Digestive System

University of Jordan

Faculty of Medicine

Batch of 2013-2019

Medical Committee
The University of Jordan

○ Slide ● Sheet ○ Handout ○ Other

☐ Anatomy ☐ Embryology

☐ Physiology ■ Histology

☐ Pathology ☐ Pharmacology

☐ Microbiology ☐ PBL

Sheet #: 3

Done by: Amr M. Najjar

Date: 8-4-2015

Price:

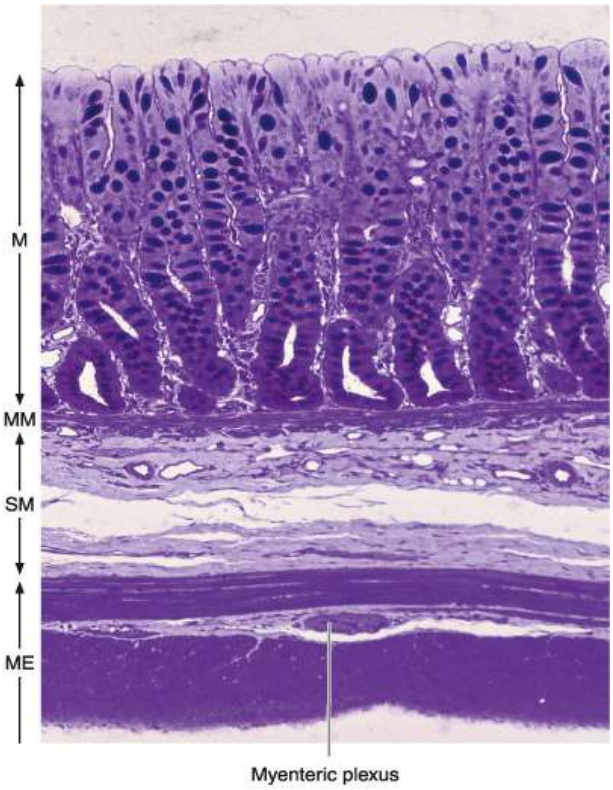
DESIGNED BY: TAMER ALTAMIMI "SMILE"

Large Intestine:

The large intestine consists of the cecum, appendix, ascending colon, transverse colon, descending colon, rectum, and anal canal. It absorbs water and electrolytes and forms indigestible material into feces, while the main function of the small intestine is absorption and secretion (histology of large intestines is different from histology of small intestines so they have different functions).

Same as esophagus and stomach and small intestines, intestinal wall is composed of the following layers (from the inner surface outward):

i. **Mucosa (mucous membrane):** consists of (1) an epithelial lining; (2) an underlying lamina propria of loose connective tissue containing small glands; and (3) a thin layer of smooth muscle called the muscularis mucosa.



As you see in the right picture, features distinguishing large intestine from small intestine are:

1. A mucosal membrane with no folds except in rectum because the mucosa of rectum in the anal canal forms several longitudinal folds called the anal columns. The mucosa of large intestine appears

smooth comparable to mucosa of small intestine with distinct projections.

2. No villi present in large intestine, while small intestine has finger like projections to increase surface area for absorption. Instead, large intestine has a very short projections called microvilli.
3. Intestinal glands of large intestine (also called crypts of Lieberkühn):
    - Enteroendocrine cells: numerous in small intestine, few in large intestine.
    - Paneth cells: located in the basal portion of small intestinal glands, they are absent in large intestine.
    - Goblet cells: present in the lining of epithelium in mucosa and glands, more numerous in large intestine than in small intestine because one of the functions of large intestines is formation of feces, so we have these gland numerous here to further lubricate the feces.

    These are simple tubular glands. (Epithelial lined tubules open on the apical surface).

4. Muscularis mucosae is well developed in the large intestine (two or three bands of smooth muscle are obviously seen), while it is undefined in small intestine.

ii. **Submucosa:** contains denser connective tissue with larger blood and lymph vessels. Lymphatic nodules present in lamina propria may be solitary (only one nodule) and extend to submucosa. There is no glands in the submucosa of large intestine. Remember

that only duodenum in the small intestine contains glands in its submucosa, they're Brunner's glands.

iii. **Muscularis externa:** is composed of smooth muscle cells organized as two sub layers inner circular and outer longitudinal as well as myenteric (Auerbach's) nerve plexus between them.

