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: 6:
HISTOPHYSIOLOGY OF THE ESOPHAGUS, STOMACH

Duration 4 hours

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THE MOTIVATIONAL CHARACTERISTIC OF THE THEME

The digestive system of the person consists of the organs making the digestive channel, and greater closely connected by it glands – a liver and a pancreas. The wall of gastro-intestinal tract is formed by 4 layers: mucosa, submucosa, muscularis externa and adventitial, or serosa

THE PURPOSE

Studying of a microscopic and ultramicroscopic structure of stomach and intestines

PROBLEMS

The student should know:

1. A general plan of a structure of gastro-intestinal tract.
2. Development of a digestive tract.
3. Features of a structure of a wall of intestine.
4. Features of a structure of a wall of a stomach.

The student should be able:

1. To define a microscopic level of the tissues of esophagus and a stomach, environments and their structure.
2. To define glands on microscopic and ultramicroscopic levels, the nobility their function.
3. To define histological features of a structure of intestines and stomach.

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 from physiology about a structure and functions of a gullet and a stomach.

CONTROL QUESTIONS FROM RELATED SUBJECTS

1. Anatomic and topographical features of intestines and stomach.
2. The basic physiological processes proceeding in intestines and a stomach.

CONTROL QUESTIONS ON THE THEME

1. Structural components of intestines (layers and their tissue structure).
2. Sources of development of the tissues of different parts of intestines.
3. A structure and functions of serous membrane.
4. Features of a structure of various departments of intestines.
6. Sources of development of membranes of a stomach.
7. A structure and functions of a mucous membrane of a stomach.
8. Epithelium of stomach.
9. Gland of stomach.

THE PRACTICAL PART

1. A general plan of a structure of a gastro enteric path.
2. Microscopy and a sketch in an album of a preparation (Exercise № 1 in album).
2. The Scheme of a structure mucous membrane of stomach – enter of a designation (Exercise №2 in album).

3. The Scheme of a structure the glands of stomach- enter of a designation (Exercise № 3 in album).

4. Microscopy and a sketch in an album of preparations: (Exercise № 2, 3, 4 and 5 in album).

SLIDES

1. Esophagus
2. Fundus of stomach
3. Pyloric part of stomach
4. Esophageal-gastric junction

QUESTIONS FOR SELF-CHECKING KNOWLEDGE

1. Structural components of esophagus (layers, tissues, structures)
2. Sources of development of tissues, forming the esophagus
3. Glands of the esophagus
4. Features in structure of the different parts of the esophagus
5. Structural components of the stomach (coats, layers, their tissues structure)
6. Sources of development of tissues of the stomach
7. Structure, tissues and functions of the mucous membrane of the stomach
8. Epithelium of the stomach
9. Fundic glands of the stomach
10. Cardiac and pyloric glands of the stomach
11. Structure, tissues and functions of the serous coats
12. Structural features of the esophageal-gastric junction

HISTOPHYSIOLOGY OF THE ESOPHAGUS, STOMACH

ESOPHAGUS is a part of the gastrointestinal tract whose function is to transport foodstuffs from the mouth to the stomach.

It has the usual four layers: mucosa, submucosa, muscularis externa and an external adventltia.

The ***mucosa*** is lined by stratified squamous epithelium, which is normally not keratinized. Lamina propria of the upper and lower ends of the oesophagus contains some tubulo-alveolar mucous glands. The lowermost glands near the stomach are called **esophageal cardiac glands**. The muscularis mucosae appears at the level of the cricoid cartilage and consists of smooth muscle fibers.

The *submucosa* contains mucous glands throughout its length, the **esophageal glands.** They are more numerous in the upper region of the esophagus. The submucosal glands are branched tubulo-alveolar glands, primarily producing mucus to lubricate the tube.

The *muscularis externa*, in the upper third of the esophagus, consists of striated muscle. The middle third contains both striated and smooth muscle. At the distal end of the esophagus, the *muscularis externa* consists of only smooth muscle cells. The muscle is arranged in two layers, an inner circular and an outer longitudinal layer.

