopic examination of stained preparations revealed that lymphoid formations in the intestines of rats and rabbits have a rounded or irregular shape, are colored in a light purple color, the size in rats is 0.1-0.3 cm, in rabbits 0.1-0.8 cm , are located from each other at a distance of 0.1 to 1.5 cm [4].

As the results obtained by different scientists show, the length and width of the small intestine LB change depending on similar factors that affect their number (age, breed and sex of animals) [16, 21, 25].

So, for example, the length and width of the PB of sexually mature white outbred rats according to T.S. Guseinov and S.T. Guseinova (2012) is - 5.20 + 0.4043.70 + 0.24 mm, according to S.A. Kashchenko and E.N. Tkacheva (2009) 4.70 + 0.1042.30 + 0.10 - 5.70 + 0.1042.50 + 0.10 mm [9, 11].

At the age of 3-4 months in rats, the number of PB was 16.70 ± 0.73, linear dimensions (length, width of plaques, distance between them, distance from the ileocecal angle to the first PB) were within 4.75 ± 0.23 mm , 2.83 ± 0.14 mm, 39.20 ± 1.96 mm, 29.90 ± 1.49 mm, respectively [15].

According to [12], the length of the lymphoid plaque is 1200 μm on average, the width is 640–560 μm; in its composition on the longitudinal section contains 7-10 single lymphoid nodules (50-55% of which with the center of reproduction) 85 μm long, 70-75 μm wide.

As shown by the results of a study by a number of scientists, even within the same breed of rats, the number of plaques varies widely. So, for example, in sexually mature white outbred rats according to S.A. Kashchenko and E.N. Tkacheva (2009), their number is 18.00 ± 0.02 - 19.20 ± 0.90 [11].

On a native specimen of the rat small intestine, Peyer's plaques were clusters of 5 to 15 lymph nodules on average [15].

In each nodule, the number of follicles is 13.5 ± 2.0. The nodules protrude dome-shapedly into the intestinal lumen and are surrounded by crypts and villi along the periphery.

The epithelium lining the dome continues at the base into the crypt. In this part, mitoses and single goblet cells containing a PIC-positive secretory product are determined in the epithelium [1]. For the most part, the epithelial lining does not contain goblet cells, but has specific M cells that are in close contact with lymphocytes and macrophages. They can capture lymphocytes and monocytes, which are capable of absorbing antigens, even being inside M cells [20,28,31].

In F1 mice (CBA × 57BL6), group lymphoid nodules in the amount of 4–7 are normally located throughout the small intestine, mainly (70–75%) in the terminal part of the ileum; are located, respectively, its antimesenteric edge, in the proper lamina of the mucous membrane and submucosa [12].

Many researchers [7, 8] count 19.3 ± 0.80 lymphoid nodules in one PB. The density of nodules per 1 cm2 is 3.35 ± 0.27. And the distance between single lymphoid nodules ranges from 2-3 to 5 cm.

Makarova M.N., et al. (2016), and Hryn V.H., et al. (2018) calculated that each large Peyer's patch consists of 18-20 individual lymphoid nodules. Naturally, along with them, along the entire length of the small intestine (with the exception of the duodenum) there are Peyer's patches of medium and small size, consisting of a proportionally smaller number of the same type of solitary lymphoid nodules.

There is also disagreement about the number of single lymphoid nodules in white rats in one PB and all plaques in the small intestine. The number of lymphoid plaques in the small intestine in white rats varies from 11 to 35 (18.6 ± 2.4). In rat pups, on the 5-10th day, single lymphoid nodules are not found in the small intestine, in the period 15-21 days, their number is 6-24 per 1 cm2, PB during this period have sizes from 0.6 * 0.6 mm to 2.0 * 2.5 mm, the density of single nodules in one plaque varies from 5 to 18 per 1 cm2 [9].

It was found that the density of single intestinal lymphoid nodules per 1 cm2 depends on their localization and on the age of the rat pups. So, for the first time they appear from the 15th day in the final section of the colon, on the 19th day in its caudal part on the antimesenteric side, and from the 21st day - throughout the intestine. The number of single nodules in a plaque varies from 15 to 17 [24].

Tissue samples for studying the internal relief of the mucous membrane of the small intestine in the area of localization of Peyer's patches were excised parts of its most distal sections, containing the largest forms of these lymphoid formations.

It should be noted that the circumference of the relief of the mucous membrane in the area of PB localization does not fundamentally differ from the relief of the small intestine, where they are absent. And the Peyer's patch itself, its inner surface fully justifies its understanding as a group association of individual lymphoid nodules, which have the form of rounded depressions, which once again emphasizes the above information [6].

Information on the cellular composition of Peyer's patches differs from one author to another.

For example, according to [2], B-lymphocytes in Peyer's patches account for 55%. The main part of lymphocytes is formed in the centers of proliferation of lymphoid nodules in Peyer's patches, where the percentage of mitotically dividing cells is 2.1%, and the sum of poorly differentiated cells is 15.69%.

The absolute number of lymphoid cells in the lymphoid tissue of the plaque (over an area of 880 μm2) varies from 25 cells (center of proliferation of the nodule) to 30 cells (diffuse lymphoid tissue) and 35 cells (mantle of the lymphoid nodule) [12].

The microtopographic features of Peyer's patches are that the internodal diffuse lymphoid tissue corresponds in the area of its location to the intestinal glands and villi. Because, in embryogenesis in white rats, small intestine PB undergoes such changes as the appearance of anlages, tissue belonging, the severity of individual structures, lymphoid transformation and the appearance of functional zones [9]. And at puberty, diffuse internodal lymphoid tissue of plaques is considered predominantly the T-zone, lymphoid nodules, and especially their mantle (dome) as the B-zone [12].

In addition, [23] conducted a comparative study of the barrier properties of the follicle-associated epithelium of Peyer's patches and the villous epithelium of the rat small intestine. The permeability of the epithelium of Peyer's patches, studied in the Ussing chamber, is significantly less than the permeability of the villous epithelium. In the tight junctions of the epithelium of Peyer's patches, the level of claudins, which limit paracellular transport, is increased, and the level of claudins, which increase the permeability of the epithelium, is decreased. It is assumed that the limitation of paracellular transport is a condition for the presentation of pathogens through specialized epithelial cells of Peyer's patches.

As for the angioarchitectonics of Peyer's patches, it is necessary to distinguish the general bloodstream of the small intestine, where there are superficially located highways that distribute blood over the entire area of the intestinal tube, and intramural networks, represented mainly by microvascular communications of the muscular and mucous membranes [13, 18, 26, 29 , 34]. Several nutritional arteries are involved in

providing trophism of an individual Peyer's plaque of the small intestine;

Conclusion

Thus, after analyzing the domestic and foreign literature available to us, we came to the conclusion that information on the macroscopic and microscopic parameters of Peyer's patches differ from different sources, although there is a general tendency for these indicators to change. Therefore, it is planned to conduct further studies to study and assess the morphological parameters of Peyer's patches in postnatal ontogenesis.

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