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Chapter 8

DIGESTIVE SYSTEM

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OUTLINE

- Introduction to digestive system
- The gastrointestinal tract
- Accessory organs of the gastrointestinal tract
 - Salivary glands
 - Liver
 - Gall bladder and biliary tree
 - Pancreas
- Histology of the gastrointestinal tract
- Embryology of the gastrointestinal tract
- Peritoneum

INTRODUCTION TO THE DIGESTIVE SYSTEM

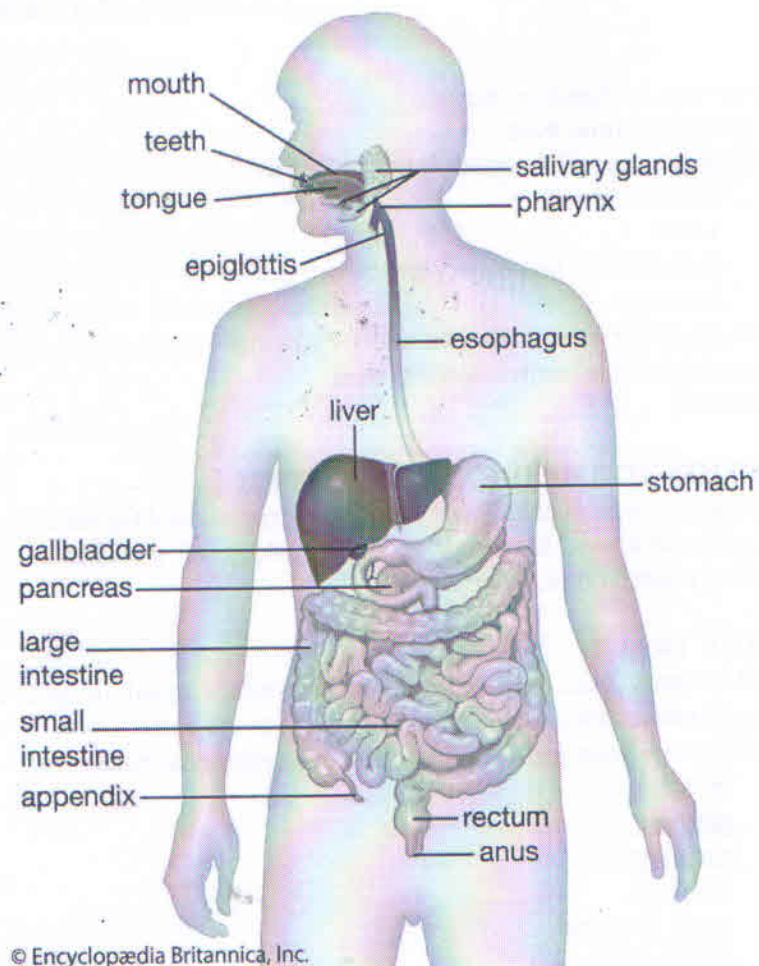
- The digestive system consists of the alimentary tract and the accessory digestive organs.
- The gross anatomy, histology and embryology of this system shall be discussed, including related clinical correlates.

ALIMENTARY TRACT

- The alimentary tract, also called the alimentary canal or gut, consists of a long continuous tube that extends from the mouth to the anus.
- The alimentary tract includes the following anatomical parts:
 - mouth
 - pharynx
 - esophagus
 - stomach
 - small intestine
 - large intestine
 - rectum; and
 - Anal canal

ACCESSORY DIGESTIVE ORGANS

- These include the salivary glands, liver, pancreas and gall bladder. These either secrete or release substances (e.g. bile and enzymes) that facilitate digestive processes.



