HISTOLOGY

Lecture 2: Alimentary Canal (2) (Small Intestine)

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Color Guide:

- Black: Slides.
- Red: Important.
- Green: Doctor's notes (Female).
- Blue: Doctor's notes (Male).
- Orange: Explanation.

GIT Block – 432 Histology Team

Objectives

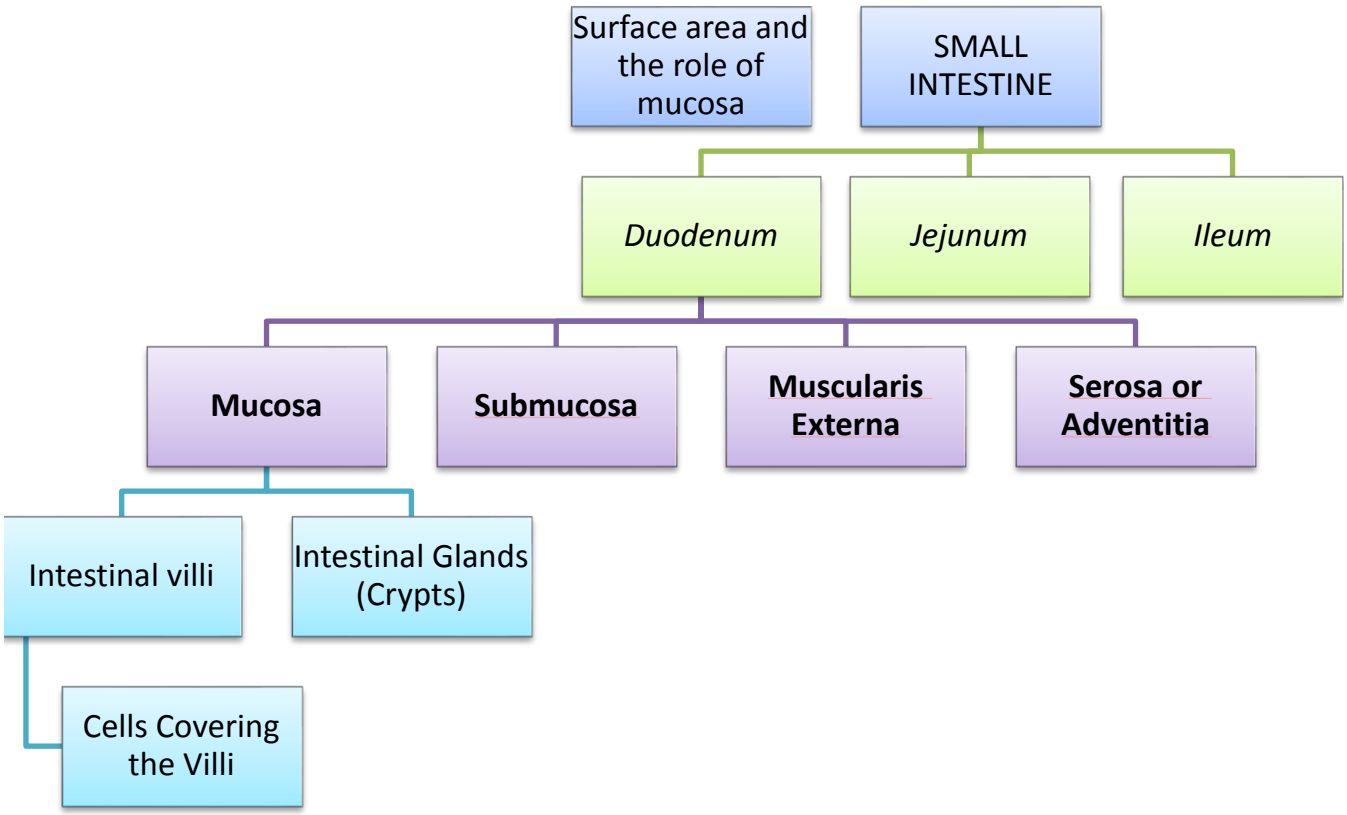
At the end of this lecture, you should describe the microscopic structure and the function of: the small intestine

1- Duodenum.

2- Jejunum.

3- Ileum.