Portion of the esophagus in the peritoneal cavity is covered by serosa. The rest is covered by a layer of loose connective tissue called the adventitia, which blends into the surrounding tissue [1, 2].

STOMACH

The stomach is a dilated segment of the digestive tract whose main functions are to add an acidic fluid to the ingested food, transform it by muscular activity into a viscous mass (chyme), and continue the digestive process by secreting the proteolytic enzyme **pepsin.** Gross inspection reveals 4 regions: **cardia, fundus, body,** and **pylorus.** The fundus and body are identical in microscopic structure, so that only 3 histologic regions are recognized. The mucosa and submucosa form the folds known as rugae.

Mucosa

The gastric mucosa consists of a **surface epithelium** that invaginates into the lamina propria, forming gastric **pits.** The epithelium covering the surface and lining the pits is a simple columnar epithelium, and all the cells secrete mucus and are called *mucous surface cells.* Mucous protects the gastric mucosa against acid and pepsin secreted by the gastric glands. Substances that cause gastric irritation, such as aspirin, can disrupt this layer and lead to ulceration [1 – 3].

The ***gastric glands*** within the **lamina propria** open into the bottom of the pits. The mucosa of the stomach is packed with these branched tubular glands.

The **muscularis mucosae** of the stomach is well developed. It is a layer of smooth muscle composed of an outer longitudinal fibers and circular fibers closer to the lumen.

There are three types the ***gastric glands***: *cardiac glands* near the esophageal orifice; *pyloric glands* in the pyloric antrum; a*nd fundic,* or main *gastric, glands* which are present over most of the stomach.

Each gland has the neck and base (or body) [3 – 6].

Cardiac Glands are simple or branched tubular glands. The terminal portion of these glands is frequently coiled and often has a large lumen. Most of the secretory cells produce mucus and lysozyme, but a few parietal cells (which secrete HC1) can be found.

Main Gastric Glands

The main gastric (or fundic) glands are present in the body of the stomach, and in the fundus. They are the most numerous. They are simple or branched tubular glands. Several glands open into each pit.

The following cells are present in the glands:

- mucous neck cells;
- parietal (oxyntic) cells;
- and chief (zymogenic) cells;
- In addition, the fundic glands contain undifferentiated cells;
- and entero-endocrine cells.

The distribution of cells is not uniform. The **neck** consists of undiffercntiated cells and mucous neck cells, while the base (or body) of the glands contains parietal (oxyntic) cells, chief (zymogenic) cells, and entero-endocrine cells [1 – 4], the group designated as amine percursor uptake decarboxylase (APUD) cells. (These cells are discussed below under the heading of gastrointestinal hormones, APUD cells, and peptides.) The undif-

ferentiated cells are located in the neck region of the gland; the APUD cells are scattered throughout

Parietal (oxyntic) cells are present mainly in the upper half of gastric glands and are intercalated between other cells. They are rounded large cells with a narrow apical part that reaches the lumen of the gland. The nucleus of the parietal cell is spherical and some cells are binucleate. The cytoplasm is intensely eosinophilic. The most striking feature is a deep, circular invagination of the apical plasma membrane forming the intracellular canaliculus. Numerous microvilli project from the surface of the canaliculi and a tubulovesicular system are under the microvilli. The eosinophilic cytoplasm is packed with a great number of mitochondria with abundant cristae. Secretory granules are not present.

Parietal cells produce the hydrochloric acid present in gastric juice. In human disease, the number of parietal cells is correlated with the acid-producing capacity of the stomach. In cases of atrophic gastritis, parietal cells are much less numerous, and the gastric juice has little or no acid.

There is evidence that the acid secreted originates from chlorides present in the blood plus a cation (H^+) resulting from the action of an enzyme – carbonic anhydrase. Carbonic anhydrase acts on CO_2 to produce carbonic acid, which dissociates into bicarbonate and H^+. Both the cation and the chloride ion are actively transported across the cell membrane and form hydrochloric acid into canaliculi, outside of the cell [3].