Hightower *et al.*, 2024

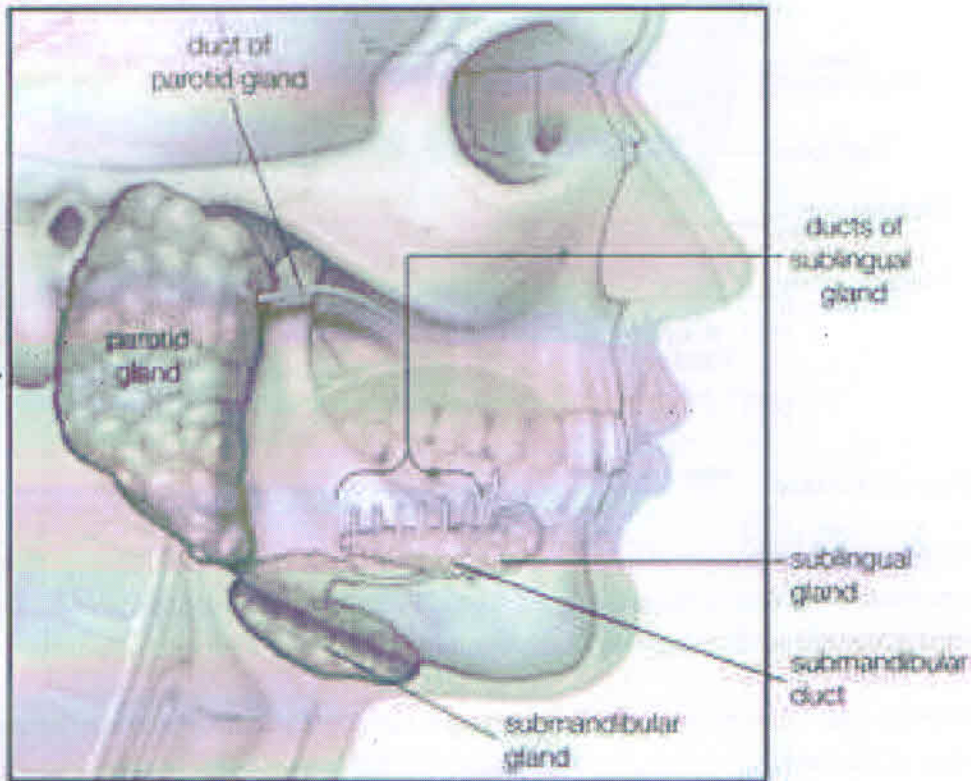
Figure 8.1. Overview of the alimentary tract and accessory digestive organs.

SALIVARY GLANDS

- Three pairs of salivary glands communicate with the oral cavity. Each is an exocrine gland with numerous acini lined by secretory epithelium. The acini secrete the contents into specialised ducts in response to nerve signals that may arise with taste, smell or appearance of food.

The major salivary glands include:

- Parotid glands
- Submandibular glands
- Sublingual glands



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Image by Lecturio

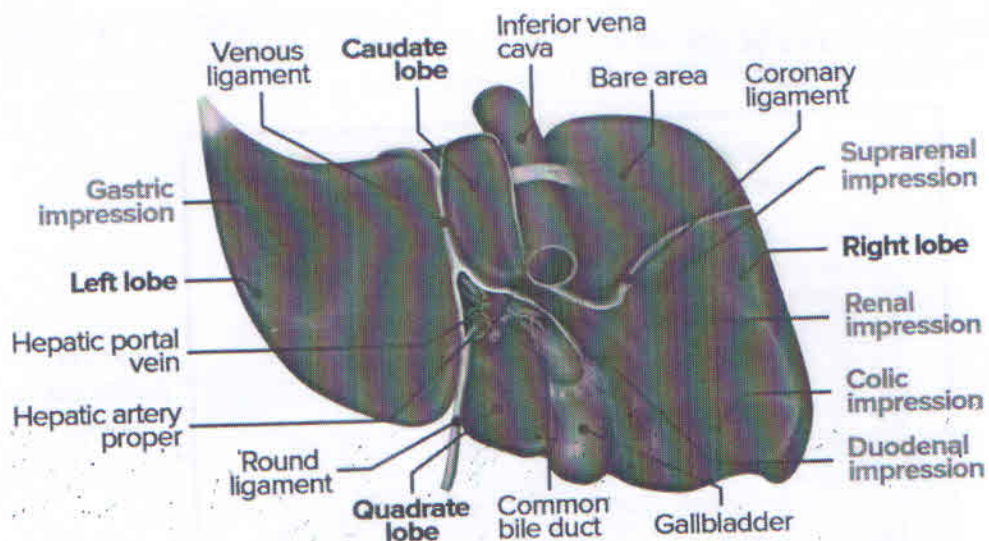
Salivary glands; 3 major pairs of salivary glands

LIVER

- The liver is a large, reddish-brown organ situated majorly in the right hypochondrium. It is surrounded by a capsule
- The liver is divided into four lobes namely the right, left, caudate and quadrate lobes. It produces bile, the substance that emulsifies fat.