- Outer longitudinal layer of muscularis of the colon is subdivided into three thickened bands of smooth muscle called teniae coli.

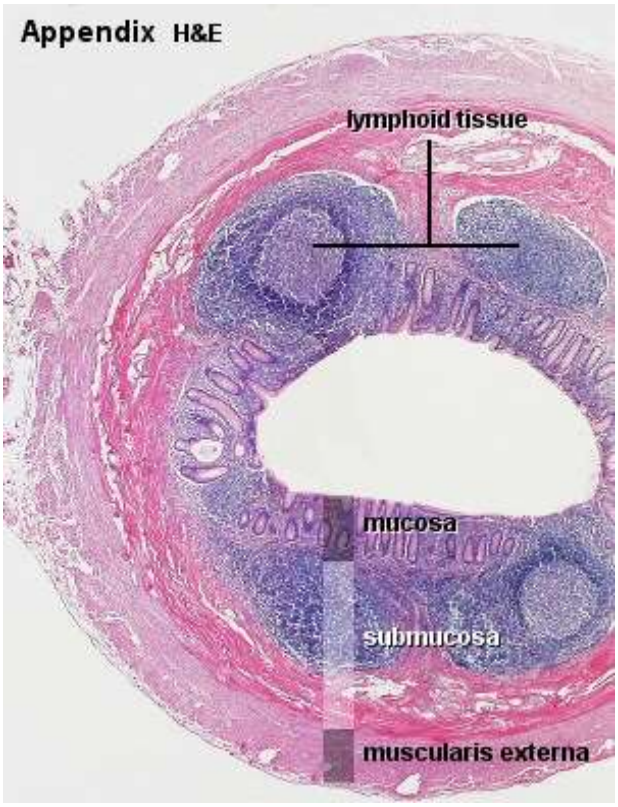
- Note: appendices epiploicae (tags of fat): are small pouches of the peritoneum or extensions from serosa filled with fat and situated along the colon. This aggregation of fat is important for energy.

- Note:
  - Intraperitoneal organs are covered in serosa (i.e. transverse colon).
  - retroperitoneal organs are covered in adventitia (i.e. ascending and descending colon) except the anterior wall of these organs because the peritoneum covers their anterior wall.

Remember: intestinal villi in small intestines, no villi in large intestine instead it has microvilli. Duodenum has glands in its submucosa. Glands are tubular and they open on the surface. Muscularis is well defined in large intestines. You might have solitary lymphatic nodules in lamina propria and extending

through the submucosa. In large intestines you have teniae coli (from outer longitudinal muscularis externa) and appendices epiploicae (from serosa). Mucosa has no foldings in large intestines (but in rectum and anal canal you have longitudinal foldings, called anal columns and its ends are called anal valves and sinuses, and these structures along with veins might make tortuous and engorged veins and it end up by biles called Hemorrhoid (البواسير), so if there was dilatation and varicose of these veins, you will have Hemorrhoid (Hemorrhoid are biles in the anal canal) these Hemorrhoid go out from the anal canal and sometimes they might cause bleeding.

Appendix:



It is a part of the large intestine connected to the cecum. Appendicitis is the most common abdominal emergency. If you are working in emergency medicine, every single night you will face 3-4 patients with appendicitis.

Even if we are 60% suspicious of appendicitis, we do appendectomy; there is no antibiotics or other treatments. The only treatment is an immediate appendectomy because if appendix is left untreated, it may

rupture and cause peritonitis (spread of infection in whole abdomen) and it's a potentially fatal infection.

