## MICROSCOPIC ANATOMY OF THE GI

### D.HAMMOUDI.MD





### Abdominal quadrants

Right upper quadrant	Left upper quadrant
Liver right lobe	Liver left lobe
Gallbladder, stomach, pylorus, doudenum, Pancreas head, R suprarenal gland, R kidney, R colic flexure, Ascending colon superior part, Transvrse colon R half.	Spleen, stomach, jejunum, prox ileum, pancreas body and tail, left kidney, L suprarenal, left colic flexure, Transverse colon left part, descending colon superior part.
Right lower quadrant	Left lower quadrant
Cecum, Appendix, Ileum, Asc. Colon, R ovary, R uterine tube, R ureter, R spermatic cord, Uterus, Urinary bladder (full)	Sigmoid colon, Desc. Colon, L ovary, L uterine tube, L ureter, L spermatic cord, Uterus enlarge, Urinary bladder (full).



### Anatomy of the Mouth and Throat



### Mouth: lips non-keratinized therefore evaporation occurs, must lick lips

Tongue: frenulum (bridle) ties down taste buds:

fungiform, circumvallate, filiform

### Oral Cavity (mouth)

Entrance to the GI tract.

Initial site of mechanical digestion (via mastication) and chemical digestion (via enzymes in saliva).

Bounded anteriorly by the teeth and lips and posteriorly by the oropharynx.

Superior boundary is formed by the hard and soft palates.

Floor, or inferior surface, of the oral cavity contains the tongue as well as the mylohyoid

#### muscle covered with mucosa.

Vestibule is the space between the cheeks or lips ar Oral cavity proper.

The lateral walls are formed by the cheeks.

Lips (labia).

Gingivae, or gums.

Labial frenulum.













### Four Layers of the GI Tract

#### •Mucosa

- Epithelium
- Lamina propria
- Muscularis muscosa
- Submucosa
- •Muscularis
  - Internal oblique (only in the stomach)
  - Inner circular layer
  - Outer longitudinal layer
- •Serosa
  - Areolar tissue
  - mesothelium

Serosa	
Longitudinal Muscle	
Myenteric Plexus	
Circular Muscle	
Submucosal Plexus	
Submucosal	
Mucosal	

layer)

General Histology

#### Mucosa • The inner layer of the tract that is a General Histology mucous membrane that is composed of a - layer of epithelium-simple Wall of Digestive Tract columnar in most of the GI tract · Nonkeratinized stratified squamous from lumen the oral cavity through the esophagus and in the lower anal canal (areas subject to abrasion) mucosa (mucous submucosa - Lamina propria- areolar connective tissue membrane (submucosal containg blood and lymphatic vessels layer) layer) - **muscularis mucosae-** a thin layer circular of smooth muscle ( is responsible for the muscle muscularis mucosal folds, or rugae, that serves to (smooth increase the surface area for digestion. muscle • Is the most highly differentiated layer) longitudinal layer of the GI tract. muscle serosa - Tissue specialization and surface (serous shape are correlated with functional membrane

differentiation along the tract.

#### Submucosa- consist of - areolar c.t. that binds the mucosa to the underlying muscle layer. Wall of Digestive Tract - blood vessels, lymphatics, a nerves plexus, glands that secrete lubricating mucus into lumen the lumen mucosa • Muscularis - A thick layer of (mucous submucosa muscle that under lies the submucosa membrane (submucosal laver) - begins at the mouth where it is layer) composed of a mixture of smooth and striated muscle (for voluntary circular swallowing) and the external sphincter muscle muscularis where it is skeletal. (smooth - At the distal pharynx it turns into all muscle smooth muscle that courses layer) longitudinal throughout the rest of the tract. muscle - The involuntary smooth muscle serosa consist of an inner circular and an (serous outer longitudinal layer. membrane layer)

### General Histology

Serosa- The outermost layer of the GI tract.