Surfaces of the Liver

The liver has a 2 surfaces- convex diaphragmatic surface and concave visceral surface



Visceral surface

Inferior view of the visceral surface of the liver. Note the uneven structure that results from impressions of the neighboring organs. The colic impression is caused by the colon's hepatic flexure; the descending portion of the duodenum forms the duodenal impression.

Note the four lobes of the liver on the visceral surface: Caudate, quadrate, left and right lobes of the liver

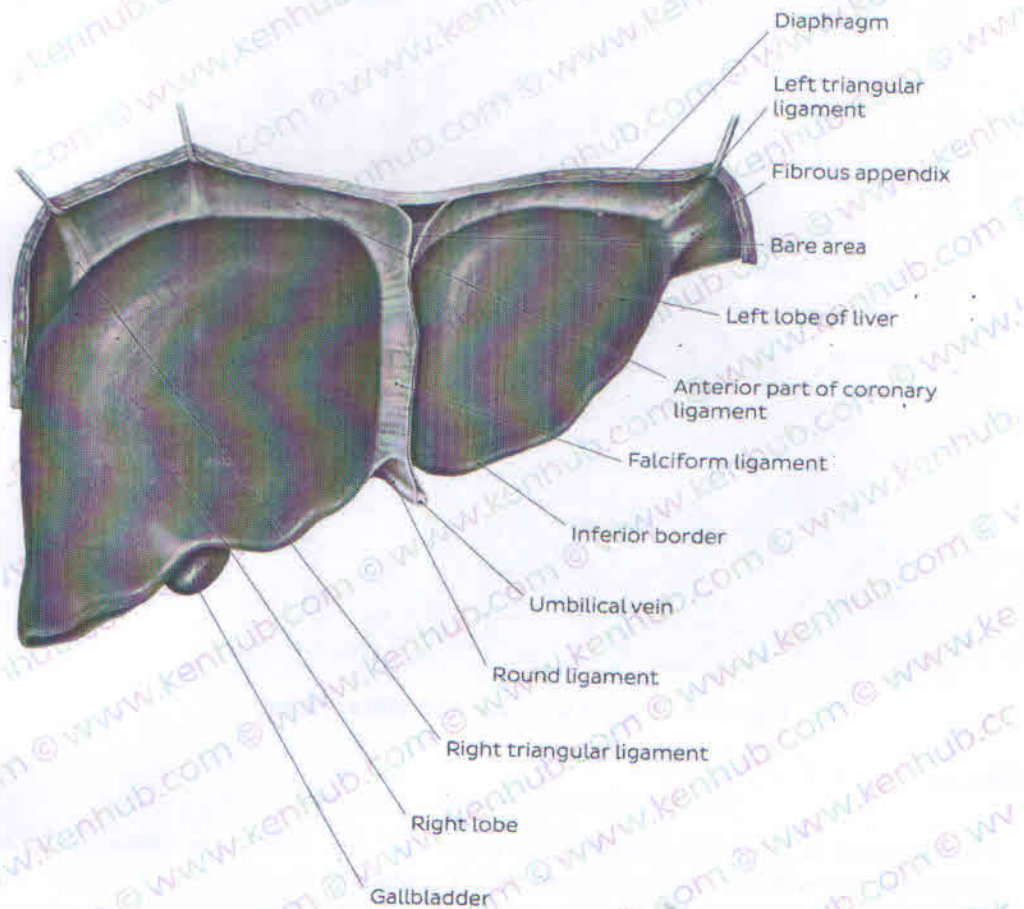
Caudate lobe

- It is located on the upper aspect of the visceral surface.
- It lies between the IVC & a fossa produced by the ligamentum venosum (a remnant of the fetal ductus venosum).

Quadrate lobe

- Located on the lower aspect of the visceral surface
- It lies between the gallbladder and a fossa produced by the ligamentum teres (a remnant of the fetal umbilical vein).

