Ministry of health Republic of Belarus
Establishment of education "Gomel state medical university"

Department of histology, cytology and embryology

MANUAL
for 1-st year students of faculty of foreign students on gynecology

Topic: 7:
HISTOPHYSIOLOGY OF THE SMALL AND LARGE INTESTINE

Duration 4 hours

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THE MOTIVATIONAL CHARACTERISTIC OF THE THEME

The digestive system of the person consists of the bodies making the digestive channel, and greater closely connected by it glands – a liver and a pancreas. The wall of digestive system is formed by 4 coats: mucoua, submucosa, a muscular and adventitial, or serous

THE PURPOSE

Studying of a microscopic and ultramicroscopic structure histophysiology features of small and large intestines.

PROBLEMS

The student should know:

1. A general plan of a structure of a wall of digestive system.
2. Development of intestines.
3. To study of histophysiological features of intestines.

The student should be able:

1. To distinguish at microscopic and ultramicroscopic levels of small intestine.
2 To explain participation of system villi and crypts of intestines.
3. To define the basic kinds of endocrine cells of intestines and their functional value.
4. To define at a microscopic level of large intestine.

REQUIREMENTS TO THE INITIAL LEVEL OF KNOWLEDGE

For full mastering a theme it is necessary for student to repeat questions from normal human anatomy and physiology about a structure and functions of small and large intestines.

CONTROL QUESTIONS FROM RELATED SUBJECTS

1. Anatomy and topography of small intestine.
2. The basic physiological processes in intestines.
3. Anatomy and topography of appendix.

CONTROL QUESTIONS ON THE THEME

1. Structural components of a small intestine
2. Sources of development of the tissues of intestines.
3. A structure and fabric structure of a mucous membrane of a thin gut.
4. A structure and function of villi
5. A structure and function of crypt.

THE PRACTICAL PART

1. A general plan of structure of a gastro enteric path.
2. Microscopy and a sketch in an album of a preparation « a duodenum » (Exercise №1 in an album).
3 The Scheme of a structure of intestinal – to enter designations (Exercise № 3 in an album).
4. Studying of diagrams.

SLIDES

1. Small intestine
2. Large intestine
3. Duodenum
4. Appendix

QUESTIONS FOR SELF-CHECKING KNOWLEDGE

1. Structural components of small intestine (coats, layers, tissues)
2. Sources of development of tissues, incoming at the structure of coats of the small intestine
3. Structure and tissues of the mucous membrane of the small intestine
4. Basic characteristic of the epithelial cells of the small intestine
5. Structure and functions of the intestinal vili
6. Structure and functions of intestinal crypts
7. Glands of the duodenum, their structure and functions.
8. Secretory elements of the small intestine
9. Features of transition from stomach to the duodenum
10. Structural components of the large intestine (coats, layers, structure of their tissues)
11. Sources of development of tissues, incoming in structure coats of the large intestine
12. Structure and tissues of the mucous layer of the large intestine
13. Similarity and differences at the structure and functions of the small and large intestine
14. Features of structure of the vermiform appendix
15. Endocrinal structures of intestine.
16. Lymph structures of intestine.

HISTOPHYSIOLOGY OF THE SMALL AND LARGE INTESTINE

The mucous membrane exhibits several special features.

The small intestine is divided into three parts: duodenum, jejunum, and ileum. The 3 segments have many characteristics in common and will be discussed together.

The small intestine contains the four layers characteristic of the alimentary canal. However, the *mucosa* and *submucosa* are significantly modified at several levels of organization to increase the luminal surface area. Amplifications of the surface include plicae circulares (also known as the valves of Kirkring), villi, and striated border. The *plicae circulares* contain a core of submucosa [1].

Villi are finger-like projections of the mucosa. They include an epithelial cover and an underlying lamina propria. The epithelium are simple columnar. It consists predominantly of the ***enterocytes*** *or intestinal absorptive cells.*

They are tall columnar cells, with a basally positioned nucleus. They contain numerous parallel microvilli at their apical surface, forming the *striated border. (It is estimated that each absorptive cell has an average of about 3000 microvilli).*

A microvillus contains a core of microfilaments comprised of actin. These filaments are continuous with a plexus of similar filaments present in the apical part of the

cell and is called the *terminal web.* The cytoplasm of absorptive cells contains the usual organelles, including lysosomes and smooth ER. Adjacent cells are united by typical junctional complexes and by scattered desmosomes. Enterocytes are organized so that they can function in the transport of metabolites.