- Composed of a thin layer of areolar tissue topped by a serous membrane (mesothelium)
- (mesothelium)
  Begins in the lower 3 to 4 cm of the esophagus and ends with the sigmoid colon
- When the outer fibrous c.t. layer is attached to

surrounding tissue it is called **adventitia** –

- See this at the oral cavity, pharynx, most of the esophagus, and the rectum It secretes fluid that allows the tract structures to glide over each other without friction. It is also referred to as visceral peritoneum.





#### ORAL CAVITY

The oral cavity is formed by a bewildering array of tissues which function in or are associated with the processes that are performed with what we typically refer to as our mouthwithin the oral cavity, the tongue, and the glands which empty their secretory products into the oral cavity, the salivary glands. In the lab you will also have the opportunity the examine one other specialized epithelial area, the lip.

The oesophagus is the first part of the alimentary canal. Its organisation is also typical for all parts of the gastrointestinal tract (GIT).

The oral cavity is divided in a <u>vestibule, the area "outside" the teeth, and an oral cavity</u> <u>proper</u>.

The entire oral cavity is lined by a stratified squamous epithelium.

The epithelial lining is divided into two broad types:

<u>Masticatory epithelium</u> covers the surfaces involved in the processing of food (tongue, gingivae and hard palate). The epithelium is keratinized to different degrees depending on the extent of physical forces exerted on it.

<u>Lining epithelium</u>, i.e. non-keratinised stratified squamous epithelium, covers the remaining surfaces of the oral cavity.





Lingual papillae - projections of the lamina propria on the dorsum of tongue. There are three types of these projections:

1. Filiform papillae - the most numerous they cover the anterior 2/3 of the dorsum. They give the tongue a roughness needed in licking semisolid foods. Heavily keratinized, they give the tongue a "coated" appearance.

2. Fungiform Papillae - located on the sides of tongue interspersed among the filiform papillae. Taste buds are found around these papillae.

3. Circumvallate Papillae - form a V - shaped formation near the posterior margin of the tongue. The largest number of taste buds are associated with these papillae. The Lingual Tonsil - an unencapsulated cluster of lymphoid tissue located at the base of the tongue.











taste buds opening into the lumen of the furrow that surrounds the papilla.

2 - core of the papilla (lamina propria of the mucosa of dorsal surface of the tongue)

3 - taste bud



- 2 keratinized layer of the epithelium
- 3 core of the papilla (lamina propria of the mucosa of dorsal surface of the tongue)
- 2 tongue muscles



### Histology Lab Part 13: Slide 32

Detail of skeletal muscle and secretory glands of the body of the tongue.

Mucous cells are to the left, with their flattened, basal nuclei, while serous cells are in the center and to the right, with their round nuclei.





View of foliate papillae, typical of rabbit and some other animals.

These have a characteristic 3-pronged connective tissue pattern extending up into the papilla, and there are taste buds on the outside walls.

Notice the bundles of skeletal muscle down below.



#### Histology Lab Part 13: Slide 29



Section of surface of tongue, showing one rather tangentially cut fungiform papilla at the left and some filiform papillae with sharp, semicornified tips at the right.

Cornification is less extensive in human tongue than in cats, dogs, etc.

### SALIVARY GLANDS

Parotid – between skin of cheek and muscle, in front of ear (largest) amalyase

Sublingual – floor of mouth, back of tongue, thick and stringy mucous

Submandibular – floor of mouth, thicker fluid than parotid.

Salivary glands: 1000-2000 ml/day. Saliva contains mucin, salivary amylase, buffers, IgA antibodies, lysozyme

•parotid [beside ear] duct opens next to 2nd upper molar
•submandibular duct opens near frenulum
•sublingual duct opens along underside of tongue

# Cells that make saliva

 Serous cells – watery fluid containing digestive enzyme amylase
 Mucous cells – secretes mucous – holds food together and moistens while swallowing





The Salivary Glands - Ducted exocrine glands producing saliva. Two types of secretory cells are found in the glandular tissue:

- 1. Serous cells producing a watery secretion containing amylase.
- 2. Mucous cells producing a viscous liquid containing the glycoprotein mucin.