The abundant mitochondria indicate that these metabolic processes are highly energy-consuming.

Parietal cells also produce an intrinsic *factor*, a glycoprotein that binds avidly to vitamin B_{12} in the stomach. The presence of intrinsic factor is normally required for vitamin B_{12} absorption, and this vitamin binds strongly to intrinsic factor in the lumen of the stomach. This complex is absorbed in the ileum and it is necessary for normal formation of erythrocytes. This explains why lack of intrinsic factor can lead to vitamin B_{12} deficiency – a disease that results in a disorder of erytropoesis known as **pernicious anemia** and is usually caused by **atrophic gastritis.** In a high percentage of cases, pernicious anemia seems to be an autoimmune disease, since antibodies against parietal cell proteins are often detected in the blood of patients with the disease.

The secretory activity of parietal cells is instigated by different mechanisms. One is through acetylcholine of the nerve endings. Histamine and a polypeptide called **gastrin,** both secreted in the gastric mucosa, act strongly to stimulate the production of hydrochloric acid. There are receptors for these agents on the plasma membrane of the parietal cell [2].

Chief cells or zymogen cells are located in the deepest part of the fundic glands. The cells are cuboldal or low columnar. Their cytoplasm is basophilic. They are typical protein-secreting and exporting cells. The rER presents in their basal cytoplasm and secretory granules in their apical pole. Chief cells secrete *pepsin* in an inactive precursor form designated *pepsinogen.* Upon contact with the acid of the gastric juice, the pepsinogen is converted to pepsin, a proteolytic enzyme.

Chief cells also secrete gastric lipase, but its enzyme activity is weak [2].

Mucous neck cells are present between parietal cells in the necks of gastric glands. They are irregular in shape, having their nuclei at the base of the cell. They contain mu-

cinogen granules in the apical cytoplasm. Unlike the neutral mucous secretions of the surface cells, mucous neck cells secrete an acidic mucus [1 – 3].

Undifferentiated cells are found in the neck region but are few in number. They are low columnar cells with oval nuclei near the bases. Many free ribosomes and polyribosomes are present. These cells multiply, differentiate and move upward to replace surface mucous cells, which have a turn over time of 3-7 days. They increase in number when the gastric epithelium is damaged, and play an important role in healing.

Other undifferentiated cells migrate deeper into the glands and differentiate into mucous neck cells, parietal cells, chief cells, and enteroendocrine cells. These cells are replaced much more slowly than surface mucous cells.

Enteroendocrine cells (APUD cell) are found near the bases of gastric glands. These cells contain membrane bound neurosecretory granules. These cells secrete the hormone *gastrin and* serotonin. (5HT). Tumors called **carcinoids** arise from these cells.

The Pyloric Glands

Pyloric glands empty into gastric pits that are relatively long, extending through almost half the thickness of the pylorit: mucosa. The glands are coiled, though not as extensively as those in the cardia of the stomach. Pyloric glands contain mucous cells, occasionally some parietal cells, APUD cells and undifferentiated cells. The latter are likewise restricted to the neck region. They produce rnucus and gastrin [1 – 3].

The pylorus has deep gastric pits and short coiled **pyloric glands** (the reverse of the situation in the cardiac region)**.** These glands secrete mucus and the enzyme lysozyme. **Gastrin (G) cells** are intercalated among the mucous cells of pyloric glands. These cells release hormone **gastrin,** which stimulates the secretion of acid by the parietal cells. Other enteroendocrine cells **(D cells)** secrete somatostatin, which inhibits the release of other hormones, including gastrin.

All gastric glands are located only within the gastric mucosa.

The **submucosa** is composed of loose connective tissue and blood and lymph vessels and is infiltrated by lymphoid cells and **mast** cells.

The **muscularis externa i**s well developed. It consists of three layers of smooth muscle: an outer longitudinal, a middle circular, and an inner oblique. At the pylorus, the middle circular layer is greatly thickened to form the **pyloric sphincter.**

The serosa is thin and covered by mesothelium [5, 6].

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