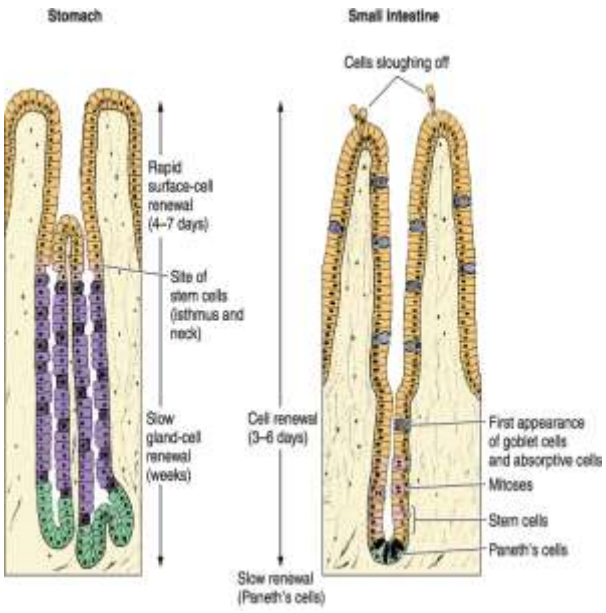
Appendix has a very small and narrow lumen. Appendix is a lymphoid tissue and has a role in immunity especially in children. It has no associated role with the digestion. In the right iliac fossa, Cecum has an opening for Appendix.

1. The lining epithelium of mucosa is simple columnar epithelium.
2. There is no importance for goblet cell in appendix, so they are decreased in number compared to the colon where these cells are very numerous.
3. The lamina propria contains crypts of Lieberkühn (intestinal glands) but with no significant function, so they are also decreased in number.
4. What really characterize the appendix is a lymphoid tissue that fills lamina propira passing and extending to submucosa.
5. Muscularis externa has inner circular and outer longitudinal smooth muscle. It differs from large intestine that it has no tinea coli. It has a mesentery called mesoappendix (it's covered by serosa, completely covered by peritoneum). The mesoappendix is two layers of peritoneum covering the appendix and containing the appendicular artery and vein. Appendix is covered by serosa.

Cell Renewal in the Gastrointestinal Tract:

1. **In stomach** the site of stem cells is neck between each gastric pit and gastric glands. These cells have a turn over time of 3 to 7 days. Some of these move upward to replace surface mucous cells while other progenitor cells migrate more deeply and differentiate into the secretory cells of the glands. The regenerated cells move upward or downward.
2. In **small intestine** stem cells are located in the base of each gland and they have a turn over time of 3 to 6 days. They might ascend or descend

- Note: stem cells can't be seen under the light microscope, they are seen by electron microscope.



Liver:

It is the largest gland in the body, weighs around 1.5 kg. It present in the right hypochondriac region and extends to epigastric region; left lobe of the liver overlies esophageal hiatus and fundus of stomach in epigastric region. It has five surfaces as we will learn in gross anatomy.

Liver is one of the association organs of the GI tract. The liver commonly repairs itself by rebuilding new liver cells when the old ones are damaged; if seven-eighths of the liver is damaged, only one-eighth of liver is enough to do necessary physiological functions of the body. But the problem is that if the patient has liver fibrosis, it will spread to all his liver cells suddenly and extensively. Fibrosis even would not leave any intact portion of liver to do normal physiological functions. One of the alcohol abuse complications is liver fibrosis or cirrhosis.

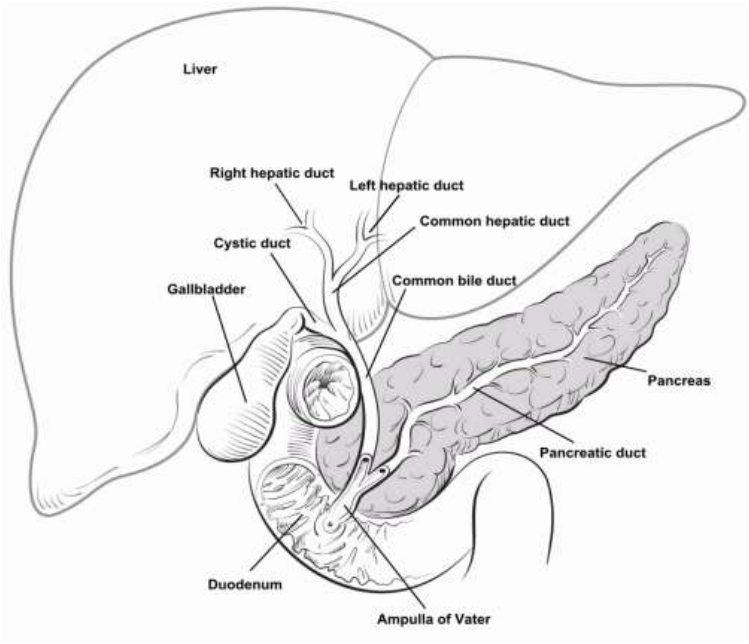
Functions:

- Exocrine and endocrine functions-an exocrine gland, secreting bile and bile salts into the intestine.
- Synthesis of some hormones, enzymes, and coagulative materials that help in coagulation.
- Detoxification of toxins through bile secretion.
- Synthesis of many proteins (i.e. albumin, globulins, antibodies "immunoglobulins" …)
- Metabolism of proteins, fat, and carbohydrates.
- Storage of glycogen for energy.

So, all the materials absorbed via the intestines reach the liver through the portal vein.

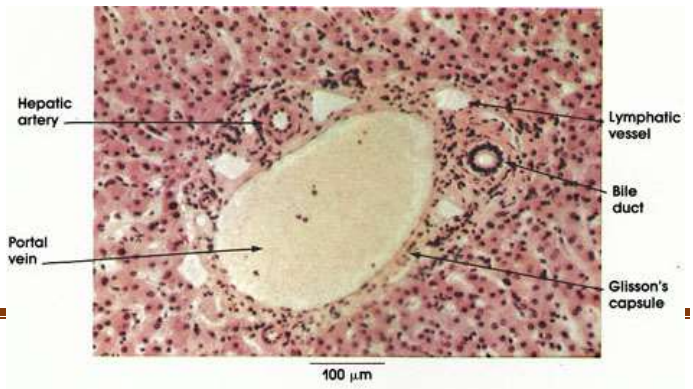
1. Hepatocytes receives oxygenated blood from hepatic artery-a branch from celiac trunk of abdominal aortal.
2. Hepatocytes receives unoxygentaed blood full of nutrient material from the portal vein.

3. The left and right hepatic ducts exit from the liver and join to form the common hepatic duct in an area called the hilum. Lower down, the gallbladder joins the common hepatic duct through a small duct called the cystic duct. The combined duct is called the common bile duct. The common bile duct passes through part of the pancreas before it joins with the pancreatic duct and empties into the duodenum at the ampulla of Vater. The bile and bile salts produced by the liver is important in the digestion of fat.



4. Glisson's capsule (capsule of the liver): a layer of thin connective tissue surrounding the liver and ensheathing the hepatic artery, portal vein, and bile ducts within the liver. Each lobe is subdivided into lobules by these capsules. (It divides the liver into lobes and lobules).

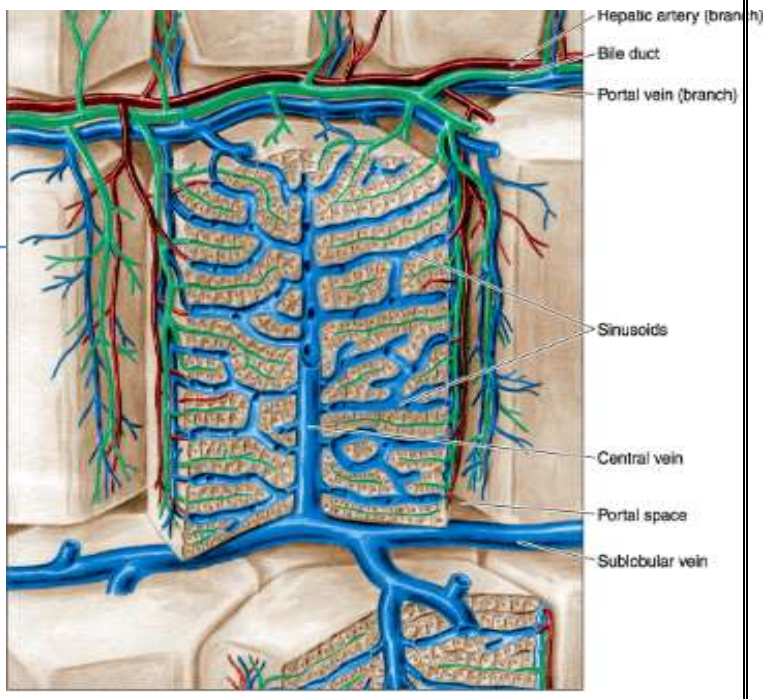
The hepatocytes are characterized by: (important question)