Convex Diaphragmatic Surface



Anatomy of the liver: Anterior view

GALL BLADDER AND BILIARY TREE

- The gallbladder is a hollow, pear shaped organ that sits in a depression on the posterior surface of the right lobe of the liver.
- It consists of a fundus, body and neck; and empties via the cystic duct into the biliary duct system.
- The main functions of the gall bladder are storage and concentration of bile. Bile is produced by the liver but stored in the gallbladder until it is needed. Bile is released from the gall bladder by contraction of its muscular walls in response to hormone signals from the duodenum in the presence of food.

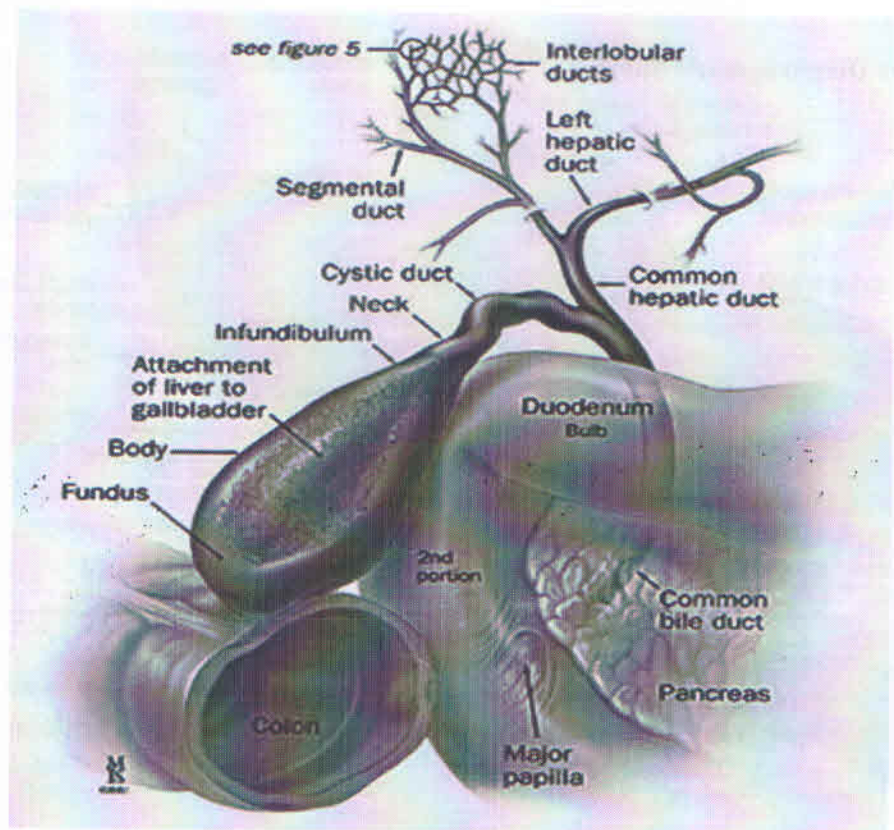


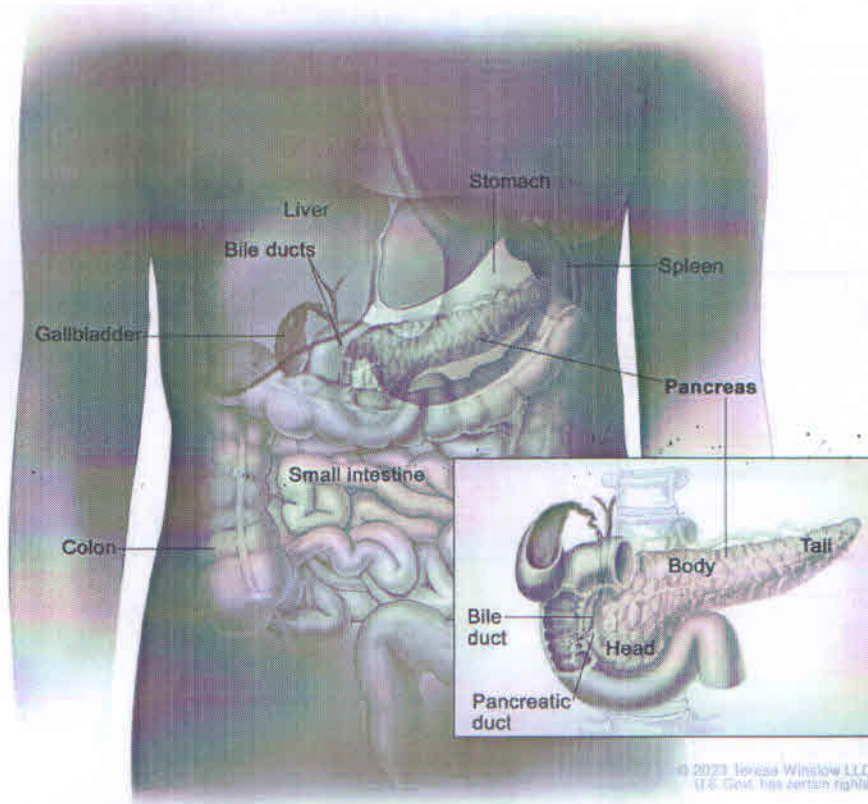
Figure 8.2: Gall bladder and Biliary tree.

