





بسم الله الرحمن الرحيم



MID | Lecture 1 Histology of Upper GIT

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Color Code:

Slides + Dr. doesn't mention

﴿ وَإِن تَتَوَلَّوْا يَسْتَبَدِلْ قَوْمًا غَيْرَكُمْ ثُمَّ لَا يَكُونُوَا أَمْتَ لَكُم ٢

اللهم استعملنا ولا تستبدلنا



GI Histology 1

Before you start: The information in gray was not mentioned by the doctor, but I believe it is important. Therefore, I recommend reading it carefully.

بسم الله الرحمن الرحيم اللهم لا سهل إلا ما جعلته سهلاً، وأنت تجعل الصعب إذا شئت سهلاً، اللهم سهل لي أمري واشرح لي صدري، ووفقني لما تحب وترضي.

Objectives

- Describe the cells of the GI tract and their function
- in stomach, the mucosa has 4 types of cells :
- 1- Parietal cells : secrete HCl
- 2- Chief cells : secrete pepsinogen
- 3- Mucus cells : secrete mucus for protection
- 4- Endocrine cells : secrete gastrin hormone
- Describe the histological features of each part of the GI tract.
- If we take a section from the GI tract we will find four layers, from inside :
- 1- Mucosa
- 2- Submucosa -> in most of the GI tract didn't have gland but in the duodenum there are gland this information is mentioned and needed after two slides
 3- Muscular layer
- 4- Adventitia or serosa

- 1- Mucosa :
- in the oral cavity , pharynx and esophagus (the upper part of GI), the type of epithelium is **"stratified squamous non keratinized"**.
- In the stomach, the lining epithelium is **"simple columnar epithelium without goblet cells**" .
- There is a layer of mucosa called lamina propria in the stomach it is filled with gastric glands because of the digestion.
 <u>Notice</u> the change in the lining and the presence of the gastric glands.
- In small intestine (duodenum , jejunum, ileum), the lining epithelium is **" simple columnar epithelium with goblet cells**". The mucosa in small intestine is fingerlike projection to increase the surface area for absorption.
- Large intestine is lining with "**simple columnar epithelium with numerous goblet cells**", because related to the function of large intestine which is absorption of water and formation of feces. "Hard feces need lubrication".

- Differentiate between different parts of the GI tract
- The duodenum (which is located after the stomach) will neutralize the acidity of the stomach by secreting alkaline secretion (because it has a glandular structure in the submucosal layer).
- <u>CLINICAL INFORMATION</u>: Most peptic ulcers are duodenal ulcers in the first inch of it, because if duodenum didn't neutralize the acidity, this will cause ulcers.

سبحان الله إ

- So the first inch of duodenum is the most site of peptic ulcers
- Appreciate the histopathology of the GI tract
- Without knowing normal histology, you can't understand pathology.
- Describe the histological basis of some clinical problems

Like smoking that affects all the organs including the stomach which affects the blood supply of it causing ischemia and peptic ulcers.

- The digestive system consists of the digestive tract—oral cavity, esophagus, stomach, small and large intestines, rectum, and anus—and its associated glands—salivary glands, liver, gall bladder and pancreas.
- Its function is to obtain the molecules necessary for the maintenance, growth, and energy needs of the body from ingested food.
- Large molecules such as proteins, fats, complex carbohydrates, and nucleic acids are broken down
 into small molecules that are easily absorbed through the lining of the digestive tract, mostly in the
 small intestine.

Proteins \rightarrow amino acids Carbohydrates \rightarrow glucose Fats \rightarrow fatty acids

They are involved in the synthesis of hormones and vitamins.

- Water, vitamins, and minerals are also absorbed from ingested food. In addition, the inner layer
 of the digestive tract is a protective barrier between the content of the tract's lumen and the
 internal milieu of the material.
- After digestion and absorption, the absorptive material go through the blood to the liver by **portal vein**.
- The functions of the liver is : metabolism, production of bile salts for digestion, production of the enzymes and hormones, storage of glucose as glycogen for energy, detoxication of toxic materials.

