

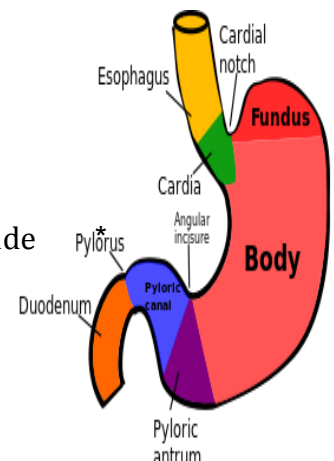
The doctor mentioned a few things about the esophagus from the previous lecture:

Esophagus

- It is about 25 cm in length (from the incisor it is 45 cm)
 - **Histological features:**
- **Mucosa:** Stratified squamous non-keratinized epithelium (protective function)
- **Lamina propria:** loose connective tissue, blood vessels, lymph nodes, sometimes has a gland: Cardiac Gland which is related to the cardia of the stomach and is therefore present in the lower third of the esophagus near the cardiac orifice.
- **Submucosa:** contains a group of mucus-secreting glands. Has a plexus: Meissner's plexus, which has parasympathetic input.
- **Muscularis Externa:** In the upper 1/3 → *Striated Muscles*. Middle → *Mixed*. Lower 1/3 → *Smooth Muscles*. It is a muscular tube. There is a plexus of nerves between the inner circular and outer longitudinal muscle layers called the Myenteric plexus which has both sympathetic (only passes through plexus) and parasympathetic input.
- Most of the esophagus is in thorax and neck → covered by **Adventitia** (connective tissue)
- Below the diaphragm (around 1.3 cm only) → covered by **Serosa** (simple squamous epithelium)

Stomach

- ❖ **Anatomically** divided into: fundus, body, and pylorus.
 - Has lesser curvature on left side and greater curvature on right side
 - Has anterior + posterior surface.
 - Located in the epigastric region.
 - Completely covered by peritoneum.
 - Both an endocrine and an exocrine organ.



- **Histologically** divided into 3 parts: (different from anatomical divisions)

1. Cardia: a small area below the cardiac orifice.

- • Cardiac orifice: is a **physiological** sphincter that prevents regurgitation of acidic chyme to the esophagus, it **is not** an anatomical sphincter because there is **no** thickening in the inner circular smooth muscle layer (unlike the pyloric sphincter).

2. Fundus and body: (both of them have the same histological structure)

- Main function: digestion and formation of gastric “acidic” chime

3. Pylorus: divided into three parts anatomically:

a) **Antrum**

b) **Pyloric canal:** 1 inch long

c) **Pyloric sphincter:** is both an anatomical + physiological sphincter because there **is thickening** in the inner circular smooth muscle layer.

- The imaginary line extending from Incisura Angularis (a small notch on the lesser curvature) to the most dependent point of the greater curvature separates the body from the pylorus.

After that comes the first part (inch) of duodenum:

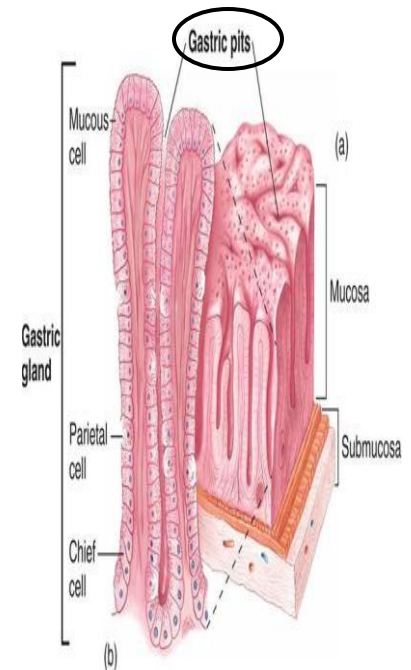
- It is important: **Why??** It is a common site of duodenal ulcer. **How??** Acidic Chyme stays in the stomach for 2-4 hours, it is then evacuated little by little on opening of the sphincter and it collects at the pylorus. It is evacuated into duodenum and causes **irritation** to the mucosa and hence **duodenal ulcers**, even though the duodenum secretes alkaline substances through glands. This is sense the alkaline secretions are not enough to neutralize the acidic chyme.
- Food stays in the stomach 2-4 hours and is digested then evacuated into the duodenum which completes the digestion of food - especially fats because the duodenum receives the common bile duct and the pancreatic duct and therefore the liver, gallbladder and pancreatic secretions complete the digestion of fat.