Mind Map



Duodenum

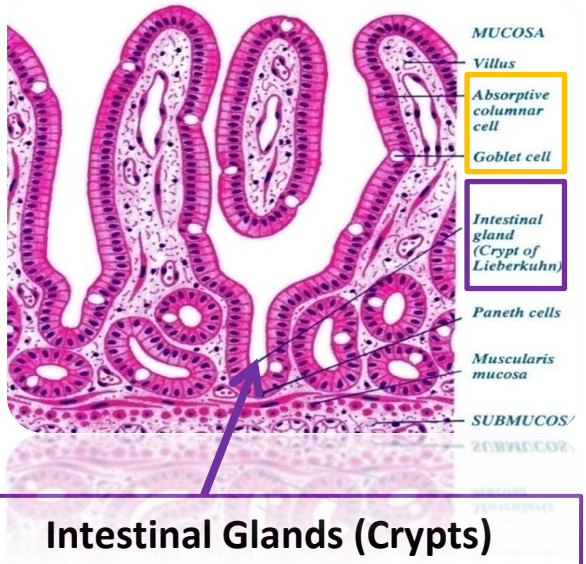
1. Mucosa:

Shows *villi* and *crypts*.

A- Epithelium: simple columnar epithelium with goblet cells. (Absorptive & contain the brush borders).

B- Lamina propria: C.T. (It has lymphatic nodules).

C- Muscularis mucosae: 2 layers of smooth muscle cells.



Intestinal villi (villus = single)

- Each Villus is a finger-like projection of small intestinal mucosa (lamina propria) and it is formed of:

I- **Central core** of loose C.T. containing:
- » Lymphocytes.
- » Fibroblasts.
- » Smooth muscle cells. (From the **Muscularis mucosae).**
- » Capillary loops.
- » Lacteal (blindly ending lymphatic channels). (They absorb the lipid component [free fatty acid (FFA) and monoglycerides → characteristic feature]. In the cell, FFA & monoglycerides aggregate to give triacylglycerol (TAG) then with cholesterol and phospholipids to form chylomicrons → lacteal → lymph → the general circulation).

II- **Villus-covering epithelium.**

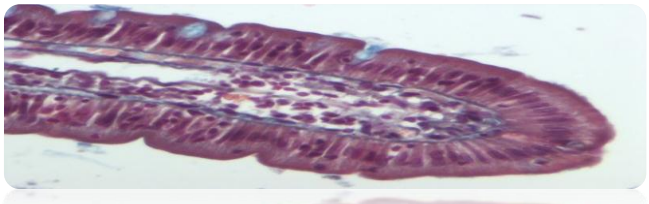
Cells Covering the Villi

1- Surface columnar absorptive cells: They have brush border (microvilli). They are covered with thick glycocalx (cell coat) that has digestive enzymes. They have Junction complex (tight, adhering and desmosome junctions).

2- Goblet cells: Increase toward the ileum.

3- Enteroendocrine cells (DNES cells). (Release hormones for regulation).

N.B: M cells (microfold cells): They phagocytose and transport antigens present in the intestinal lumen. They are mainly found within epithelium overlying lymphatic nodules of lamina propria. (It's an antigen-presenting cell).



Intestinal Glands (Crypts)

- Simple tubular glands that open between villi (invaginations of epithelium into the lamina propria).
- Composed of 5 cell types:

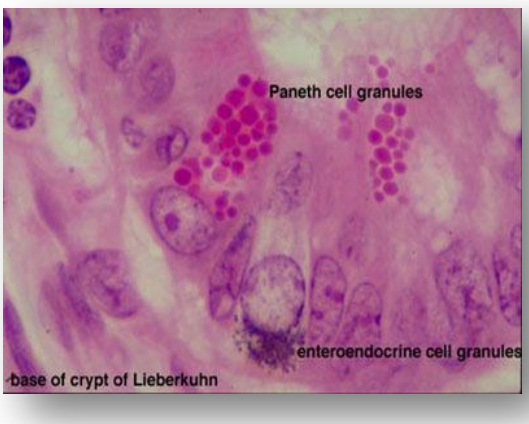
1. Columnar absorptive cells. (There might be food in the crypts and has to be absorbed).

