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INTEGRATION OF DIGESTIVE-ABSORPTIVE AND IMMUNE FUNCTIONS IN THE SMALL INTESTINAL MUCOSA

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Abstract. This article studies the mechanisms of formation of integration of the digestive-absorptive and immune systems in the small intestinal mucosa in early postnatal ontogenesis. The materials and methods used, as well as the results obtained during the study, are described in detail.

Keywords: small intestine, nutrient, homeostasis, digestive-absorption system, immune system, mucous membrane.

INTRODUCTION

According to numerous studies, the mucous membrane of the small intestine, like the entire digestive tract, was located at the interface between the external and internal environments, experiencing the constant influence of substances of various chemical natures, developing and forming structures whose functions are to break down, form barriers, and regulate the homeostasis of the internal environment of the body [1].

MATERIALS AND METHODS

If the sequential physicochemical degradation of various nutrients is carried out due to the integration of the digestive organs into the functional system [2], then the barrier-protective immunity of the mucous membrane system, its integration with the functional one is the subject of intensive research. At birth of mammals, the structures and functions of the small intestine are relatively well developed [3]. However, the peripheral organs of the immune system, in particular the small intestine, are in their infancy. B-lymphocytes are characterized by “non-response” to antigens of food and microbial origin [4]. Given the biological feasibility of autonomous development of both digestion and immune dynamics of the change from natural milk nutrition to defective one, there is a need to study the mechanisms of their integration as the most optimal way to regulate homeostasis, to optimize the adaptation of the functional system of both the organ and the organ as a whole.

According to the purpose of the study, the mucous membrane of the jejunum and ileum, small intestine of white outbred rats at the age of 1, 3, 7, 14, 21 (natural breastfeeding) and 90 (definitive feeding) days after birth was examined using light and electron microscopy. Under the microscope MBS-9, the number of plaques was stereoscopically counted in the dynamics of age and along the small intestine; the number of lymphatic nodules in them, linear parameters, and relationships between stromal and immune cells were determined morphologically (light and electron microscopy).

RESULTS AND DISCUSSION

In 3-month-old sexually mature rats with normal histological, light-optical and electron-microscopic intestinal microflora, the afferent link of the ISSO consists of 5–6 lymphatic nodules, dome-shaped protruding into the small intestine and lined with a single layer of prismatic epithelium, infiltrative, and numerous lymphocytes. Structurally and functionally, the lymphatic nodule has an embryonic (germinal) center, follicular (B-lymphocytes; Bl), parafollicular (T-lymphocytes; Tl) zones, and a dome (Tl and Tb).

The surface of the dome is formed by M-single neuroreceptor [2] and numerous meta-epithelial T-lymphocytes. According to the literature, M cells transport antigens from the intestine by receptor-mediated endocytosis to interepithelially located antigen-binding T cells [1], which regularly migrate to the dome zone of the lymph nodes of plaques. In the latter, interacting with macrophages, they stimulate T and B blasts. If G. V. Pinegin, M. M. Karsova [3] consider high functional activity and weak ability to synthesize proinflammatory cytokines to be a characteristic feature of macrophages, then in the dome zone their activity is determined by the properties of the digested antigen. On this basis, the differentiation of stimulated T and B blasts is regulated in the dome zone.

The lymph node zones have a characteristic cell composition in the plaques along the small intestine, and it does not differ significantly when compared with the data of other authors [4]. If in 3-month-old rats the number of Peyer's patches along the small intestine varies from 17 to 28 (on average 24.5±1.8), then in one-day-old rats they are barely detectable, in particular in the duodenum and ileum. They represent a diffuse accumulation of lymphocytes with the proper plate of the mucous membrane. In the dynamics of age (1, 3, 7, 14, 21 and 90 days after birth) the number of Peyer's patches constantly increases. After 2 weeks, when the animals switch to mixed feeding, their number increases to 10.5 ± 1.4 and the germinal zone appears for the first time, where blast and lymphatic dividing lymphoblasts are concentrated. Macrophages are single, contain a moderate number of polymorphic liposomes in the cytoplasm. After the animals switch to final feeding, the number of Peyer's patches along the small intestine becomes the same as in rats. In addition, all the characteristic afferent link of the ISSO, structural and functional zones, and epithelium, which is infiltrated by T-lymphocytes, are clearly formed.

CONCLUSION

Thus, in the small intestinal mucosa in early postnatal ontogenesis, highly adapted digestive-absorptive and immune systems are simultaneously formed, closely integrating with each other. By the time of transition to definitive nutrition, several stages of digestion are formed, interconnected with SJgA, due to which homeostasis of the internal environment of the body is ensured, protection of antigens contained in food and microorganisms. The third, water-electrolyte level is located as a thin strip between the NESS and the glycocalyx of enterocytes lining the surface of the small intestinal mucosa. It is balanced in electrolyte composition, pH, sterile, contains only enteric enzymes, a high concentration of SJgA [3]. The fourth level of regulation of homeostasis of the internal environment should be considered the glycocalyx and plasma membrane of the microvilli of enterocytes of the villi.

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