Histology of the stomach:

It consists of: mucosa, submucosa, muscularis externa and serosa.

i. Mucosa :

- **Lining epithelium:** simple columnar epithelium, the cells mainly secrete an alkaline mucus.
- It forms **rugae**: folding of submucosa and mucosa (submucosa invaginates through the mucosa) this is to increase the surface area of the stomach. This aids in digestion.
 - **Lamina Propria** (loose connective tissue) rich in:
 1. Blood vessels
 2. Lymphatics
 3. Gastric glands: Tubular glands (simple or branched). Have ducts called **gastric pits** that open onto the surface of the mucosa.
 - **Muscularis Mucosa**



❖ The characteristics of the mucosa and glands of the *Cardia*:

- The size of the gland's secretory portion vs. the duct: the area of the gland takes up mostly about half of the mucosa, and the duct (the gastric pit) takes up the upper half of the mucosa, so the ratio is approximately 1:1.
- Types of Cells present:
 - **Cheif Cells** are absent
 - **Parietal Cells** are very few in number
 - **Mucous Cells** are present
 - **Stem Cells** are present
 - **Endocrine Cells** are present.
- Most of the secretion is mucous and is rich in lysozyme (antibacterial enzyme)

Note:

- By the light microscope: we can see mucous + chief + parietal cells
- By the electron microscope: we can see enteroendocrine + stem cells

❖ The characteristics of the mucosa and glands of the *Fundus and Body*:

- Large area: mostly functions in digestion
- The size of the gland's secretory portion vs. the duct: the secretory portion fills up more than half of the mucosa whereas the gastric pits are wide and short. (Gastric gland fills up most of the lamina propria)

- These gastric glands have 3 parts :

a. Isthmus b. Neck c. Base

- Each type of cells is concentrated at a specific area

- Types of cells present in gastric glands:

1. Mucous (neck) cells:

- Concentrated at the **neck and the isthmus**.
- Simple columnar epithelium
- Secrete mucus to neutralize acids and protect the mucosa of the stomach.

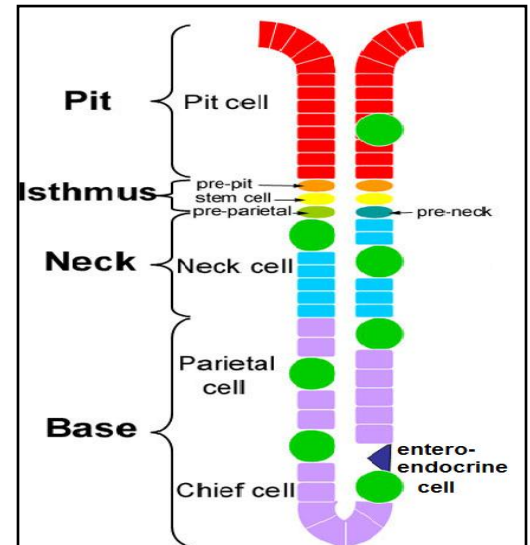
Q: How does the stomach protect itself from its own acidity? By the secretion of mucus by different cells: the mucous cells in the surface epithelium and the simple columnar mucous neck cells in the gland.

2. Stem Cells:

- Concentrated **between the isthmus and the neck**. They must be in the middle since when they undergo mitosis the cells may either ascend upward and replace surface mucous cells or they could move downward.
- Simple columnar epithelium responsible for regeneration by mitotic division.
- Turnover occurs every 4 to 7 days.

3. Parietal (Oxyntic) Cells:

- Concentrated at the **neck**, may be found in the isthmus as well.
- Secrete **HCl** and **intrinsic factor** which increases the absorption of vitamin B 12 **especially** in the ileum (in the small intestine).
- Slide 11: Light (faint) colored cells, Acidophilic → Parietal.



- May be **active** or **inactive**

The cytoplasm contains tubulovesicular structures

- Intracellular canaliculi present inside the cytoplasm
- Indicate HCL formation and accumulation of HCL towards the apex.

- Slide 12: related to biochemistry, not that important. What matters is to know that the canaliculi indicate accumulation of HCL at the apex.