PANCREAS

- The pancreas is a lobular, pinkish-grey organ that lies behind the stomach. Its head communicates with the duodenum and its tail extends to the spleen.
- The pancreas is approximately 15cm in length, with a long, slender body connecting the head and tail segments.
- The pancreas has both exocrine and endocrine functions. The exocrine portion makes up 80-85% of the pancreas. The endocrine pancreas consists of the islets of Langerhans that produce insulin and glucagon.

Anatomy of the Pancreas

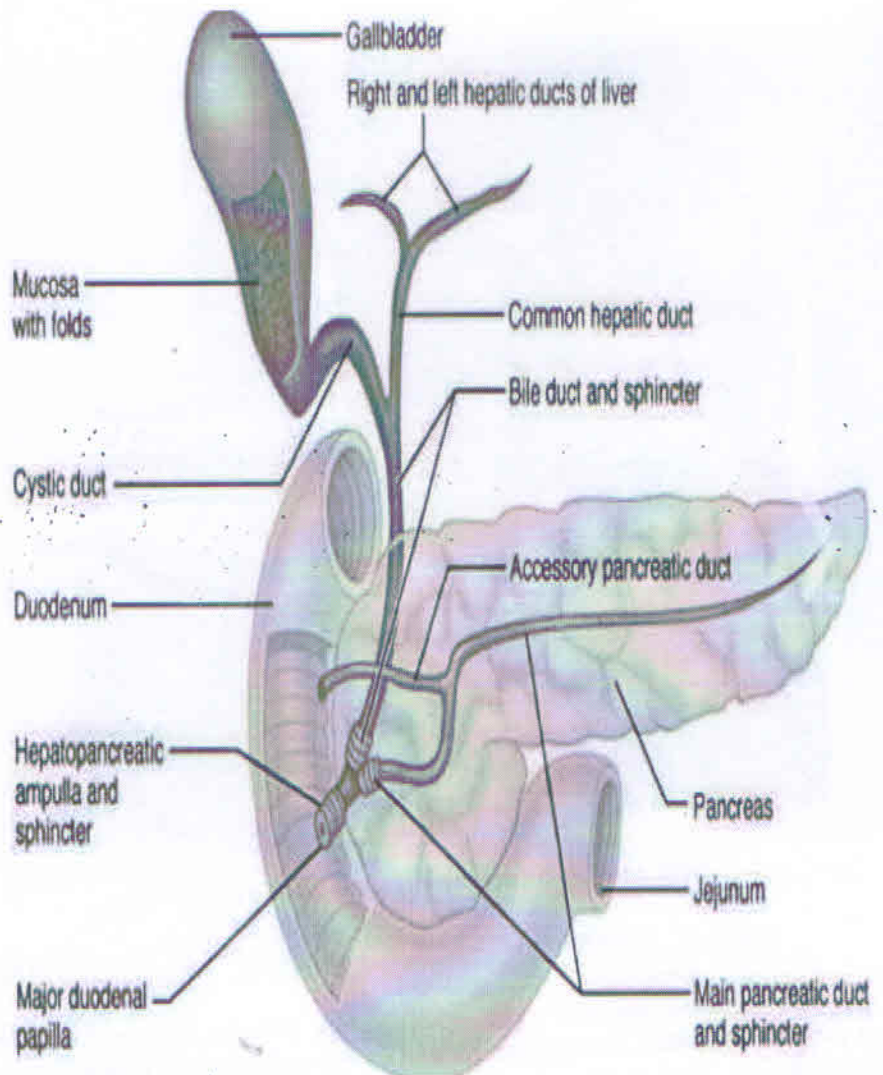
The pancreas has three areas: the head, body, and tail. It is found in the abdomen near the stomach, intestines, and other organs.



