

Hope academic team



GASTROINTESTINAL SYSTEM



Histology

Lecture : 1

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Histology of the stomach

The wall of the stomach has the same general layout seen in the rest of the alimentary tract.

The stomach is formed from:

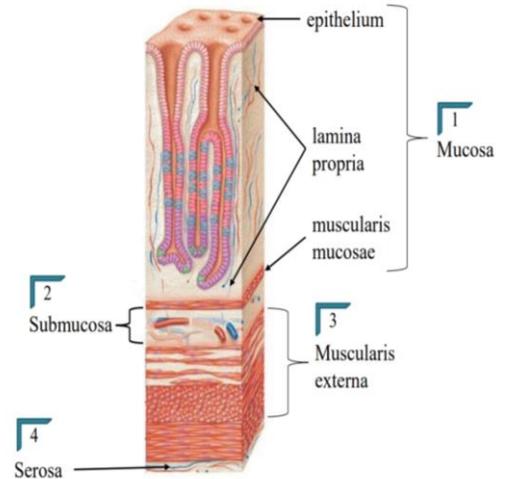
mucosa (epithelium underlying is lamina propria ((connective tissue)),

muscularis mucosae ((muscle layer that separates the mucosa from submucosa)),

submucosa ((is a connective tissue layer)),

muscularis externa,

serosa (the outermost layer of the stomach)

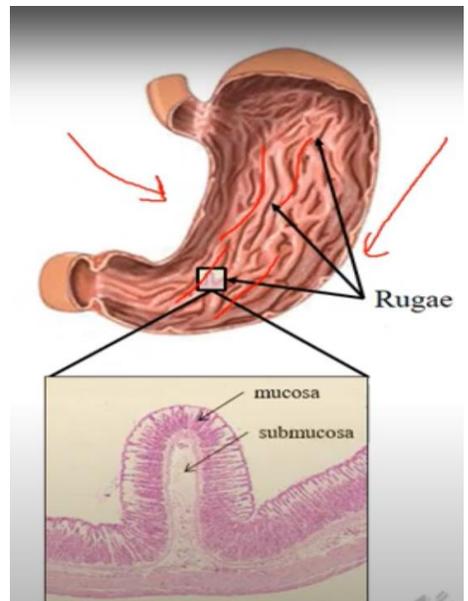


The inner surface of an empty stomach shows several longitudinal folds of mucosa and submucosa called Rugae.

We can see folds run in the same direction formed from mucosa and submucosa

- These disappear when the stomach is distended, thus allowing the stomach to increase in size

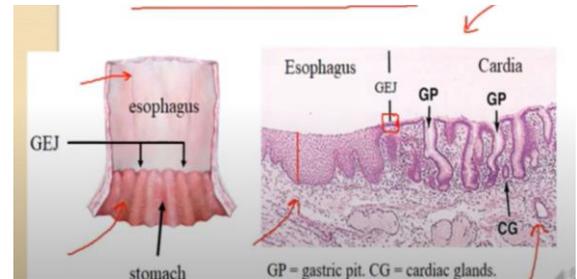
(these folds allow the stomach to be distended)



Mucosa - Epithelium

- The stomach is lined by simple columnar epithelium.
- This simple columnar epithelium begins **Abruptly((suddenly))** at the gastro-esophageal junction (GEJ).

as we can see in the right figure the esophagus is made from stratified squamous non-keratinized epithelium, then we have the cardia of the stomach((the first part of the stomach where the esophagus meet the stomach)) so there is a transition between 2 types of epithelium at the site where the esophagus meet the stomach the stratified squamous epithelium will stop suddenly and the simple columnar epithelium will begin



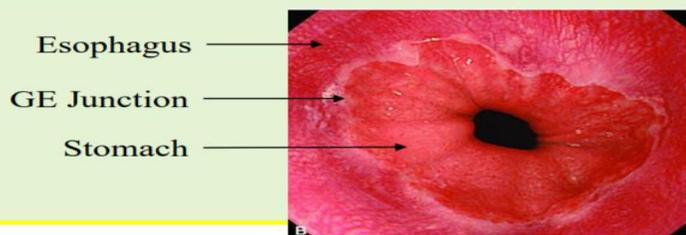
in the left figure

grossly we can see differences in the mucosa of the esophagus and mucosa of the stomach

so we can see such differences while endoscopy

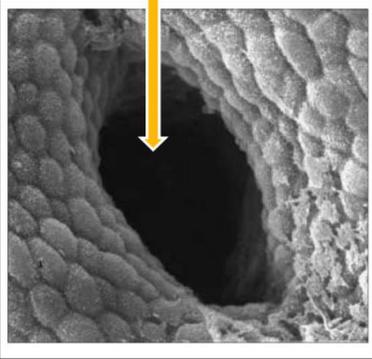
Endoscopic difference between the Esophageal and Gastric mucosa