General Structure of the Digestive Tract

- The entire gastrointestinal tract presents certain common structural characteristics
- is a hollow tube composed of a lumen whose diameter varies, surrounded by a wall made up of four principal layers: the mucosa, submucosa, muscularis, and serosa.
- The mucosa comprises an epithelial lining; a lamina propria of loose connective tissue rich in blood and lymph vessels and smooth muscle cells, sometimes also containing glands and lymphoid tissue
- and the muscularis mucosae, usually consisting of a thin inner circular layer and an outer longitudinal layer of smooth muscle cells which affect the shape of mucosa separating the mucosa from the submucosa. The mucosa is frequently called a mucous membrane.



- The submucosa is composed of <u>dense connective tissue</u> with many blood and lymph vessels, lymph nodes and a submucosal (also called Meissner's) nerve plexus (plexus means sympathetic and <u>parasympathetic</u> which is more important because it's secretomotor which stimulates the glands to secrete, also innervates the muscles to move).
- It may also contain glands in <u>duodenum and esophagus</u> and lymphoid tissue.
- In duodenum because of high acidity of the stomach so the glands are called brunner's gland .
- In esophagus because it's located before stomach which has high secretions and glands.



- The **muscularis** contains smooth muscle cells that are spirally oriented and divided into two sublayers according to the main direction the muscle cells follow.
- In the internal (inner) sublayer (close to the lumen), the orientation is generally circular; in the external (outer) sublayer, it is mostly longitudinal.
- The muscularis also contains the **myenteric (or Auerbach's) nerve plexus in physiology it's** called <u>enteric plexus</u>, which lies between the two muscle sublayers, the plexus innervates the glands and it's responsible for peristaltic movement of the GI tract.
- blood and lymph vessels in the connective tissue between the muscle sublayers.
- The myenteric plexus (the parasympathetic from vagus nerve) —> The myenteric
 plexus is part of the enteric nervous system and is modulated by parasympathetic
 fibers from the vagus nerve.
- <u>Parasympathetic</u> means it has preganglionic and postganglionic neurons, and there is a synapse in the ganglia.
- Sympathetic is mostly postganglionic because it comes after the ganglia without relay in the target organ.

- The **serosa** is a thin layer of loose connective tissue, rich in blood and lymph vessels and adipose tissue, and a simple squamous covering epithelium (**mesothelium**).
- In the abdominal cavity, the serosa is continuous with the mesenteries and with the peritoneum.
- If it is surrounded by connective tissue we call it <u>Adventitia</u>, if it is surrounded by peritoneum we call it <u>Serosa</u>
- For example, the esophagus is extends from the neck and the thorax reaching the abdomen (lies under the diaphragm by 1.3 cm).
- The segment below the diaphragm is covered by serosa, But the part that is in the neck and thorax is covered by adventitia.
- In places where the digestive organ is bound to other organs or structures, however, the serosa is replaced by a thick adventitia, consisting of connective tissue containing vessels and nerves, without the mesothelium.



Basic mucosal forms in the GI tract

The histology of an organ reflects its function.

- Protective : stratified squamous non keratinized epithelium that is found in the oral cavity, pharynx, the esophagus and the anal canal
- Why <u>Stratified</u> ? Because it provides protection and allows regeneration after injuries as in the anal canal, where hard stool may cause an injury.
- Seceretory : the mucosa consists of a long closely packed tubular glands, found in the stomach and as
 we said it has simple columnar epithelium without goblet cells but it has gastric glands (
 which have 4 types of cells) in the lamina propria.
- Absorptive ; the mucosa is arranged in a fingerlike projections called vili with intervening short glands called **crypts of Lieberkühn**, that is typical for the small intestine.
- In the duodenum some crypts extend from the muscularis mucosa to the submucosa (Brunners Gland) in addition to the crypts of lieberkühn, so we have two types of glands because the duodenum needs to neutralize the acidity of stomach (alkalization).
- Absorptive/protective ; the mucosa is arranged into closely packed tubular glands specialised for water absorption and mucus secreting goblet cells, and the glands are filled with mucus cells .
- It lines the whole large intesine

The Oral Cavity

- The oral cavity is lined with **stratified squamous epithelium**, keratinized or nonkeratinized, depending on the region.
- The keratin layer (+ dense CT) protects the oral mucosa from damage during masticatory function and is present mostly in the gingiva (gum) and hard palate. (Keratinized)
- The lamina propria in these regions has several papillae and rests directly on bony tissue.
- Nonkeratinized squamous epithelium covers the soft palate, lips, cheeks, and the floor of the mouth.
- The dorsum of the Tongue is <u>parakeratinized</u>, while the lower surface is <u>nonkeratinized</u>.
- The lamina propria has papillae (invagination between the mucosa and submucosa), similar to those in the dermis of the skin, and is continuous with a submucosa containing diffuse small salivary glands.
- In the lips, a transition from the oral nonkeratinized epithelium to the keratinized epithelium of the skin can be observed.
- The soft palate has a core of skeletal muscle, numerous mucous glands, and lymphoid nodules in its submucosa.