2. Goblet cells: secrete **mucus**.

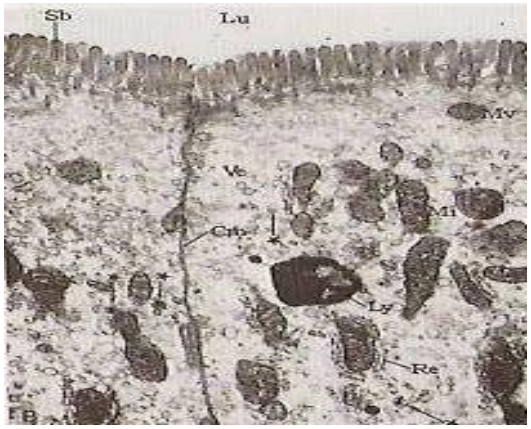
3. Paneth cells: secrete **Lysozymes** (antibacterial). (Maintains the sterile environment of the small intestine + they are "unique" only found in small intestine).

4. Enteroendocrine cells: secrete **hormones**.

5. Stem cells: regenerative cells.

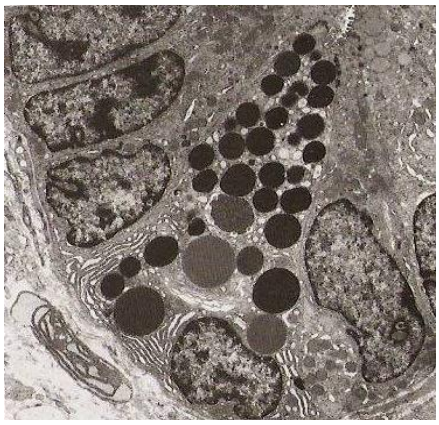


Electron microscopy in low power of the duodenal mucosal villi and crypts:



Columnar Absorptive cells

(It shows the complex junction which is important in leakage prevention of food or enzyme).



Paneth cell

(It shows the nucleus and the lysozymes which require abundant amounts of RER).

2. Submucosa:

- Connective tissue containing blood vessels & nerves.
- Contains **Brunner's glands** (secrete **mucus**). (It's a hallmark and it's an exocrine gland with ducts opening into the crypts and it's very important in neutralizing acidic chyme by releasing alkaline mucus).

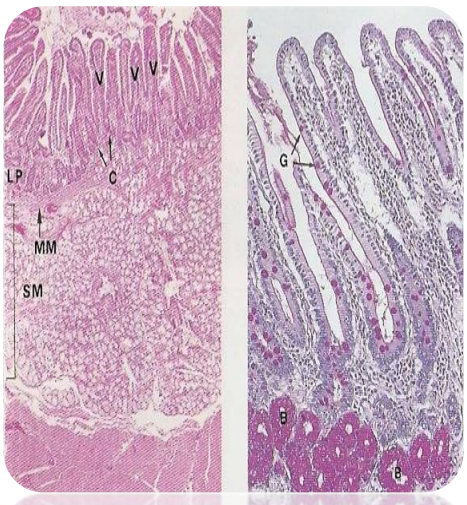
3. Muscularis Externa:

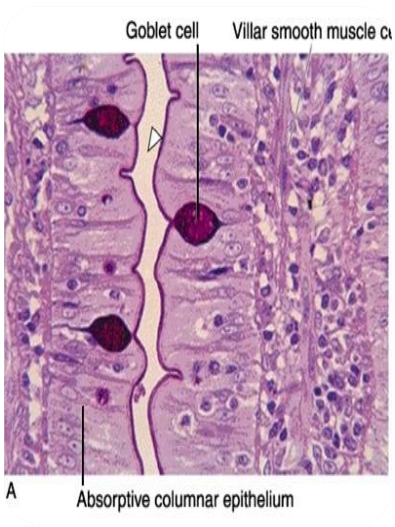
- 2 smooth muscle layers:
  - Inner circular layer.
  - Outer longitudinal layer.

