INTERNATIONAL JOURNAL OF
INTEGRATIVE AND MODERN MEDICINE

# Morpho-Functional Characteristics of the Small Intestine

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**Abstract:** The small intestine and its parts have been studied by scientists for hundreds of years. Today, the development of the organ, interaction of its layers, vessels, development of the innervation apparatus, topography, histogenesis and many other issues related to morpho-biochemical changes in this organ have been studied. However, the morpho-functional characteristics of the small intestine have not been sufficiently addressed.

**Keywords:** small intestine, morphology, lymphoid tissue, gastrointestinal tract.

Scientists believe that the small intestine is not only a member of the digestive system, but also an active component of the immune-endocrine system. Researchers have proven that many glands of internal secretion are activated in the small intestine. It contains certain receptor areas, the stimulation of which affects the endocrine system. Therefore, essential hormonal processes in the whole body depend on the state of the small intestine [1, 4].

The main functions of the small intestine are digestion - absorption, immunological, endo- and exocrine, evacuator and excretory functions. Due to the wide range of activities and possible adaptive changes of the small intestine, the study of its structure and functions is of particular interest to morphologists, immunologists and gastroenterologists [1, 2, 5].

In the early postnatal period of the mammalian organism, the small intestine develops rapidly. In the first 7 days of life, the mass of a rat increases 2 times on average, and after 2 weeks - 4 times. At the same time, the small intestine increases by 2 times, the diameter of the duodenum increases by 40%, the diameter of the small intestine by 40%, and the diameter of the intestine between the ribs and abdomen by 25%. In the proximal and distal areas of the small intestine, the number of tics increases by 40 and 60%. Compared to the first days of life, the number and depth of crypts increase by 2 times. With age, the crypts and hairs are more densely located, and their openings are enlarged. All layers of the small intestine, especially the mucous layer, thicken by the 14th day of life. The submucosal base is thickened, the muscular layer is atrophied, making up about a third of the thickness of the intestinal wall [6].

On the 21st day of life, the functional and structural formation of the small intestine is completed [12]. On the 15th day of postnatal ontogenesis, the structural components of the white rat small intestine (mucous layer, its hairs, crypts, epitheliocytes, submucosa base, muscle and serous layer) are formed. The thickness of the wall of the duodenum is 401.66 (11.80) µm, the thickness of the small intestine is 387.19 (7.91) µm, the thickness of the intestine between the ribs and the abdomen is 273.72 (16.56) µm; height of hairs on mucosa, 207.40 (37.10) µm, 265.13 (3.19) µm, 121.35 (16.56) µm, respectively; crypt depth, 56.30 (2.10) µm, 50.41 (3.13) µm and 48.79 (8.90) µm, respectively. On the 45th day of postnatal development, the morphometric indicators of the studied structures in the white rat small intestine increase sharply. In the duodenum, hair height increases by 36.6%, in the small intestine by 22.8%, and in the rib and lower intestine by 44.9% [8].

The gastrointestinal tract is heavily colonized by various microbes, including bacteria, fungi, viruses, and parasites [10]. Bacteria are the majority, with up to 100 trillion microbial cells and more than 1000 species [11].

Dysbacteriosis, which involves compositional changes in the gut microbiota, may increase the risk of disease [3, 9]. The gut microbiota is receiving increasing attention as an important environmental factor in the development of fibrogenesis [15].

The gastrointestinal tract is constantly under the influence of various physical and chemical factors. In the intestine, the interaction of bacteria with epitheliocytes is largely dependent on mucus, which is mainly composed of highly glycosylated mucin-2 secreted by goblet cells of the mucosal epithelium. Mast cells line the entire length of the small and large intestine and are responsible for the development and maintenance of the protective layer of mucus through the synthesis and secretion of high molecular weight glycoproteins known as mucins. Today, the main task of biological experiments is to study the fundamental mechanisms of the organism's adaptability to the effects of physical and chemical factors at the level of cells, tissues, and organs. In this case, the gastrointestinal tract is the first to respond to exogenous influences of various origins [19].

Epithelial cells of the intestine are in constant contact with food, many foreign antigens that come to the biological barriers, the main function of which is to support the hemostasis of the body. The integrity of the epithelium, which is necessary for this, is ensured by intensive processes of cell regeneration. Among the cells of the intestinal epithelium, a separate group of cells is distinguished - goblet cells (JH), which belong to single mucus-secreting glands.

The epithelium of the small intestine is of endodermal origin. These endodermal cells differentiate into different types of secretory and absorptive cells. The remaining layers are derivatives of the splanchnic mesoderm. The endodermal epithelium of the intestine proliferates in the 6th week and completely covers the intestinal opening. Hair appears in the proximal area of the duodenum and small intestine in the 7th week. Hair development reaches the distal region of the small intestine at week 9 and the distal region of the intestine between the ribs and abdomen at week 11 [17].

The intestine plays an important role in the digestion and absorption of ingested food, as well as in the excretion of undigested food, microorganisms and their life products. The functional integrity of epithelial cells in the intestinal mucosa depends on the directed control of the mucosa, the close contacts between cells, epithelial cells, and the innate and adaptive immune response in the individual [20]. Microbes and microbial toxins are recognized by intestinal epithelial cells and a sensor system of immune cells, which activate the innate defense system in the intestinal tract. The epithelium of the intestinal mucosa consists of four main types of cells - absorptive enterocytes, JH, Panetta cells and enteroendocrine cells, which are continuously renewed [11]. The morphology of JH is characterized by an elongated theca with mucin granules located below the apical membrane.

In most intestinal infections, JH induction, mucin synthesis, and secretion often occur during the acute phase. But chronic infection leads to weakening of JH and changes in the quantity and quality of the mucous membrane, due to changes in the synthesis and secretion of mucins, as well as microbial glycosidases and proteases [19]. As the intestine is constantly exposed to various biotic and abiotic negative factors that eventually lead to hypoxia, in addition to destructive changes, adaptive changes, including changes in cellular behavior, must occur in it, which is necessary to support monad functioning. Chronic hypoxia causes changes in all components of the intestinal wall. In the epithelial location of the hairs, there is a violation of integrity, an increase in the number of JH, and neutral mucins are replaced by acidic sialomucins. Edema develops in the mucous and muscular layers and submucosal base, coarse hairy connective tissue grows, disrupting the morphofunctional integrity of the "crypt-hair" system.

Thus, the importance of goblet cells in the development of mucus, as a result of which the intestinal epithelium is protected from bacteria and food masses, is determined by their functional activity. These cells can also accumulate Fe in the form of ferritin and release it according to the body's needs. Under the influence of physical and chemical factors, non-specialized changes occur in the somatic cells, indicating the involvement of these cells in the compensatory-adaptive capabilities of the organism [27].

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