Tongue

- The tongue is a mass of striated muscle covered by a mucous membrane whose structure varies according to the region
- The muscle fibers cross one another in three planes; they are grouped in bundles, usually separated by connective tissue
- Because the connective tissue of the lamina propria penetrates the spaces between the muscular bundles, the mucous membrane is strongly adherent to the muscle
- The mucous membrane is smooth on the lower (ventral) surface of the tongue
- The tongue's dorsal surface is irregular, covered anteriorly by a great number of small eminences called lingual papillae.

Lingual papillae:

- Fungiform: mushroom in shape
- Filiform: more numerous and make projections on the surface
- Circumvallate: circle surrounded by groove



- The posterior one-third of the dorsal surface of the tongue is separated from the anterior two-thirds by a V- shaped boundary
- Behind this boundary, the surface of the tongue shows small bulges composed mainly of two types of small lymphoid aggregations:
- small collections of lymphoid nodules
- and the lingual tonsils, where lymphoid nodules aggregate around invaginations (crypts) of the mucous membrane

This papillae is composed of cells, also it has a small pore on the surface for the passage of secretions, also it has some hairlets on the pore, which takes the taste to a bipolar cell (taste cell). This cell has been called bipolar because it has the hairlets on one pole and the filaments of the chorda tympani nerve on the other pole.



look closely at the circumvallate (will be discussed later), it's circular surrounded by a deep groove, in a sagittal section it looks like half a circle.



There are also stem cells at the base of the bud.

Taste buds wise: Fungiform -> ✓ Filiform -> X Circumvallate -> ✓

Papillae

- Papillae are elevations of the oral epithelium and lamina propria that assume various forms and functions. There are four types
- Filiform Papillae
- Filiform papillae have an elongated conical shape; they are quite numerous and are present over the entire surface of the tongue
- Their epithelium, which does not contain taste buds, is keratinized.

Foliate papilla is rudimental in humans, prominent in animals.



- Fungiform Papillae
- Fungiform papillae resemble mushrooms in that they have a narrow stalk and a smooth-surfaced, dilated upper part
- These papillae, which **contain scattered taste buds on their upper surfaces**, are irregularly interspersed among the filiform papillae.
- Foliate Papillae
- Foliate papillae are poorly developed in humans
- They consist of two or more parallel ridges and furrows on the dorsolateral surface of the tongue and contain many taste buds.



Taste buds





В

Circumvallate Papillae

- Circumvallate papillae are 7–12 extremely large circular papillae whose flattened surfaces extend above the other papillae
- They are distributed in the V region in the posterior portion of the tongue
- Taste buds are on the <u>medial</u> surface of the cleft (lateral to the circumvallate)
- Numerous serous (von Ebner's) glands drain their contents into the deep groove that encircles the periphery of each papilla
- This moat like arrangement provides a continuous flow of fluid over the great number of taste buds present along the sides of these papillae
- The glands also secrete a lipase that probably prevents the formation of a hydrophobic layer over the taste buds that would hinder their function.
- This flow of secretions is important in removing food particles from the vicinity of the taste buds so that they can receive and process new gustatory stimuli



- Along with this local role, lingual lipase is active in the stomach and can digest up to 30% of dietary triglycerides
- Other small mucous salivary glands dispersed throughout the lining of the oral cavity act in the same way as the serous glands associated with this type of papilla to prepare the taste buds in other parts of the oral cavity, such as the anterior portion of the tongue, to respond to taste stimuli.



The taste buds are **medial** to the cleft, **lateral** to the circumvallate.

