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General Morphological Aspects Lymphoid Tissue of the Small Intestine

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SUMMARY

The article summarizes the basic provisions on the emerging ideas about the so-called immune system of the mucous membranes and, in particular, the intestine. Previously, the idea of cellular and humoral immunity was formed, then about the system of mononuclear phagocytes and, obviously, it is quite acceptable to isolate the immunity of the intestinal mucosa.

Relevance. The gastrointestinal tract is a highly specialized organ that is involved in the absorption, processing and assimilation of nutrients. In addition, it performs other equally important functions. The intestine is an important organ of the immune system: it is constantly in contact with a large number of substances and agents of the environment, as well as factors that affect the vital activity of the whole organism. The article presents the characteristics of the components of the immune system of the digestive tract and their role in the formation of the body's immune response to antigenic effects.

Exposure to environmental antigens is a key factor in the development of protective reactions against various pathogenic microorganisms and many organic and inorganic substances, including carcinogens [7]. The intestine is the main area where immunocyte sensitization occurs, which then colonize other mucous membranes and serve as the starting point for cell circulation between various organs. The immunocompetent tissues of the digestive tract are called lymphoid tissue. This tissue plays an important role in protecting the body from antigens. It should be noted that mucus secretion and intestinal peristalsis are also defense mechanisms.

Lymphoid tissue in the wall of the digestive tract exists in four anatomical zones:

1) lymphocytes located basally between the epithelial cells of the mucous membrane - intraepithelial lymphocytes;
2) lymphocytes located in the connective tissue of their own layer of the mucous membrane - lymphocytes of their own layer;

3) specific accumulations of lymphoid cells in the mucous membrane of the small intestine, in particular in the jejunum - Peyer's patches;

4) solitary lymphoid follicles of the mucous membrane [1, 5].

Salivary glands, pharyngeal lymphoid tissue, regional lymph nodes, and liver reticuloendothelial tissue are important components of the digestive tract immune system.

Intraepithelial lymphocytes are localized basally between the epithelial cells of the mucous membrane, especially in those places that are in contact with the external environment. The average number of lymphocytes of this type is 21 per 100 epithelial cells. These lymphocytes differ in their shape and size, as well as in the content of granules in the cytoplasm. They can migrate in both directions across the basement membrane. Granules of intraepithelial lymphocytes and mast cells are similar in structure and chemical composition, so some suggestion is made that these lymphocytes are T-lymphocytes that are specifically associated with mast cells of the intestinal mucosa. Among intraepithelial lymphocytes, T- and B-lymphocytes were isolated, but their exact division into groups is still unknown [1]. Although lymphocytes of their own layer have been studied by many specialists more intensively than intraepithelial lymphocytes, the data on them are very scattered and contain many contradictions. It has been established that in the mucous membrane of the human small intestine they contain up to 11,000 per millimeter. Among the lymphocytes, B cells predominate, their number is more than 50%, containing surface IgA. The rest of the B-lymphocytes are represented by cells with surface IgM and IgG. T-lymphocytes are also present, but little is known about their subclasses, except that they produce antibodies and can enter the intestinal mucosa through direct contact with plaques [3].

The most important property of the intestine is the phenomenon of lymphocyte recirculation. Sensitized by antigens (both food and infectious), Peyer's patch lymphocytes migrate to the mesenteric lymph nodes, and from there, through the lymphatic vessels through the thoracic duct and the circulatory system, they are sent to their own layer of the intestinal mucosa, mainly in the form of IgA-secreting cells. This mechanism ensures the formation of clones of lymphocytes and the formation of specific antibodies in areas of the mucous membrane remote from the focus of primary sensitization. In the process of sensitization of plasma cells with subsequent cloning of lymphocytes producing antibodies with certain properties (similar to those that acted as a matrix), not only native immunoglobulin molecules are involved. Antigens that have entered the intestinal lumen or on the mucous membranes are recognized by memory immunoglobulins (IgG), after which the information is transmitted to the immunocompetent cells of the mucous membrane, where the plasma cells responsible for the synthesis of IdA and IdM are cloned from sensitized lymphocytes as a result of the protective activity of these immunoglobulins, are activated mechanisms of immunoreactivity or immunotolerance. The immune system "remembers" antigens, which is facilitated by genetic factors, as well as IgG antibodies transmitted, for example, from mother to fetus during pregnancy, and immunoglobulins that enter the gastrointestinal tract of a child with breast milk. As a result of recycling and cloning of lymphocytes, the immune response covers the entire mucosa of the gastrointestinal tract [3, 4].