4. Serosa or Adventitia:

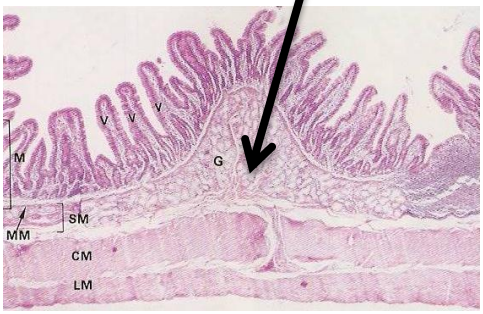
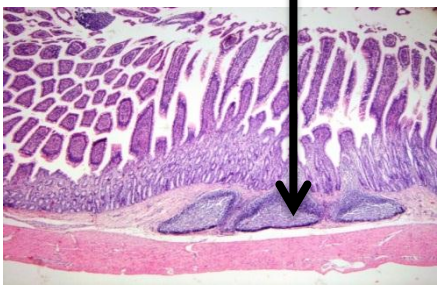
Except for the 2nd & 3rd parts of the duodenum, which have adventitia, the entire small intestine is invested by a serosa (because the 2nd and 3rd parts are covered by transverse colon → adventitia).

Microscopic pictures of the duodenum:





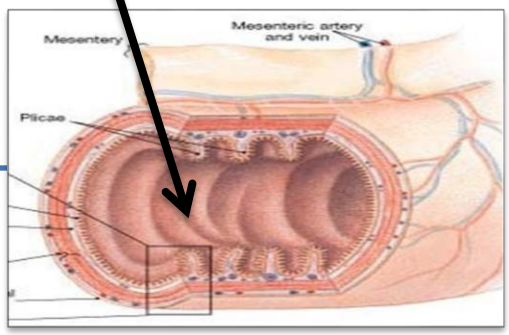
Regional differences of small intestine:

Duodenum	Jejunum	Ileum
Its submucosa has **Brunner's glands.**	It has **neither** Brunner's glands **nor** Peyer's patches.	Its lamina propria, opposite the attachment of the mesentery, has lymphoid nodules (**Peyer's patches)** that extend to the submucosa.
		

SMALL INTESTINE

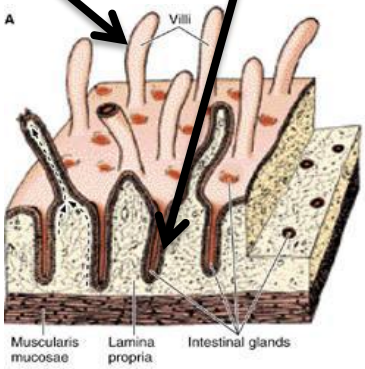
To increase surface area hence absorption, the mucosa has:

Plicae circulares (seen by the naked eye)



*** Villi** it increases the surface up to 10 times

*** Intestinal crypts** (crypts of Lieberkühn)



*** Microvilli (Brush border):** it increases the surface up to 20 times

Notes:

- **Plicae circulares** are transverse folds arranged in a circular pattern, it increases the absorption surface 2-3 times.
- They don't disappear because they don't distend for absorption (in opposition, rugae disappear in distended stomach).
- The **mucosa and submucosa** take the mountain-like fold shape but the muscularis externa and the serosa/adventitia are straight.

* Those structures are components of **the mucosa**, and the brush borders are parts of the epithelium covering the villi.

Summary

- The duodenum is the most important part of the small intestine, because it's where complete digestion and main absorption is found.
- **Plicae circulares:** increases 2-3 times, **Villi:** increases up to 10 times, **Microvilli:** increases up to 20 times so all of them increasing the surface for absorption about 600 times.
- Increasing the surface area enables the absorption of essential macro/micro nutrients even in slightest food intake.
- The duodenal mucosa has villi and crypts caused by the modified mucosal epithelium.
- **In the villi:**

❖ The cores land mark Lacteal (blindly ending lymphatic channels).
❖ The epithelium surrounding its core has the M cells and goblet cells.

- The **crypts** are simple tubular glands and their land mark is paneth cells.
- The microvilli at the apex of the simple columnar epithelium absorptive cell of the villus are highly folded to increase the surface area.
- The landmark in the sub mucosa of the duodenum is the presence of the Brunner's glands which are not found in the jejunum or the ilium.

Questions

Q1: Paneth cells secrete?

a- Mucus
b- Hormones
c- Lysozymes

Q2: The villus is covered by all the following except?

a- Simple columnar epithelium with goblet cells
b- Brunner's glands
c- Goblet cells

Q3: In which part of the small intestine we can find Peyer's patches?

a- Duodenum.
b- Ileum.
c- Jejunum.

Answers:

1	2	3
C	B	B

If you have any questions or suggestions please do not hesitate to contact us on:

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Best of luck!