- central rounded nucleus (some hepatcytes might be binucleated).
- The base is basophilic (basophilic bodies)
- radially disposed around central vein
- hexagonal lobules (in the center of the hexagonal lobules, there's central vein, and hepatocytes radiate to this central vein)

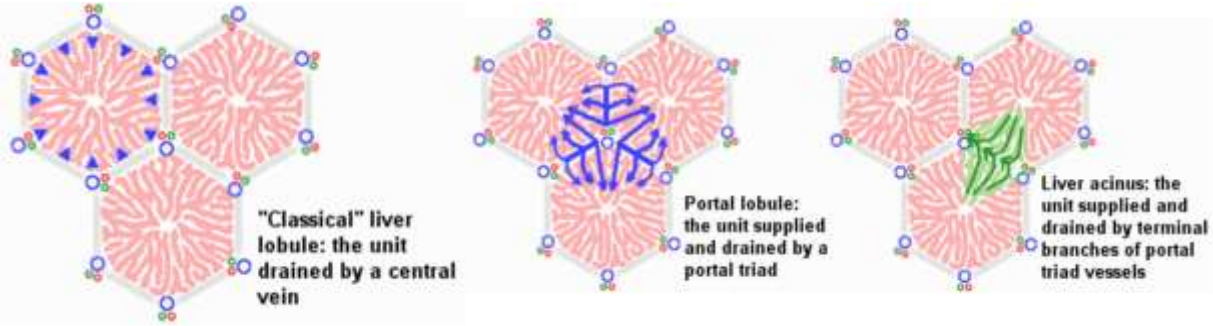
- On one side of the hepatocytes, we have Liver sinusoids that receive the blood from hepatic artery (oxygenated blood) and portal vein (loaded with nutrients). After hepatocytes have done their action they carry deoxygenated blood to central vein of in the center of the hexagonal lobule.
- Portal triad is the area at the corner of hexagonal. It contains: (1) bile duct (bile ductule), (2) hepatic artery, (3) portal vein, lymphatics and connective tissue.

  They drain into central vein hepatic vein inferior vena cava



  This is classical liver lobule. It is hexagonal in shape. In the center you notice central

vein, at the corner you notice portal triad or portal space (bile duct, hepatic artery, portal vein)



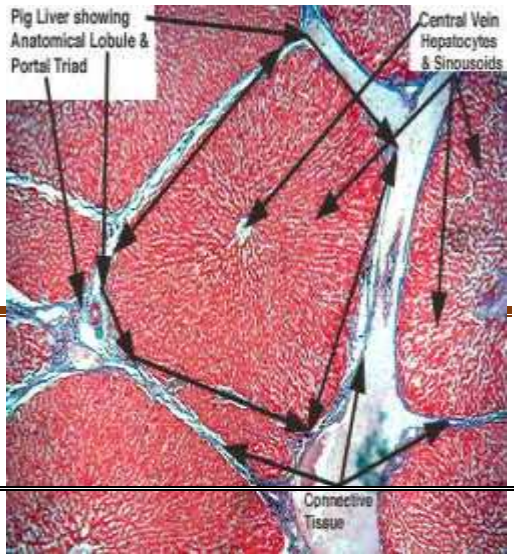
There are three types of lobules in the liver:

1. Classical: central vein is present in its center
2. Portal : portal triad is present in its center, between three adjacent classical lobules
3. Liver acinus: diamond, between two central veins and two portal triads, depends on oxygen reaching hepatocytes, the area between two portals is rich in oxygen while around the area around central vein has less oxygen.

