Project Title

Glandular stomach – Structure, types of glands, cells, and function

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Abstract

The stomach is a muscular organ located on the left side of the upper abdomen. The stomach receives food from the esophagus. As food reaches the end of the esophagus, it enters the stomach through a muscular valve called the lower esoph-ageal sphincter. The stomach secretes acid and enzymes that digest food. Ridges of muscle tissue called rugae line the stomach. The stomach muscles contract periodi-cally, churning food to enhance digestion. The pyloric sphincter is a muscular valve that opens to allow food to pass from the stomach to the small intestine. The Glandular stomach is the part of the stomach that is lined with glandular mucosa and receives the food from the esophagus. The mucosa contains gastric glands that secret gastric acid. It includes man types of glands including cardiac glands , fundic (oxyntic) glands and pyloric glands.

Introduction

The glandular stomach aka glandular mucosa or gastric mucosa is the mucous membrane layer of the stomach, which contains the glands and the gastric pits. In humans, it is about 1 mm thick, and its surface is smooth, soft, and velvety. It consists of simple columnar epithelium, lamina propria, and the muscularis mu-cosae. In its fresh state, it is of a pink-ish tinge at the pyloric end and of a red or reddish-brown color over the rest of its surface. In infancy it is of a brighter hue, the vascular redness being more marked.It is thin at the cardiac extremity, but thicker toward the pylorus. During the con-tracted state of the or-gan it is thrown into numerous plaits or rugae, which, for the most part, have a longitudi-nal direction, and are most marked toward the py-loric end of the stomach, and along the greater curvature. These folds are entirely obliterated when the organ becomes distended.

When examined with a lens, the inner surface of the mucous membrane presents a peculiar honeycomb appearance from being covered with funnel-like depressions or foveolate of a polygonal or hexagonal form, which vary from 0.12 to 0.25 mm. in diameter. These are the ducts of the gastric glands, and at the bottom of each may be seen one or more minute orifices, the openings of the gland tubes. Gastric glands are simple or branched tubular glands that emerge on the deeper part of the gastric fo-veola, inside the gastric areas and outlined by the folds of the mucosa

Project Aim and Outline

1. What glandular stomach is
2. Types of glands in glandular stmach
3. cardiac glands (in the proximal part of the stomach)
4. fundic (oxyntic) glands (the dominating type of gland)
5. pyloric glands:
6. Surface
7. Types of cell

Results

1. Types of glands

The gastric glands are located in different regions of the stomach. The glands and gastric pits are located in the stomach lining. The glands themselves are in the lamina propria of the mucous membrane and they open into the bases of the gastric pits formed by the epithelium. The various cells of the glands secrete mucus, pepsinogen, hydrochloric acid, intrinsic factor, gastrin, and bicarbonate.

1.1. cardiac glands (in the proximal part of the stomach)

They are found in the cardia of the stomach which is the part nearest to the heart, enclosing the opening where the esophagus joins to the stomach. Only cardiac glands are found here, and they primarily secrete mucus. They are fewer in number than the other gastric glands and are more shallowly positioned in the mucosa. There are two kinds - either simple tubular with short ducts or compound racemose resembling the duodenal Brunner's glands.

The cardiac glands mainly contain mucus-producing cells called foveolar cells. The bottom part of the oxyntic glands is dominated by zymogenic (chief) cells that produce pepsinogen (an inactive precursor of the pepsin enzyme). Parietal cells, which secrete hydrochloric acid (HCl) are scattered in the glands, with most of them in the middle part. The upper part of the glands consist of mucous neck cells; in this part the dividing cells are seen.

1.2. fundic (oxyntic) glands (the dominating type of gland)

Called the oxyntic glands and found in the fundus and body of the stomach. They are simple almost straight tubes, two or more of which open into a single duct. Oxyntic means acid-secreting and they secrete hydrochloric acid (HCl) and intrinsic factor.

1.3. pyloric glands:

The pyloric glands contain mucus-secreting cells. Several types of endocrine cells are found in throughout the gastric mucosa. The pyloric glands contain gastrin-producing cells (G cells); this hormone stimulates acid production from the parietal cells. Enterochromaffin-like cells (ECLs), found in the oxyntic glands release histamine, which also is a powerful stimulant of the acid secretion. The A cells produce glucagon, which mobilizes the hepatic glycogen, and the entero-

chromaffin cells produce serotonin, which stimulates the contraction of the smooth muscles.

1.4. Surface

The surface of the mucous membrane is covered by a single layer of columnar epithelium. This epithelium commences very abruptly at the cardiac orifice, where there is a sudden transition from the stratified epithelium of the esophagus. The epithelial lining of the gland ducts is of the same character and is continuous with the general epithelial lining of the stomach. An important iodine concentration by sodium-iodide symporter (NIS) is present in mucinous cells of surface epithelium and gastric pits of the fundus and pyloric part of the stomach.

Layer of stomach	Name	Secretion	Region of stomach	Staining
Isthmus of gland	Foveolar cells	Mucus gel layer	Fundic, cardiac, pyloric	Clear
Body of gland	Parietal (oxyntic) cells	Gastric acid and intrinsic factor	Fundic on-ly	Acidophilic
Base of gland	Chief (zymogenic) cells	Pepsinogen and gastric li-pase	Fundic on-ly	Basophilic
Base of gland	Enteroendocrine (APUD) cells	Hormones gastrin, hista-mine, endorphins, serotonin, cholecystokinin and somato-statin	Fundic, cardiac, pyloric	–

Types of cell

Transverse section of fundic gland

Diagram depicting the major determinants of gastric acid secretion

There are millions of gastric pits in the gastric mucosa and their necessary narrowness determines the tubular form of the gastric gland. More than one tube allows for the accommodation of more than one cell type. The form of each gastric gland is similar; they are all described as having a neck region that is closest to the pit entrance, and basal regions on the lower parts of the tubes. The epithelium from the gastric mucosa travels into the pit and at the neck the epithelial cells change to short columnar granular cells. These cells almost fill the tube and the remaining lumen is continued as a very fine channel.