	Esophagus	Stomach
Color	Pink in color	Red in color
Brightness	Not shiny	Shiny – due to the presence of mucous layer
Surface	Smooth - No folds	Presence of folds – Rugae (unless the stomach is inflated during procedure)

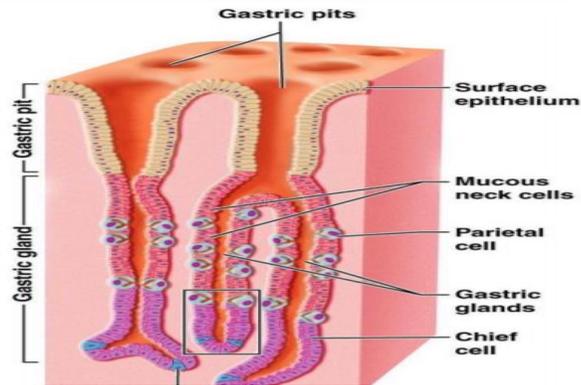


****We can see folds in the stomach when the stomach is not distending**

- The epithelium invaginates the lamina propria to form **Gastric Pits**



- **Branched Tubular Gastric Glands** open into these pits



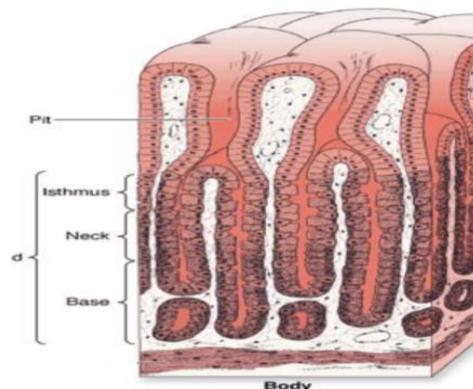
We can see in this microscopic figure that the epithelium passes down to the lamina propria

The gastric pits are considered as ducts to the gastric glands

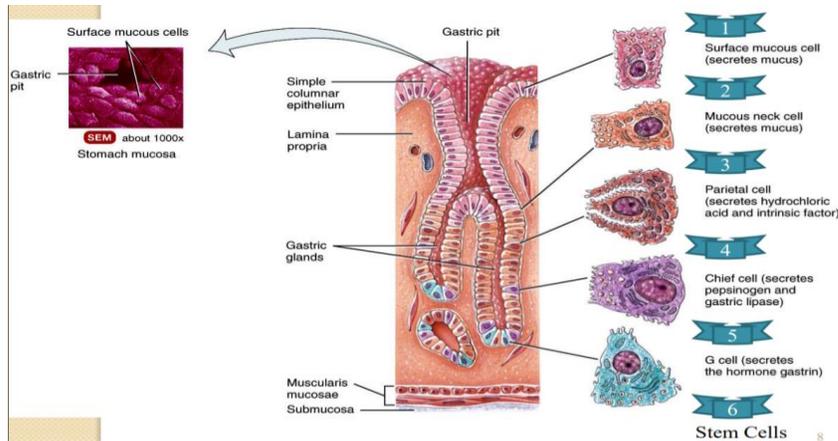
Each gastric gland is divided into the following regions:

1. Isthmus - at its junction with the pit
2. Neck - next to the isthmus
3. Base - the deepest part

((down to the lamina propria))



Cells of the Gastric Epithelium



G cells are type of endocrine cells

1) Surface Mucous Cells:

- Line the lumen of the stomach and the gastric pits.
- Columnar cells (these the cells that make columnar epithelium). Basal part contain the oval nucleus and rough endoplasmic reticulum. The apical part is filled with mucinogen granules. (forms mucus)
- The mucus secreted by these cells:
- Forms a thick, viscous, gel-like coat on the surface of the stomach that can be easily seen. This coat acts as a physical barrier against microorganisms and the abrasive effects of food in the stomach. That's why we can see the stomach shiny in the endoscope because of the mucus
- Contains bicarbonate ions that neutralize the acid in the lumen thus protecting the wall of the stomach.



Prostaglandins increase the thickness of the mucus and the amount of bicarbonate ions produced by these cell thus enhancing their protective property. Aspirin (and other NSAIDs) reduces the production of prostaglandins thus reducing the protection provided by surface mucous cells.