5. Chief (Zymogenic) Cells:

- Concentrated at the **base**.
- Secrete **pepsinogen, gastric lipase** and possibly **rennin**.
- Have zymogenic granules at the apex and a basophilic base due to the presence of RNA and an abundant rough endoplasmic reticulum.
- Slide 11: Dark colored cells near the base, Basophilic → Chief Cells

6. Enteroendocrine cells:

- Concentrated at the **base**, some may be found **between the neck and the isthmus**.
- Secrete **gastrin**, a hormone which is important in digestion and secretion, and in its upper part it may secrete **serotonin**.
- *So the stomach is both an endocrine and an exocrine organ.*

❖ The characteristics of the mucosa and glands of the *Pylorus*:

- The size of the gland's secretory portion vs. the duct: the Gastric pits take up more than half of the mucosa and are long whereas the secretory portion is short (takes up less than half). This differs from one part of the stomach to another according to function and type of cells.
- Types of Cells:
 - Parietal: Very few in number
 - Chief cells are absent.
 - We might find other types of cells such as D cells which secrete somatostatin.
- Aggregation of lymphocytes and the formation of lymphatic nodules take place in the pylorus. This wasn't seen in the body or in the fundus.
- **The more distally you go in the GI tract, the more the lymphocyte aggregation seen.**
- **Type of Gland: coiling branched tubular.**

- **Pyloric Sphincter**: At the pylorus, the middle circular smooth muscle layer is greatly thickened to form the **pyloric sphincter**.
- **Pyloric Gland**: The pylorus has deep gastric pits into which the branched, tubular **pyloric glands** open. The secretory portions of the glands are short and the pits are longer.

❖ **SUMMARY:**

	<i>Stem Cells</i>	<i>Entero enocrine</i>	<i>Mucous Cells</i>	<i>Chief cells</i>	<i>Parietal Cells</i>	<i>Lymph nodes</i>	<i>Gland Size and Type</i>	<i>Duct size</i>	<i>Properties</i>
<u>Cardia</u> (small area below cardiac orifice)	✓	✓	✓	X	Few	X	Takes up the lower half of the mucosa	Takes up the upper half of the mucosa	Produce mucus and lysozyme
<u>Fundus + body</u> (large area)	✓	✓	✓	✓	✓	X	Takes up more than half of the mucosa. Simple branched tubular.	Takes up less than half of the mucosa. Wide and short.	Main function is digestion
<u>Pylorus</u>				X	Few	✓	Short – takes up less than half of the mucosa. Coiling branched tubular.	Long – takes up more than the half of the mucosa.	Aggregation of lymphatics is seen.

ii. Submucosa

- It invaginates through the mucosa to form rugae that increase the surface area of stomach and help in the digestion of food.

- ◆ **Miseener's plexus:** Parasympathetic. Responsible for the contraction of muscularis mucosa (changes the shape of mucosa) and for the gland in the submucosa. Some books say there is a connection between it and the Myenteric plexus.

iii. Muscularis Externa

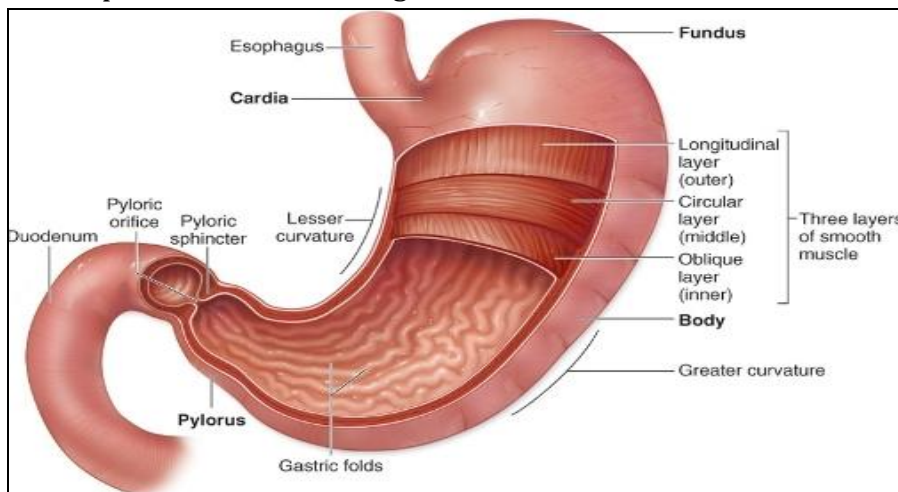
- We know that most of the muscles of GI tract the lower third of esophagus are **smooth muscles:** inner circular and outer longitudinal layer. The exception is the stomach which has:
 - Innermost Layer: Oblique
 - Middle Layer: Circular
 - Outer Layer: Longitudinal

◆ **Myenteric (Auerbach's) nerve plexus:**

- Lies between the outer longitudinal and inner circular layers of the muscularis.
- Responsible for peristaltic movement and secretions of the gastric glands.
- A recent paper states that this plexus may be a separate plexus independent of the CNS, and depends only on stimulations from the mucosa and the submucosa and performs a reflex action.

iv. Serosa:

- Simple squamous epithelial cells covering the stomach from outside.