Source: National Cancer Institute

DUCTS OF THE PANCREAS

- It has two main ducts:
 - ✓ **main pancreatic duct**, and
 - ✓ **accessory pancreatic duct**.
- The ducts drain enzymes through the **ampulla of Vater** into the duodenum.
- It measures about 15-25cm long



HISTOLOGY OF THE GASTRO-INTESTINAL TRACT

- Gastrointestinal tract (GIT) has a general plan of histology with some distinctions that reflect the specialization in functional anatomy of the different segments of the tract.
- The GIT can be divided into four concentric layers in the following order (from internal externally):

- Mucosa
- Submucosa
- Muscular is external (external muscular layer)
- Serosa (for the most part)

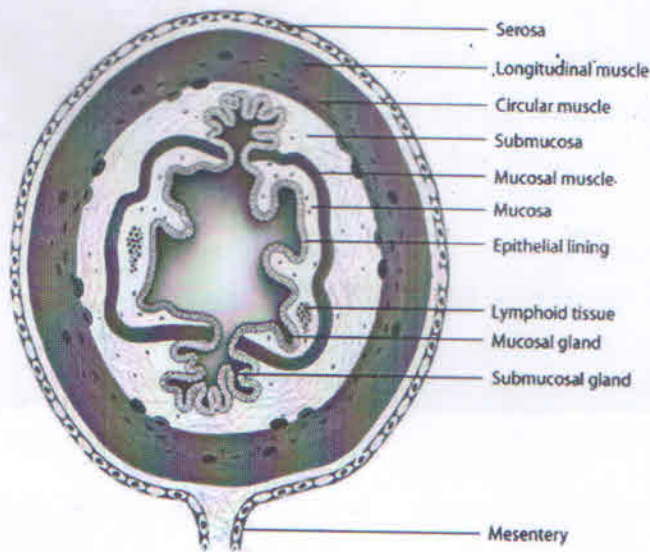
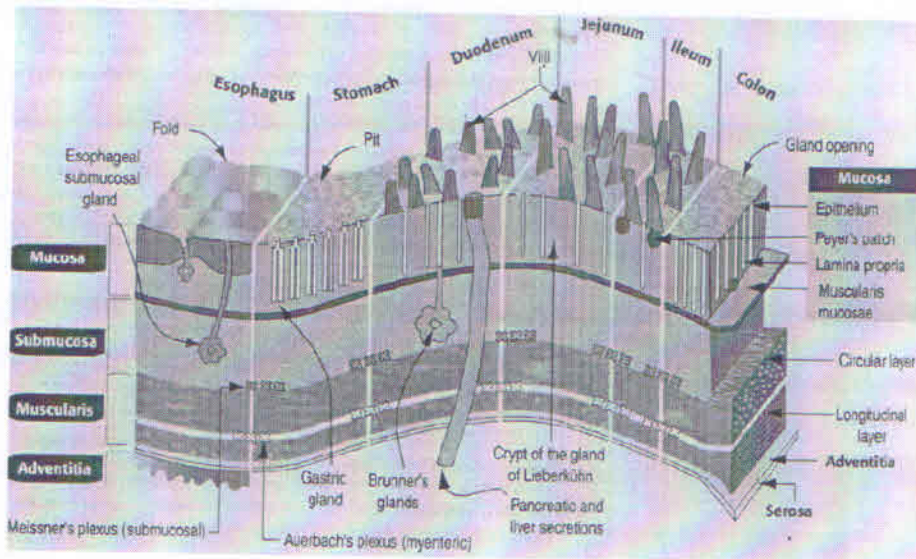
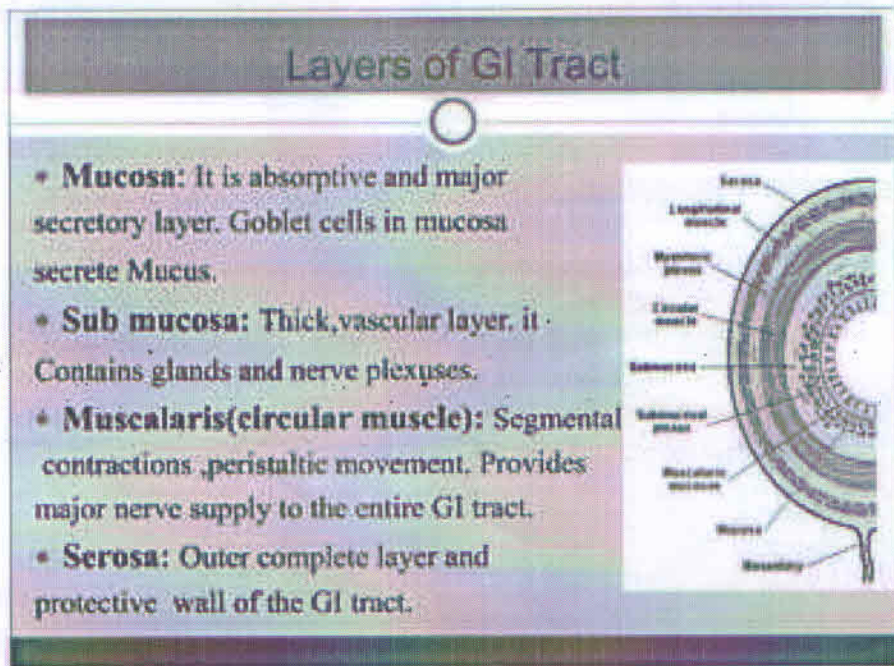