Salivary Glands

Secretion:

- Parotid: serous (protein)
- Submandibular: mixed (serous and mucus)
- Sublingual: mucus mostly
- Saliva is a complex fluid that has digestive, lubricating, and protective functions
- In addition to the small (minor) salivary glands scattered throughout the oral cavity, there are three pairs of large salivary glands: the parotid, submandibular (submaxillary), and sublingual glands
- In humans, the minor salivary glands secrete 10% of the total volume of saliva, but they account for approximately 70% of the mucus secreted.

• A capsule of **connective tissue**, rich in collagen fibers, surrounds the large salivary glands.

The connective tissue protects the glands and extends between their branches. The septa, which divide the lobes and lobules, contain nerve endings, as well as blood and lymphatic vessels that reach every cell.

- The parenchyma of the glands consists of secretory end pieces and a branching duct system arranged in lobules, separated by septae of connective tissue originating from the capsule
- The secretory end pieces present two types of secretory cells: serous and mucous
- as well as the non-secretory myoepithelial cells
- This secretory portion is followed by a duct system whose components modify and conduct the saliva to the oral cavity.

- Serous cells are usually pyramidal in shape, with a broad base resting on the basal lamina and a narrow apical surface with short, irregular microvilli facing the lumen
- They exhibit characteristics of polarized proteinsecreting cells.
- Adjacent secretory cells are joined together by junctional complexes and usually form a spherical mass of cells called <u>acinus</u>, with a small lumen in the center where secretions are released from, then move to the large duct.

(The lumen connects the acini with the duct for secretion of the acini's content.)

• This structure can be thought of as a grape attached to its stem; the stem corresponds to the duct system.

Detailed explanations in the following slides. p.s if the slide contains a pre-explained topic, it'll be in bold. The gland is divided into lobes and further into lobules. Inside each lobule, there are acini .



Notice how the acini for a purely serous gland is (this is the parotid gland).

A: packed serous Acini ID: intercalated duct SD: striated duct (better seen on the right image)

submandibular

Both of them are tubuloacinar glands of both mucus and serous secretion. Examining the pictures we can tell that the submandibular is more serous while sublingual is more mucous.

sublingual





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Serous vs mucous secretion

Cell type	serous	mucous
Nucleus	Rounded	Flattened + more basal
Boundaries	Ill defined	Well defined
lumen	Narrow	Wide
secretion	Watery + enzymes -> digestive	Mucin (glycoprotein ->protection)
appearance	Granulated	Foamy

Myo (muscle containing cell) epithelial cell, it's present found under the basement membrane, pumps/squeezes the content of the secretory cells when it contracts into the lumen, it's more common in <u>serous glands.</u>

The dr. Mentioned this info explaining slide 33 (imp for the exam):

Serous overlying the mucous in a crescent shaped arrangement is called serous demilune.

It's commonly seen in submandibular and lesser in sublingual due to its lower content of serous cells.

This figure shows the striated duct of the pancreas; a: shows it under LM

B: SEM of the apical end of the cells opening into the lumen.

C: SEM bases of cells with the basal lamina removed (the letter B shows how these cells relate to/connect with neighboring cells)

Let's talk about ducts now! It carries the secretions to the target area -> Parotid: vestibule of oral cavity. Submandibular: oral cavity under the tongue. Sublingual: floor of the mouth.

We said the lumen is connected to a duct; it's called **intercalated duct** has 5-8 cuboidal cells, further away from the acini it becomes **striated duct** >10 <u>basally straited cells</u>, then it leaves the lobules and becomes **interlobular/ interlobar duct** (in the CT) a stratified cuboidal/columnar cells, the further it goes it forms the **main excretory duct** a stratified squamous non-keratinized.

- **Mucous cells** are usually cuboidal to columnar in shape; their nuclei are oval and pressed toward the bases of the cells.
- They exhibit the characteristics of mucus-secreting cells containing glycoproteins important for the moistening and lubricating functions of the saliva
- Most of these glycoproteins are called mucins and contain 70–80% carbohydrate moieties in their structure
- Mucous cells are most often organized as **tubules**, consisting of cylindrical arrays of secretory cells surrounding a lumen.