The main function of intestinal immunoglobulins (Ig) is immune rejection at the mucosal surface. It is known that IgA predominates among immunoglobulins in all secretions and in the intestinal lamina proper. Secretory IgA, which plays the role of the main destroyer of antigens and immunomodulator of the mucous membrane of the gastrointestinal tract, is retained near epithelial cells as a result of interaction with the glycocalyx, largely due to the presence of intestinal microflora. IgA occupies a favorable position, preventing the absorption of antigens. The two-dimensional IgA molecule can function as an agglutinin, reducing bacterial adherence to enterocytes. Of particular importance in the immunological functions of the gastrointestinal

tract is given to the small intestine, in which organized lymphoid tissue is represented by grouped lymph nodes, appendix and lymph nodes of the buttocks. These organs include a zone with follicular structures containing mainly B-lymphocytes, and an intrafollicular (paracortical) zone, consisting mainly of T-lymphocytes, located around high endothelial venules. The epithelial structures of clustered lymph nodes are specialized for antigen uptake by macrophages [2]. Peyer's patches are structurally organized and decorated accumulations of lymphoid cells in the submucosal layer of the small intestine. Thus, in humans, they appear along the entire small intestine as early as the 24th week of intrauterine development. Peyer's patches are surrounded by M-cells, which are devoid of villi and are responsible for transport and partly metabolic processes. These include the ability to transport macromolecules and particles from the intestinal lumen to Peyer's patches lymphocytes. Plaques do not develop well in animals raised in sterile conditions. Peyer's patches contain up to 40% of T-lymphocytes, which are located in the interfollicular space [5, 6]. The greatest concentration of Peyer's plaques was noted in the appendix, the appendix of the caecum. It is known that not all animals have it, for example, cats do not have it, but it is present in humans, monkeys, rabbits and a number of ruminants. The main function of this organ is to protect the intestines and its microflora from pathogenic agents. The appendix also performs a number of secondary functions: synthetic (produces amylase and lipase) and hormonal (produces hormones involved in the contraction of intestinal sphincters and regulating its peristalsis) [2, 4].

Single lymphoid follicles are found in the mucosa and submucosa of the intestine. But unlike Peyer's patches, they do not have a close relationship with the epithelium. This type of lymphatic formation contains T cells, B lymphocytes, and macrophages. The sensitized lymphocytes later migrate to the mesenteric lymph nodes and from there to the thoracic duct and circulatory system of their own intestinal layer. An important role in the activity of the colon is played by the immunogenesis system, which is in direct contact with various bacterial antigens. It contains a large number of Ig-bearing cells. Cells carrying IdA and IdM are located mainly in the surface epithelium, and carriers of IgG are located in the basal sections of the colon mucosa. IgG-secreting cells are mainly found in the lamina propria [2]. The mucous membrane of a healthy mammal cannot completely block the penetration of antigens from the intestinal cavity into its wall, and then into the circulating blood. For example, botulinum toxin, once in the intestine, does not linger in the intestinal lumen, but passes through the intestinal wall into the interstitial lymph. It is hypothesized that this detour of antigen migration to bypass the IgA system may be some sort of gut adaptation to protect against antigens, or a manifestation of a complex multi-step strategy for protecting the gut from antigens [4]. Thus, throughout the intestine, lymphatic tissues and their elements are very widely represented. They are diverse in structure and function. Cellular immunity of the intestine, in contrast to the system of antibodies secreted by it, has not been studied enough. It is known that systemic cellular immune responses are rarely detected after oral exposure to antigens. It is possible that when a healthy organism receives harmless antigens (for example, antigens of normal microflora), cellular immunity reactions do not develop in the intestinal mucosa. Or if an immune reaction occurs, then the immune cells of the intestine cannot store information about the antigen in memory cells. This indicates the presence of immune memory mechanisms in the gut, but they, unlike the systemic immune response, are not long-term.

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