Figure 8.3 Histological plan of the intestine.





Mannan, 2015

Key facts about upper digestive tract histology

Table quiz

Oral cavity

Oral vestibule: Non keratinized stratified squamous epithelium
 Oral cavity proper: Non keratinized and partially keratinized stratified squamous epithelium
 Lips: Keratinized stratified squamous epithelium
 Tongue: Keratinized and non keratinized squamous epithelium as well as lingual papillae

Oropharynx and laryngopharynx	Non keratinized stratified squamous epithelium, as well as fibrous connective tissue and elastic cartilage
Esophagus	Non keratinized stratified squamous epithelium
Stomach	Simple columnar epithelium

EMBRYOLOGY OF THE DIGESTIVE ORGANS

- The anatomical parts of the alimentary canal are derivatives of the embryonic foregut, midgut and hindgut.
- The accessory digestive organs arise as outgrowths of the embryonic gut.

FOREGUT

- The derivatives of the foregut are
 - ✓ The primordial pharynx and its derivatives
 - ✓ The lower respiratory system
 - ✓ The esophagus and stomach
 - ✓ The duodenum, distal to the opening of the bile duct
 - ✓ The liver, biliary apparatus (hepatic ducts, gallbladder, and bile duct), and pancreas
 - ✓ These foregut derivatives, other than the pharynx, lower respiratory tract, and most of the esophagus, are supplied by the **celiac trunk**, the artery of the foregut

MIDGUT

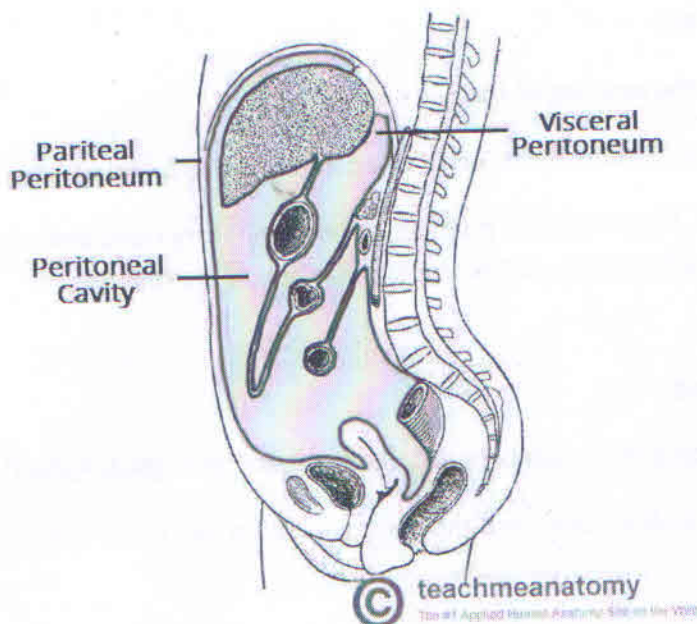
- The derivatives of the midgut are:
 - ✓ The small intestine (including the duodenum distal to the opening of the bile duct)
 - ✓ The cecum, appendix, ascending colon, and the right one half to two thirds of the transverse colon
 - ✓ The midgut derivatives are supplied by the **superior mesenteric artery**.