Submandibular Glands - are bilaterally located at the median aspect of the mandibular angle. Their ducts bring saliva to the oral cavity at the base of the frenulum. They are mixed glands, containing approximately equal numbers of serous and mucous cells.

Sublingual Glands - are anterior to the submandibular glands under the tongue. Cells of these glands are mostly mucous producing. Very little amylase is found in this saliva.

Parotid Glands - are anterior and inferior to the external ears lying in a connective tissue capsule. Parotid ducts bring saliva into the vestibule along side of the second upper molar.

The glandular cells are mostly serous.

### Salivary Glands

Collectively produce and secrete saliva.

• a fluid that assists in the initial activities of digestion

Volume of saliva secreted daily ranges between 1.0 and 1.5 L.

Most is produced during mealtime, but

Smaller amounts are produced continuously to ensure that the oral cavity remains moist. Water makes up 99% of the volume of saliva.

Also contains a mixture of other components.

Three pairs of large, multicellular salivary glands:

- parotid glands
- •submandibular glands
- •sublingual glands



### The Submandibular Glands

#### Inferior to the body of the mandible.

Produce most of the saliva (about 60–70%).

A duct opens from each gland through a papilla in the floor of the mouth on the

### htered sides of the lingual frequence to the oral cavity mucosa.

Each gland extends multiple tiny sublingual ducts that open onto the inferior surface of the oral cavity, posterior to the submandibular duct papilla.





#### PAROTID SALIVARY GLAND

Stained with haematoxylin and eosin 1 - serous secretory units (acini) 2 - intercalated excretory

duct 3 - striated excretory duct

4 - interlobular excretory duct

5 - interlobular connective tissue septa



#### PAROTID SALIVARY GLAND

Stained with haematoxylin and eosin

- 1 serous secretory units
- 2 striated excretory duct
- 3 interlobular excretory duct



#### PAROTID SALIVARY GLAND

Stained with haematoxylin and eosin 1 - serous secretory units

- 2 intercalated excretory duct
- 3 striated excretory duct





### PAROTID SALIVARY GLAND interlobular excretory duct

- Stained with haematoxylin and eosin
- 1 interlobular excretory duct
- 2 interlobular connective tissue septa



#### SUBLINGUAL SALIVARY GLAND

Stained with haematoxylin and eosin

- 1 lobules of the gland
- 2 interlobular connective tissue septa
- 3 interlobular excretory duct

#### SUBLINGUAL SALIVARY GLAND

Stained with haematoxylin and eosin 1 mucous part of mixed secretory unit

- 2 serous part (serous demilune) of mixed secretory unit
- 3 serous secretory unit
- 4 mucous secretory unit
- 5 intercalated excretory duct
- 6 striated excretory duct
- 7 interlobular excretory duct
- 8 interlobular connective tissue septa



#### SUBLINGUAL SALIVARY GLAND

Stained with haematoxylin and eosin

- 1 mucous part of mixed secretory unit
- 2 serous part (serous demilune) of mixed secretory unit
- 3 serous secretory unit
- 4 mucous secretory unit
- 5 myoepithelial cells



#### SUBLINGUAL SALIVARY GLAND

Stained with haematoxylin and eosin

- 1 mucous part of mixed secretory unit
- 2 serous part (serous demilune) of mixed secretory unit
- 3 serous secretory unit
- 5 myoepithelial cells
- 6 intercalated excretory duct
- 7 interlobular excretory duct
- 8 interlobular connective tissue septa



#### SUBMANDIBULAR SALIVARY GLAND

Stained with haematoxylin and eosin 1 - serous secretory unit

- 2 mixed secretory unit
- 3 intercalated excretory duct
- 4 striated excretory duct
- 5 interlobular excretory duct
- 6 interlobular connective tissue septa
- 7 mucous part of mixed secretory unit
- 8 serous part (serous demilune) of mixed secretory unit



#### SUBMANDIBULAR SALIVARY GLAND

Stained with haematoxylin and eosin

- 1 serous secretory unit
- 2 mixed secretory unit
- 3 intercalated excretory duct
- 4 striated excretory duct