2) Neck Mucous cells:

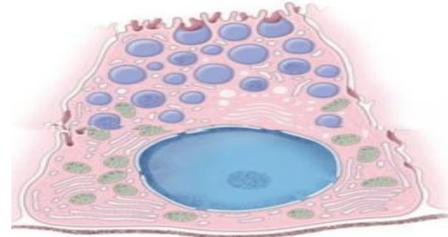
These are present in the neck region of the gastric glands. They produce thin mucus that doesn't form a visible coat over the mucosa. so the surface mucous cells are different from these cells by the location and the type of mucus produced

3) Stem cells:

Undifferentiated highly mitotic cells that are usually present in the neck region of the gastric glands. They divide and differentiate to form the surface epithelial cells and the various cells of the gastric glands

4) Chief cells:

- Lower part of the gland.
- Abundant rough endoplasmic reticulum in the basal part which makes this part Basophilic.
- Acidophilic secretory vesicles in apical part.



These vesicles are acidophilic because the content of these vesicles are secreted into the lumen of the stomach

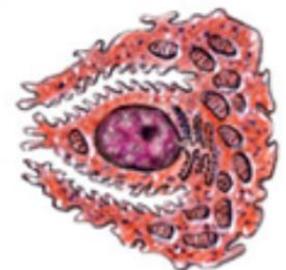
- Secrete Pepsinogen and Gastric Lipase. (function)

So these cells secrete proteins that's why it is abundant in endoplasmic reticulum

5) Parietal (Oxyntic) Cells:

- In upper part of gland
- Large pyramidal cells
- Central nucleus
- Abundant mitochondria gives Eosinophilic and acidophilic usually appear red in color
- Special features depending on activity
- Long life span is about 200 days

Most of the cells in the gastric epithelium have short life span, however parietal cells have long life span



- **Function:**

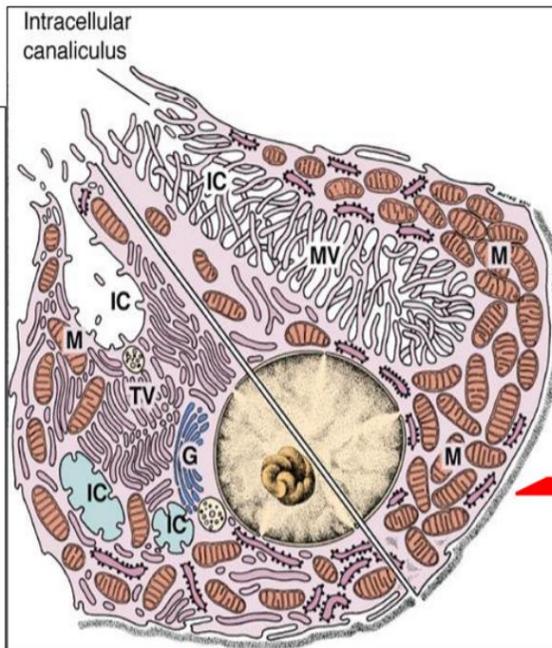
- a) **Secretion of HCl (for digestion)**

- b) **Secretion of Intrinsic Factor (Important for the absorption of Vitamin B12 which is important in erythropoiesis)**

the special features of parietal cells depend on the activity are:



Resting phase:
the canaliculus is short and the microvilli are absent; however, the cytoplasm is filled with **tubulovesicular structures** that fuse with the cell membrane when the cell is activated producing the deep canaliculus and the microvilli



Active phase:
the cell has a deep circular invagination, the **intracellular canaliculus**, into which protrude numerous microvilli. This provides an increased surface area for secretion

the microvilli provides surface area for secretion

The canaliculus is short and filled with tubular structures and vesicles structures

So once the cell is activated the tubulovesicular will fuse with intracanalicular producing microvilli, the cell will return to active shape

Differences between Parietal and Chief cells of the gastric epithelium

Feature \ Cell	Parietal	Chief
Location	Upper part of gastric glands	Lower part of gastric gland
Size	Larger	Smaller
Cytoplasm	Acidophilic	Basophilic
Vesicles	Tubulovesicles	Secretory vesicles in the apical part of the cell
Secretes	Hydrochloric acid Intrinsic Factor	Pepsinogen Gastric Lipase

****The parietal cells are acidophilic due to presence of mitochondria and chief cells are basophilic due to presence of endoplasmic reticulum**

****vesicles are found in the apical cells**

****secretion :**

Hydrochloric acid is not stored inside the vesicle so in parietal cells there are pumps that become expressed when the cell is activated and intrinsic factor is thought that is stored in the tubular vesicles themselves and then secreted outside of the cell by exocytosis

Factors protecting gastric mucosa against HCl:

The parietal cell produce hydrochloric acid and the PH inside the stomach is low less than 2 it is very important for digestion but also is dangerous for the mucosa so there are several mechanisms for the mucosa to protect itself from HCL:

1. Mucus and bicarbonate secreted by the surface epithelium.

So the bicarbonate neutralize the acid in the stomach, so the surface of the stomach is high because of neutralization

2. The surface epithelial cells have tight intercellular junctions and ion transporters that maintain the H⁺ and HCO₃⁻ concentrations.