HINDGUT

- The derivatives of the hindgut are
 - ✓ The left one third to one half of the transverse colon, the descending colon and sigmoid colon, the rectum, and the superior part of the anal canal
 - ✓ All hindgut derivatives are supplied by the **inferior mesenteric artery**.

PERITONEUM

- The peritoneum
- Is the largest and the most complexly folded serous membrane that lines the abdominopelvic cavity,
- Forms a closed peritoneal cavity in males. In females, this cavity is 'open'. In the female, therefore, the peritoneal cavity communicates with the exterior via the genital tract.
- Exists in two layers: parietal and visceral peritoneum. Parietal peritoneum lines the abdominopelvic wall; while visceral peritoneum invests abdominopelvic organs. The mesenteries, greater and lesser omenta are large folds of peritoneum.
- The structure of the peritoneum and the peritoneal cavity. Note how the visceral layer invaginates to cover the organs.



O'Neill, 2024

Figure 8.4 Peritoneum and some of its folds.

CASE STUDY

A 60-year-old man was admitted in the hospital because of severe pain in the epigastric region, as well as haematemesis. He had earlier indicated that he drinks heavily. Clinical examinations revealed the presence of caput medusae, oesophageal varices and ascites. Discuss the anatomical basis of the patient's haematemesis, caput medusae and ascites. What do you understand by 'Portal hypertension'?

SAQ

1. Write a short note on the microscopic anatomy of the Islet of Langerhans and its clinical correlates.
2. Discuss the appendix in relation to its possible positions, autonomic innervation and clinical correlates.
3. In tabular form, differentiate between small and large intestines.
4. Highlight five major sites of Porto-systemic anastomoses. Add a note on its associated clinical importance.
5. An ultrasound of a pregnant woman revealed a fetus with polyhydramnios. At birth, the baby presented with persistent aspiration/choking after being breastfed and an inability to swallow breast milk. With your knowledge of anatomy:
 - a. What is the most likely cause for this presentation?
 - b. With the aid of simple diagrams, describe the various types of the congenital abnormalities of the organs involved.
 - c. List three reasons why this condition may occur.

ONE IN FIVE SESSION

1. The following are supplied by the celiac trunk **EXCEPT**

- a) Biliary apparatus
- b) The esophagus
- c) stomach
- d) The duodenum, (E)
- e) Pharynx

2. The following matching are correct **EXCEPT**

- a) Jejunum-----☐ absence of villi
- b) Ileum -----☐ Peyer's patches
- c) Duodenum-----☐ Brunner's gland (A)
- d) Crypts of Lieberkuhn -----☐ Paneth cells
- e) Stomach -----☐ chief cells

3. Which of the following is **NOT** a derivatives of the midgut
- a. small intestine
 - b. Caecum
 - c. appendix (E)
 - d. ascending colon
 - e. lateral 1/3rd of the transverse colon
4. Portal hepatis contain the following **EXCEPT**
- a. hepatic vein
 - b. hepatic ducts
 - c. hepatic artery (A)
 - d. bile duct
 - e. portal vein
5. One of the following is **NOT** a derivatives of the hindgut
- a. transverse colon
 - b. descending colon
 - c. sigmoid colon (E)
 - d. Rectum
 - e. inferior part of the anal canal
6. One of the following surgical incisions is appropriate for appendectomy:
- a. Subcostal
 - b. Parasagittal
 - c. Median (D)
 - d. McBurney
 - e. Suprapubic

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