Look at the following figures to the right, and be sure to identify:

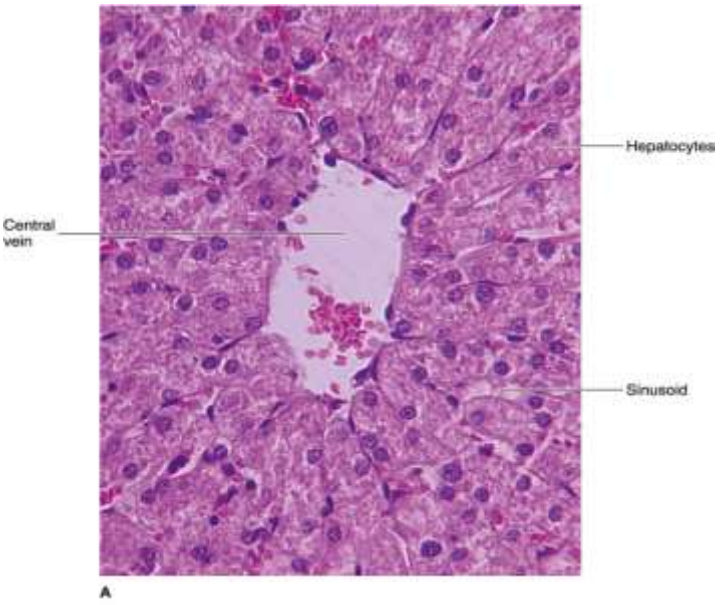
Classical lobule in humans

- Central vein
- Connective tissue

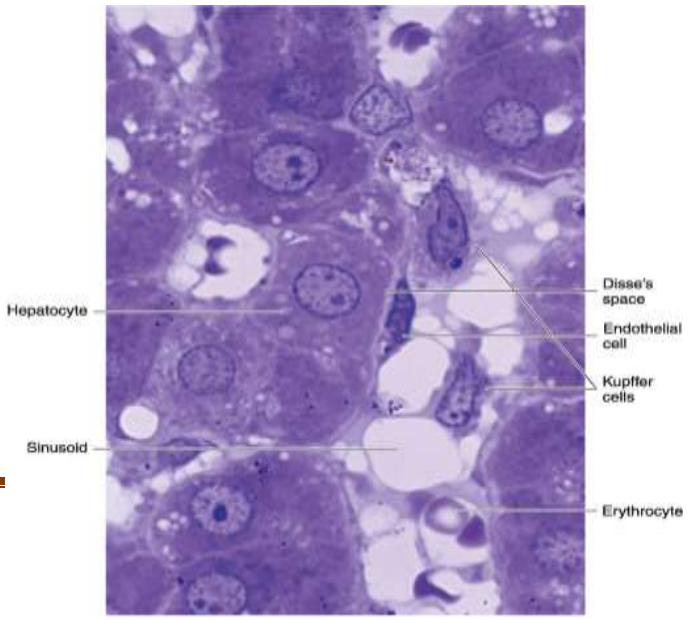


- Portal triad (found in corners).
- Branch of portal vein is the largest structure (lumen is very large), while the arteriole from hepatic artery is rounded and small, the bile duct consists of simple cuboidal epithelial cells and contains bile so it appears violet in color.

- Central vein
- Hepatocytes: deposited radially
- Liver sinusoids: spaces in one side of hepatocytes, they contain mixed blood from hepatic artery and portal vein. The epithelium lining the Liver sinusoids is fenestrated endothelial epithelium.



- Hepatocytes
- Sinusoids
- Kupffer cells: macrophages in the wall of Disse's space that make metabolism of



old aged erythrocytes, digest hemoglobin and bacteria.

- Disse's space: between hepatocytes and endothelial wall of sinusoids (like a barrier between them). There is no direct communication between blood in sinusoids and blood in hepatocytes because of this space that separates between them. It contains fat cells called "ito cells" (lipid droplets in the cell body of these cells store vitamin A), microvilli, and reticular fibers.

- Note: direction of blood from artery and vein to the sinusoids, whereas the direction of bile is from bile duct toward porta hepatis (bile duct "canaliculi" is found between 2 adjacent hepatocytes). Duct starts as canaliculus, bile ductile, then hering canal, then it becomes bile duct. Remember that sinusoids are found at one side of hepatocytes.