Cells found in the gastric glands include foveolar cells, chief cells, parietal cells, G cells and enterochromaffin-like cells (ECLs). The first cells of all the glands are foveolar cells in the neck region–also called mucous neck cells that produce mucus. This is thought to be different from the mucus produced by the gastric mucosa.

Fundic glands found in the fundus and also in the body have another two cell types–gastric chief cells and parietal cells (oxyntic)).

The chief cells are found in the basal regions of the gland and release a zymogen – pepsinogen, a precursor to pepsin.

The parietal cells ("parietal" means "relating to a wall") are found in the walls of the tubes. The parietal cells secrete hydrochloric acid–the main component of gastric ac-id. This needs to be readily available for the stomach in a plentiful supply, and so from their positions in the walls, their secretory networks of fine channels called canaliculi can project and ingress into all the regions of the gastric-pit lumen. An-other important secretion of the parietal cells is intrinsic factor. Intrinsic factor is a glycoprotein essential for the absorption of vitamin B12.

The parietal cells also produce and release bicarbonate ions in response to histamine release from the nearby ECLs, and so serve a crucial role in the pH buffering system.

The enterochromaffin-like cells store and release histamine when the pH of the

stomach becomes too high. The release of histamine is stimulated by the secretion of gastrin from the G cells. Histamine promotes the production and release of HCL from the parietal cells to the blood and protons to the stomach lumen. When the stomach pH decreases (becomes more acidic), the ECLs stop releasing histamine.

The G cells are mostly found in pyloric glands in the antrum of the pylorus; some are found in the duodenum and other tissues. The G cells secrete gastrin. The gastric pits of these glands are much deeper than the others and here the gastrin is secreted into the bloodstream not the lumen.

Surface:

Like the other parts of the gastrointestinal tract, the human stomach walls consist of a mucosa, submucosa, muscularis externa, subserosa and serosa.

The inner part of the lining of the stomach, the gastric mucosa, consists of an outer lay-er of column-shaped cells, a lamina propria, and a thin layer of smooth muscle called the muscularis mucosa. Beneath the mucosa lies the submucosa, consisting of fibrous connective tissue. Meissner's plexus is in this layer.

Outside of the submucosa lies another muscular layer, the muscularis externa. It con-sists of three layers of muscular fibres, with fibres lying at angles to each other. These are the inner oblique, inner circular, and outer longitudinal layers. The presence of the inner oblique layer is distinct from other parts of the gastroin-testinal tract, which do not possess this layer.

- **The inner oblique layer: This layer is responsible for creating the motion that churns and physically breaks down the food. It is the only layer of the three which is not seen in other parts of the digestive system. The antrum has thicker skin cells in its walls and performs more forceful contractions than the fundus.**

- **The middle circular layer: At this layer, the pylorus is surrounded by a thick circular muscular wall, which is normally tonically constricted, forming a func-tional (if not anatomically discrete) pyloric sphincter, which controls the movement of chyme into the duodenum. This layer is concentric to the longitudinal axis of the stomach.**

- **Auerbach's plexus (AKA myenteric plexus) is found between the outer longi-**

tudinal and the middle circular layer and is responsible for the innervation of both (caus-ing peristalsis and mixing)

The outer longitudinal layer is responsible for moving the bolus towards the pylo-rus of the stomach through muscular shortening.

To the outside of the muscularis externa lies a serosa, consisting of layers of connective tissue continuous with the peritoneum.

Glands

The mucosa lining the stomach is lined with a number of these pits, which receive gas-tric juice, secreted by between 2 and 7 gastric glands. Gastric juice is an acidic fluid con-taining hydrochloric acid and the digestive enzyme pepsin. The glands contains a num-ber of cells, with the function of the glands changing depending on their position within the stomach.

Within the body and fundus of the stomach lie the fundic glands. In general, these glands are lined by column-shaped cells that secrete a protective layer of mucus and bicarbonate. Additional cells present include parietal cells that secrete hydro-chloric acid and intrinsic factor, chief cells that secrete pepsin, and neuroendo-crine cells that secrete serotonin.

Glands differ where the stomach meets the esophagus, and near the pylorus. Near the junc-tion between the stomach and the esophagus lie cardiac glands, which primarily secrete mu-cus. They are fewer in number than the other gastric glands and are more shallowly posi-tioned in the mucosa. There are two kinds - either simple tubular with short ducts or compound racemose resembling the duodenal Brunner's glands. Near the pylorus lie pyloric glands and are located in the antrum of the pylorus. They secrete mucus, as well as gastrin produced by their G cells

Conclusions

The three types of gland are all located beneath the gastric pits within the gastric muco-sa–the mucous membrane of the stomach. The gastric mucosa is pitted with innumera-ble gastric pits which each house 3-5 gastric glands

The cardiac glands are found in the cardia of the stomach which is the part nearest to the heart, enclosing the opening where the esophagus joins to the stomach. Only cardiac glands are found here and they primarily secrete mucus. They are fewer in number than the other gastric glands and are more shallowly positioned in the mucosa. There are two kinds - either simple tubular with short ducts or compound racemose resembling the duodenal Brunner's glands.

The fundic glands (or oxyntic glands), are found in the fundus and body of the stomach. They are simple almost straight tubes, two or more of which open into a single duct. Oxyntic means acid-secreting and they secrete hydrochloric acid (HCl) and intrinsic fac-tor

The pyloric glands are located in the antrum of the pylorus. They secrete gastrin pro-duced by their G cells

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