3. Rapid turnover of the surface epithelial cells: about 5 days.

Every 5 days new epithelial cells are formed whereas parietal cells have long lifespan

4. Extensive blood vessels in the lamina propria that provide nutrients, remove toxic material and help replace damaged cells.

Failure of these factors will make the gastric mucosa susceptible to damage by HCl and this will ultimately lead to ulceration. Damage to parietal cells will also lead to Vitamin B12 deficiency (due to lack of intrinsic factor), which causes pernicious anemia.

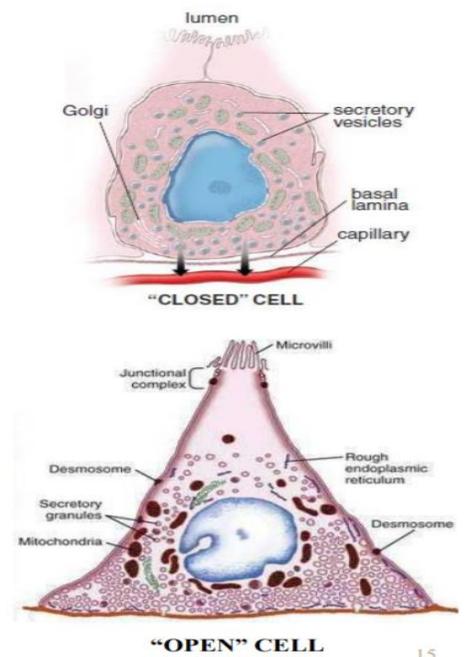
6) Enteroendocrine cells:

- Found in the lower part of the gland.
- Secrete hormones. which secretes hormones to the blood vessel in which the blood vessel is found in the lamina propria under the epithelium this is why the secretory granules found in the lower part of the cell
- Secretory granules are usually found in the lower part of the cell. Example: G-cells which secrete gastrin. (G is from the hormone they secrete)
- They could of two types: (whether they are in contact with lumen)

1. Closed type in which the cell is not in contact with lumen.

Closed cell rests on the basal lamina and the other cells surround the closed cell so it will not be in contact with the lumen

2. Open type: the cell has a wide basal region (rest on the basal lamina and have the secretory granules) with a thin apical process that reaches the lumen. The process ends in several microvilli which act as chemoreceptors that detect the contents of the lumen(so the cell is in contact with the lumen through apical process and microvilli).



Regional differences in mucosa

Anatomically the stomach is divided into 4 parts (the cardia/fundus/the body/the pylorus)

But histologically they are divided into 3 regions only :

1) The Cardia: simple branched spiral gland. Mainly mucus secreting.

2) Pylorus: Deep pit. 2-3 spiral glands open into pit. Mucus and Gastrin secreting.

3) Fundus/Body: Pit not deep. 5-7 tubular glands open into pit (**more glands opening into the pit**). All cell types, mainly Parietal and Chief cells, are present.

So the main function of the stomach performed by glands is found in the body /fundus because they have the majority of parietal and chief cells whereas the cardia and pylorus are mainly mucus secreting

Why we have in the cardia and pylorus excessive mucus secretion?

Because the cardia is where esophagus meet the stomach and pylorus is where duodenum meet the stomach so both of these sites have to be protected from hydrochloric acid by mucus because of it's harmful effects so if some acid passes through these regions they will be neutralized by mucus

The other layers: because we only talked about the epithelium of the stomach

- **Mucosa**: lamina propria is a loose connective tissue layer that surrounds and supports the gastric pits and glands. It's highly vascular and contains smooth muscle cells and some lymphoid cells. The muscularis mucosae is a smooth muscle cell layer that separates the mucosa from the submucosa.
- **Submucosa** is a connective tissue layer present under the mucosa. It contains the submucosal plexus (part of enteric nervous system) and some lymphoid cells, macrophages, and mast cells.
- **Muscularis externa** has 3 layers: outer Longitudinal, middle Circular and inner Oblique. Help mix food well with gastric juice also stomach provides mechanical digestion it breaks down food particles so it requires good muscle strength this is why we have 3 layers of muscularis externa. Circular layer in pylorus thickens to form the pyloric sphincter. The myenteric plexus (enteric nervous system) is located between these layers.
The pyloric sphincter is anatomical because we can see thickening of a muscle while in esophageal sphincter there is not anatomical because there is no thickening of a muscle (nor esophagus neither stomach and it is called physiological sphincter)
- **Serosa (visceral peritoneum)**: areolar connective tissue and mesothelium. Continuous with the lesser and greater omenta.

Good luck HOPE 😊