#### **ESOPHAGUS**

#### Stained with haematoxylin and eosin

- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica adventitia
- 5 epithelium of the mucosa
- 6 lamina propria of the mucosa
- 7 muscularis mucosae
- 8 glands in the lamina propria







#### **ESOPHAGUS**

Stained with haematoxylin and

- eosin
- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica adventitia
- 5 epithelium of the mucosa
- 6 lamina propria of the mucosa
- 7 muscularis mucosae
- 8 glands in the lamina propria



### STOMACH

#### cardiac orifice entrance and pyloric sphincter exit

lesser curvature (lesser omentum), greater curvature (omentum), body, fundus,

pyloric region, rugae.

gastric pits lined with: mucous neck cells mucus 880 chief cells pepsinogen parietal cells HCI distention of stomach causes release of **gastrin** Gastrin stimulates release of gastric fluids from gastric pits

Peptic ulcers due 80% to Helicobacter pylori.

# **Gastric Secretions**

<u>3 Main cells</u>:

- 1. Mucous cells mucous
- 2. chief digestive enzymes
  - a. Pepsin digests protein
  - b. Alkaline substance protects lining
  - c. Intrinsic factor absorbs Vitamin B12
- 3. parietal cells  $\rightarrow$  hydrochloric acid





#### Subdivisions

The greater omentum is often defined to encompass a variety of structures. Most sources include the following three:

•Gastrocolic ligament - to transverse colon

•Gastrosplenic ligament - to spleen •Gastrophrenic ligament - to thoracic diaphragm

•The splenorenal ligament (from the left kidney to the spleen) is occasionally considered part of the greater omentum






















































## FUNDAL PART OF THE STOMACH

- Stained with haematoxylin and eosin
- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica serosa
- 5 epithelium of the mucosa
- 6 lamina propria of the mucosa (contains glands)
- 7 muscularis mucosae



# PYLORIC PART OF THE STOMACH

- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 5 lamina propria of the mucosa (contains glands)
- 7 gastric pits in the mucosa
- 8 muscularis mucosae















Perforated colon cancer This was a cancer of the hepatic flexure which perforated, producing a bacterial peritonitis with abundant free bile as well.



#### <u>Mucosa</u>

Plica Circularis - Folds in mucosa and submucosa Villi - mucosal projections Columnar epithelium - with increasing numbers of Goblet cells as it approaches the large intestine Crypts of Lieberkuhn (intestinal glands)-Paneth cells - eosinophilic, granular cells at base of intestinal glands of Lieberkuhn Enteroendocrine cells (APUD cells)



Villus in the duodenum showing the simple columnar epithelium on the surface and the lacteal running down the center of the villus surrounded by lamina propria. Submucosa Submucosal (Meissner's) plexus (found scattered in the submucosa)

#### Muscularis Externa

inner circular smooth muscle layer outer longitudinal smooth muscle layer

•Myenteric (Auerbach's) plexus (found beween the two layers of the muscularis externa) Serosa

Connective tissue of mesentery or peritoneum is found on the outermost surface of the digestive tube within the peritoneal cavity. Mesothelium lines the outer surface of the parts that are not retroperitoneal.

As you look through the slides, be thinking of the four basic layers and how their components may differ from one part of the small intestine to the other.

The nerves of the small intestines are derived from the plexuses of parasympathetic nerves around the superior mesenteric artery.

From this source they run to the **myenteric plexus (Auerbach's plexus)** of nerves and ganglia situated between the circular and longitudinal muscular fibers from which the nervous branches are distributed to the muscular coats of the intestine.

From this a secondary plexus, the <u>plexus of the submucosa (Meissner's plexus, Submucous</u> <u>plexus, submucosal plexus</u>) is derived, and is formed by branches which have perforated the circular muscular fibers. This plexus lies in the submucous coat of the intestine; it also contains ganglia from which nerve fibers pass to the muscularis mucosae and to the mucous membrane.