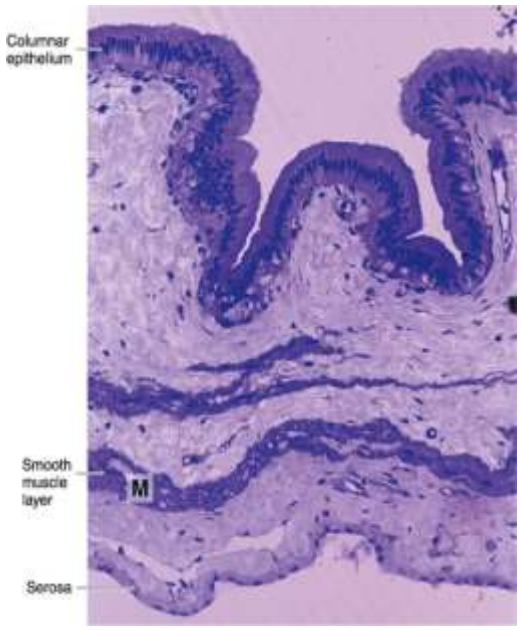
Gall Bladder:

It is attached to visceral surface of the liver. It is pear-shaped and has fundus, body, Hartmann's pouch, and neck. From neck cystic duct goes out, it joins the hepatic duct (hepatic duct comes from the right and left hepatic ducts) after this joining we will have common bile duct. Its function is to concentrate of bile. Imagine if the liver was the only source of bile secretion, then when somebody eats (كوارع), a meal full of fat, he needs 20 L of bile (because it is diluted secretion), while actually gallbladder secretes only 2 mL (because it is concentrated secretion). The gall bladder concentrates bile by the following mechanism:

- The sphincter of Oddi which opens in the duodenum is always closed, so the secretion from the liver goes back to gall bladder and absorption of water occurs and thus bile gets more concentrated.
- This sphincter opens by stimulation by CCK hormone (cholecystokinin), so the secretion can reach the duodenum.

Histology of gall bladder:

1. The lining epithelium is simple columnar epithelium.
2. No goblet cells.
3. Abundant folding of mucosa.
4. Lamina propria of gall bladder very and it contains no glands except in the neck there is tubuloacinar mucous gland near the cystic duct, so there will be production of mucus.
5. No submucosa or muscularis mucosa.
6. Irregular muscluaris externa: no inner circular neither outer longitudinal, and no peristaltic movement.

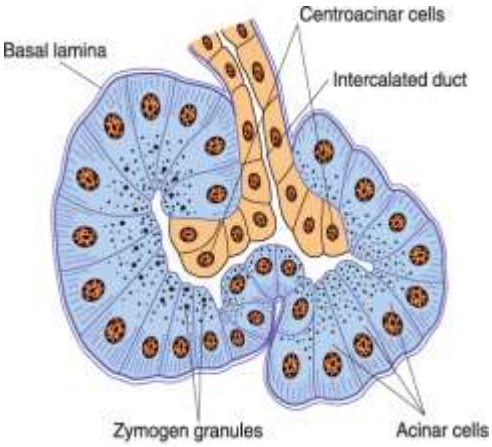


Pancreas:

It is a mixed gland (exocrine and endocrine), exocrine portion is named pancreatic acini (the same as parotid acini). Pancreas secretion contains a large amount of enzymes and proteins. the islets of Langerhans are the regions of the pancreas between acini, these islets of Langerhans contain its endocrine (i.e., hormone-producing) cells. They contain:

- Alpha cells: producing glucagon
- Beta cells: producing insulin
- Gamma and Delta cells

Exocrine portion – Pancreatic acini:



- Centroacinar cells: between acinar cells, these cells are not present in parotid gland. They are pale staining cells with large central nucleus.
- Intercalated duct: both striated and intercalated ducts are present in parotid gland, while in the pancreas only intercalated ducts are present, no striated ducts in pancreas.
- Cells of pancreas (pancreatic acini) is characterized by basophilic base, and acidophilic apex containing zymogen

granules. That is why the cells of pancreatic acini are highly polarized.

Differences between pancreatic acini and parotid acini:

- Pancreatic acini are characterized by
  1. Centroacinar cells
  2. Only intercalated duct
  3. No striated duct
  4. Polarity (not present in parotid)

Dedication to Correction Team

"If you can dream it, you can do it."

- Walt Disney

End of Sheet

Best of Luck :)