Small Intestine

- It is about 6 meters in length.
- It consists of: **duodenum, jejunum and ileum**. To differentiate them:

	<i>Length</i>	<i>Relation with peritoneum</i>	<i>Relation with posterior abdominal wall</i>	<i>Shape of intestinal villi</i>	<i>Special landmarks (to distinguish)</i>	<i>Function</i>
Duodenum	10 inches or 25 cm	retroperitoneal (behind it) except for the first and last inches	Fixed with the posterior abdominal wall	Leaf-like projection	Brunner's Gland in the Submucosa	Complete digestion
Jejunum	-	intraperitoneal (completely covered by peritoneum)	Mobile	Finger-like projection	Has Plicae Circulares	Absorption
Ileum	-	intraperitoneal (completely covered by peritoneum)	Mobile	Finger-like projection	Peyer's patches and opposite to them: M Cells.	Absorption

Histology of small intestine:

- It consists of: mucosa, submucosa, muscularis externa and serosa or adventitia.

❖ **Mucosa**

- The epithelium is simple columnar epithelium. Could be for secretion or absorption.

It contains:

1. **Plicae Circulares:** resemble the rugae in the stomach.

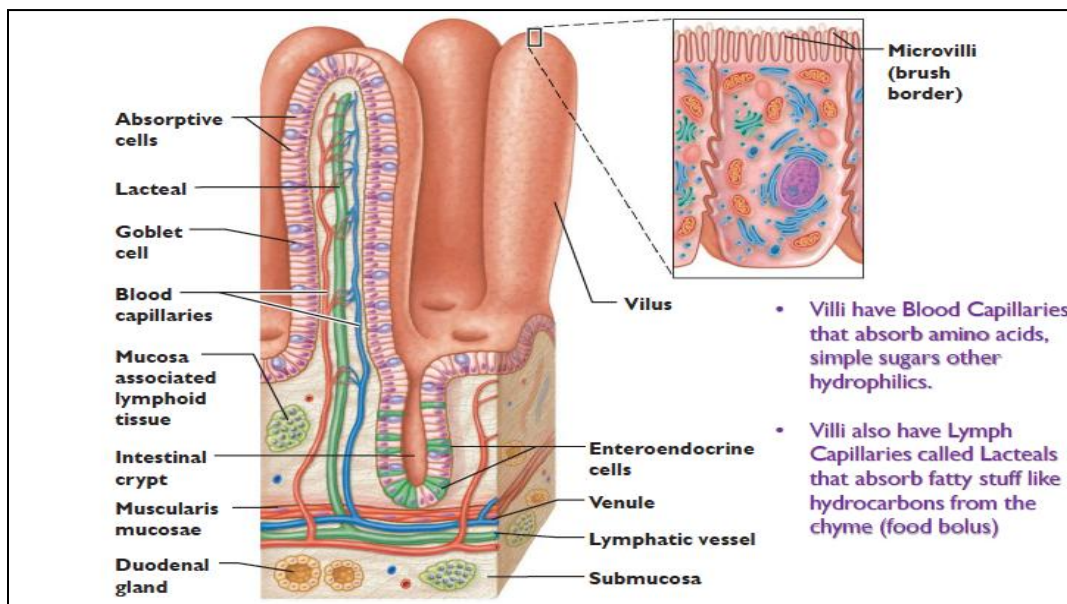
- An invagination of submucosa through the mucosa, to increase the surface area of small intestine for absorption.
- Very clear in the Jejunum.
- The mucosa of the small intestine forms finger-like projections on the side of plicae circularis; this is also to increase the surface area.

2. Intestinal Villi:

- Present as projections, shape differs among the duodenum, jejunum and ileum.
- 0.5 - 1.5 mm in length
- They are outgrowths of the mucosa (epithelium + lamina propria)
- In the **duodenum** → leaf-like projections
- In the **jejunum** and **ileum** → fingerlike projection
 - Upper half of the finger: Villi
 - Lower half of the finger: has glands (crypts of Lieberkühn)

❖ Histological Structure of The Villi:

1. The lining epithelium is made up of simple columnar epithelial cells (continuous with that of the gland)
2. Goblet cells are present on the surface
3. Smooth muscles are present
4. Its surface has **microvilli** and is referred to as the **Striated or Brush border** because it contains a large no. of microvilli. This increases the surface area.
5. Blood capillaries are present
6. Lymphatic capillaries are present and form blind ends at the end of the finger called **lacteals**. Lacteals are responsible for the absorption of fat. So fat in the small intestine has specific absorptive structures called lacteals present in the villi.