The nerve bundles of the submucous plexus are finer than those of the myenteric plexus. Its function is to innervate cells in the epithelial layer and the smooth muscle of the (muscularis externa).





the epithelial lining has been detached so all you see on each villus is the lamina propria bounded by a naked basement membrane.

Crypts of Lieberkuhn are intestinal glands, which contain **Paneth** cells, which in turn, contain eosinophilic granules. The submucosa is marked by pockets of **Brunner's glands** (mucous-producing glands)



# Brunner glands (or Pancreal glands)

are compound tubular submucosal glands found in that portion of the duodenum which is above the sphincter of Oddi.

The main function of these glands is to produce an alkaline secretion (containing bicarbonate) in order to: protect the duodenum from the acidic content of chyme (which is introduced into the duodenum from the stomach); provide an alkaline condition for the intestinal enzymes to be active, thus enabling absorption to take place; lubricate the intestinal walls. They are the distinguishing feature of the duodenum







### JEJUNUM

- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica serosa
- 5 villi
- 6 glands (crypts) in the lamina propria of the mucosa





## ILEUM

Stained with haematoxylin and eosin

- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica serosa
- 5 villi
- 6 epithelium of the mucosa (covers villi)
- 7 connective tissue of the lamina propria of the mucosa
- 6 glands (crypts) in the lamina propria of the mucosa





mucosa submucosa Peyer's patches (lymphatic tissue in submucosa) intestinal glands muscularis externa serosa





# COLON

Stained with haematoxylin and eosin

- 1 tunica mucosa
- 2 tunica submucosa
- 3 tunica muscularis propria
- 4 tunica serosa
- 5 glands (crypts) in the lamina propria of the mucosa



#### COLON

Stained with mucicarmin

- 1 tunica mucosa
- 2 tunica submucosa
- 3 goblet cells in the epithelium of crypts (stained with red-magenta color)





The crypts of Lieberkühn (or intestinal glands) are glands found in the epithelial lining of the small intestine and colon. the crypts secrete various enzymes, including sucrase and maltase, along with endopeptidases and exopeptidases.

Also new epithelium is formed here, keeping in mind that the epithelium at this site is frequently worn away by the passing food.

Loss of proliferation control in the crypts is thought to lead to colorectal cancer.

The basal portion of the Crypt contains multipotent stem cells. At each mitosis one daughter remains a stem cell while the other differentiates and migrates up the side of the crypt and eventually the villus.

Goblet cells are among the cells produced in this fashion.





# Upper Jejunal Mucosal Immunopathology



























# LIVER

Stained with haematoxylin and eosin

- 1 hepatic artery
- 2 portal vien
- 3 bile duct
- 4 hepatocytes



# LIVER

- 1 hepatic artery
- 2 portal vien
- 3 bile duct
- 1, 2, 3 portal tract



## LIVER

Stained with haematoxylin and eosin

- 4 hepatocytes
- 5 terminal hepatic (centrilobular) venule

#### LIVER

- Stained with haematoxylin and eosin
- 4 hepatocytes
- 5 terminal hepatic (centrilobular) venule
- 6 hepatic sinusoid



# LIVER

- Stained with haematoxylin and eosin
- 1 capsule
- 2 liver parenchyma

#### LIVER

- 1 capsule
- 2 liver parenchyma
- 4 hepatocytes



#### PANCREAS

- Stained with haematoxylin and eosir
- 1 glandular acinus
- 2 islet of Langerhans
- 3 main duct
- 4 interlobular duct
- 5 interlobular connective tissue septa



# PANCREAS

Stained with haematoxylin and eosin 1 - acinus

- 2 islet of Langerhans
- 3 interlobular connective tissue septa
- 4 intralobular duct
- 5 interlobular duct

#### PANCREAS

Stained with haematoxylin and eosin 1 - acinus

- 2 islet of Langerhans
- 3 interlobular connective tissue septa
- 4 blood vessels



### PANCREAS

Stained with haematoxylin and eosin

- 1 acinus
- 2 islet of Langerhans
- 3 intralobular duct

4 - interlobular connective tissue septa



# vascularization