The surface of each microvillus is covered by a layer of *glycocalyx.* The striated border is the site of activity of the disaccharidases of the small intestine. These enzymes are synthesized by enterocytes. They bound to microvilli, hydrolyze the disaccharides into monosaccha-rides, which are easily absorbed. An analogous localization has been postulated for dipeptidases that hydrolyze dipeptides into their component amino acids [1 – 3].

A more important function of the enterocytes is to absorb the metabolites that result from the digestive process. These cells are responsible for absorption of amino acids, carbohydrates, and lipids present in digested food.

Goblet cells are interspersed between the absorptive cells. [A goblet is literally a drinking glass which is broad above, and has a narrow stem attached to a base. Goblet cells are so named because of a similar shape] *They are* most numerous In the terminal ileum. *They produce acid glycoproteins (*mucus) *whose main function is to protect and lubricate the lining of the intestine. According their function* these cells have a well-developed Golgi complex and abundant rough endoplasmic reticulum [1, 2].

Between the villi are small openings of simple tubular glands called **intestinal glands (crypts or glands of Lieberkiihn).** The epithelium of the villi is continuous with that of the crypts. In the crypts, one finds **undifferentiated** cells, some **absorptive cells and goblet cells, Paneth cells, and enteroendocrine cells.**

Mainly **undifferentiated cells** line the crypts. They proliferate actively by mitosis. The newly formed cells migrate upwards from the crypt to reach the walls of villi. Here they differentiate either into typical enterocytes, or into goblet cells. These cells migrate towards the tips of the villi where they are shed off. In this way, the epithelial lining is being constantly replaced, each cell having a life of only a few (3- 6) days.

Near the bases of the crypts there are **Poneth cells**. They are exocrine cells that contain prominent eosinophilic secretory granules with lysozyme. Lysozyme possesses antibacterial activity and controls intestinal flora. They may also produce other enzymes [3 –6].

The gastrointestinal tract contains a series of widely distributed enteroendocrine cells. At least 12 different cell types have been identified within the epithelium of the gastrointestinal tract. They produce hormones, active amine and peptides, which act as endocrine and paracrine substances (somatostatin, secretin, gastrin, cholecystokinin (CKK), gastric inhibitory peptide). All the cells possess a broad base adjacent to the basal lamina and small membrane-limited secretory granules at these pole of the cell.

The endocrine cells of the gastrointestinal tract are part of a larger group of cells designated as APUD. APUD cells secrete a variety of regulator substances in other tissues and organs including respiratory epithelium, adrenal medulla, islets of Langerhans, thyroid gland (parafollicular cells), and pituitary gland. Granules in some APUD cells can be displayed with silver staining procedures. These cells were originally designated as *argentaffin* or *argyrophilic cells;* granules in other APUD cells can be displayed with bichromate solutions, and these were designated as *chromaffin cells.*

The result of a tumor of a gasliointestinal endocrine cell is the *Zollinger-Eliison syndrome,* or *gastrinoma.*

Very similar cells are also to be seen in the pancreas. All these cells are now grouped together under the term gastro-entero-pancreatic endocrine system.

Under the epithelium is the lamina propria. The lamina propria is composed of loose connective tissue with blood vessels and nerve fibers. The endothelium lining the capillaries is fenestrated thus allowing rapid absorption of nutrients into the blood. Each villus contains a centrally placed lymphatic capillary called a *lacteal* [1, 2].

Just below the basal lamina, a layer of antibody-producing lymphoid cells and macrophages exists, forming an immunologic barrier at this region. In the more distal part, especially in the ilium are the aggregations of nodules called *Peyer's patches.* M (membranous epithelial) cells cover the Peyer's patches. They are flat cells and can endocytose antigens and transport them to the underlying lymphoid cells.

The *muscularis mucosae* consist of two thin layers of smooth muscle cells, an inner circular and an outer longitudinal. Isolated smooth muscle cells extend from the muscularis mucosae the villi, They are responsible for the rhythmic movements of the villi. Movement of both the villi and microvilli play an important role in mixing the microenvironment.

The submucosa of the duodenum contains glands referred to as *Brunner's glands.* These are mucus-secreting branched tubuloalveolar glands. The secretion has been shown to be alkaline, viscous, and high in bicarbonate. These features suggest a protective role against the acid chyme that enters the duodenum from the stomach [5, 6].

PROLIFERATIVE ZONE of THE GASTROINTESTINAL TRACT

Cells of the basal layer of the esophageal epithelium, of the neck of gastric glands, of the lower half of the crypts of the intestine are proliferating cells.

High replacement rate explains why the intestine is promptly affected by the administration of antimitotic drugs, as in cancer chemotherapy. This atrophy of the epithelium results in defective absorption of nutrients, excessive fluid loss, and diarrhea [2].

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