❖ Glands in the lamina propria :

• **Crypts of Lieberkühn/Lieberkühn glands/Intestinal glands:**

- Similar to the gastric glands in the stomach.
- The gland is also made up of *simple columnar epithelium* like the stomach, but the difference is that it HAS **Goblet Cells**:

- **Types of cells in the Glands:**

1. Goblet Cells:

- Glandular simple columnar epithelial cells.
- Secrete mucus
- Increase as you go distally. They are not present in the stomach. They are less abundant in the duodenum and increase in number as they approach the ileum and the large intestine (colon) due to its function: formation of feces which requires lubrication.
- These cells produce acid glycoproteins of the mucin type to form mucus, whose main function is to protect and lubricate the lining of the intestine

2. Enteroendocrine Cells

3. Stem Cells: present at the lower part base of the gland: replacement occurs from down to above in one direction.

4. Paneth's cells:

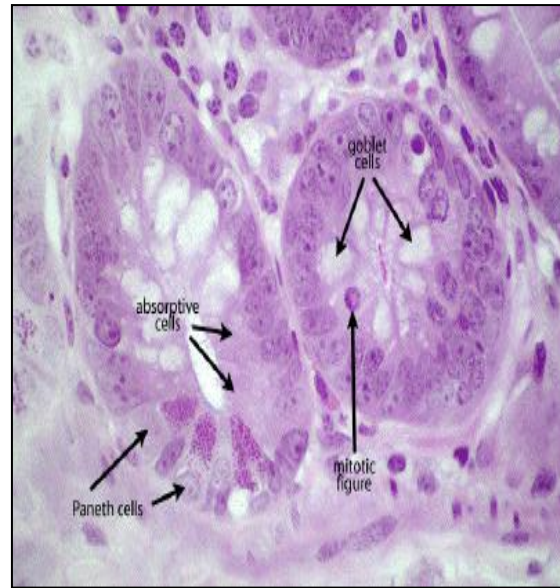
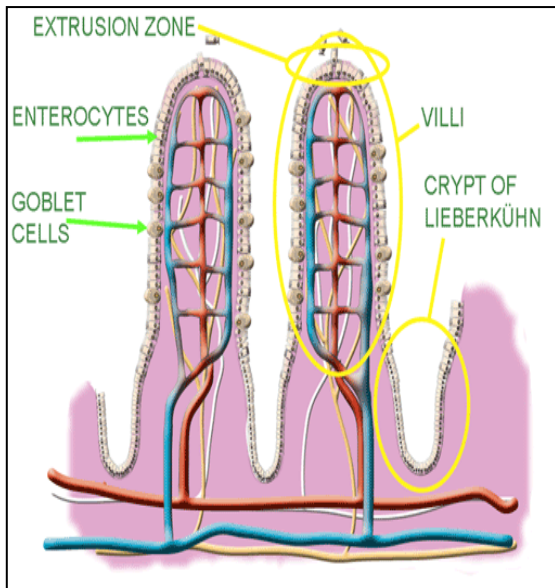
- Present at the base of the gland. Only present in the gland (crypts of lieberkuhn of small intestine), not present in the villi or the stomach.
- Clear in the **Jejunum** and **Ileum**
- Acidophilic
- It secretes the lysozyme which:
 1. Has a role in controlling the intestinal flora
 2. Is an antibacterial

5. Absorptive Cell/Enterocyte:

- Tall columnar cells, each with an oval nucleus at the basal half of the cell
- Each absorptive cell is estimated to have an average of 3000 microvilli, and 1 mm² of mucosa contains about 200 million of these structures
- At the apex of each cell is a homogeneous layer called the **striated (brush) border** (a layer of densely packed **microvilli**)
- The Brush border is very clear at the duodenum

6. Microfold Cells (M Cells) :

- Mostly present in **Ileum**
- Opposite to peyer's patches
- Reach the surface
- **Have macrophages + lymphocytes**
- Function: M cells can endocytose antigens and transport them to the underlying macrophages and lymphoid cells, which then migrate to other compartments of the lymphoid system (nodes)
- Form antibacterial and antiviral globuli.



○ What increases the surface area of small intestine??

1. Villi
2. Microvilli
3. Plicae Circulares

If we spread these surfaces their area would be 200 m²!!

❖ Submucosa

❖ Muscularis externa

❖ Serosa / Adventitia:

- Adventitia: for the posterior surface of the duodenum only since the anterior surface is covered by peritoneum and is hence covered by serosa.

Please forgive me for any mistakes

#sorry p: ولو رَجَع الزَّمانُ يَوْمًا لَ اِخْتَرْتُ الطَّبَّ غَضَبًا

Done by: Sara Al-S3ood ☺