Myoepithelial cells

- are found between the basal lamina and the basal plasma membrane of the cells
- forming secretory end pieces and intercalated ducts (to a lesser extent), which form the initial portion of the duct system
- Myoepithelial cells surrounding each secretory portion, usually two to three cells per secretory unit, are well developed and branched (and are sometimes called **basket cells**
- whereas those associated with intercalated ducts are spindle shaped and lie parallel to the length of the duct
- These cells show several characteristics that resemble smooth muscle cells, including contractility. However, they also establish intercellular junctions among themselves and with secretory cells, such as desmosomes
- Although the contraction of myoepithelial cells accelerates the secretion of saliva, their main function seems to be the prevention of end piece distention during secretion due to the increase in intraluminal pressure

- In the **duct system**, secretory end pieces empty into the **intercalated ducts**, lined by cuboidal epithelial cells
- These cells have the ability to divide and differentiate into secretory or ductal cells
- Several of these short intercalated ducts join to form striated ducts
- characterized by radial striations that extend from the bases of the cells to the level of the central nuclei.
- Intercalated and striated ducts are also called intralobular ducts because of their location within the lobule.
- When viewed in the electron microscope, the striations are seen to consist of infoldings of the basal plasma membrane with numerous elongated mitochondria that are aligned parallel to the infolded membranes; this structure is characteristic of ion-transporting cells

- The striated ducts of each lobule converge and drain into ducts located in the connective tissue septae separating the lobules, where they become **interlobular**, or **excretory**, **ducts**
- They are initially lined with pseudostratified or stratified cuboidal epithelium, but more distal parts of the excretory ducts are lined with stratified columnar epithelium containing a few mucussecreting cells
- The main duct of each major salivary gland ultimately empties into the oral cavity and is lined with **nonkeratinized-stratified squamous epithelium**.

- Vessels and nerves enter the large salivary glands at the hilum and gradually branch into the lobules.
- A rich vascular and nerve plexus surrounds the secretory and ductal components of each lobule
- The capillaries surrounding the secretory end pieces are very important for the secretion of saliva, stimulated by the autonomic nervous system.
- Parasympathetic stimulation, usually through the smell or taste of food, promotes vasodilation and a copious watery secretion content.
 Sympathetic stimulation produces small amounts of viscous saliva, rich in organic material

Parotid Gland

- The parotid gland is a branched acinar gland; its secretory portion is composed exclusively of serous cells
- containing secretory granules that are rich in proteins and have a high amylase activity
- This activity is responsible for most of the hydrolysis of ingested carbohydrates.
- The digestion begins in the mouth and continues for a short time in the stomach, before the gastric juice acidifies the food and thus decreases amylase activity considerably
- Intercalated and striated ducts are easily observed within the lobules, due to their length.
- As in other large salivary glands, the connective tissue contains many plasma cells and lymphocytes
- The plasma cells secrete IgA, which forms a complex with a **secretory component** synthesized by the serous acinar, intercalated duct, and striated duct cells
- The IgA-rich secretory complex released into the saliva is resistant to enzymatic digestion and constitutes an immunological defense mechanism against pathogens in the oral cavity.

The number of the nuclei is less, also it's cuboidal

Submandibular (Submaxillary) Gland

- The submandibular gland is a branched tubuloacinar gland.
- its secretory portion contains both mucous and serous cells.
- The serous cells are the main component of this gland and are easily distinguished from mucous cells by their rounded nuclei and basophilic cytoplasm
- In humans, 90% of the end pieces of the submandibular gland are serous acinar, whereas 10% consist of mucous tubules with serous demilunes
- Serous cells are responsible for the weak amylolytic activity present in this gland and its saliva
- The cells that form the demilunes in the submandibular gland secrete the enzyme lysozyme, whose main activity is to hydrolyze the walls of certain bacteria
- Some acinar and intercalated duct cells in large salivary glands also secrete lactoferrin, which binds iron, a nutrient necessary for bacterial growth
- <u>Striated ducts are easily observed in the human submandibular gland</u>, All rights reserved.
 but intercalated ducts are very short.

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Sublingual Gland

- The sublingual gland, like the submandibular gland, is a branched tubuloacinar gland formed of serous and mucous cells
- Mucous cells predominate in this gland; serous cells are present almost exclusively on demilunes of mucous tubules
- As in the submandibular gland, cells that form the demilunes in this gland secrete lysozyme.
- Intralobular ducts are not as well developed as in other major salivary glands.

There is an intercalated, striated ducts.

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Maily mucous cells, very little serous demilune present.

Minor Salivary Glands

- These nonencapsulated glands are distributed throughout the oral mucosa
 and submucosa
- Saliva is produced by small groups of secretory units and is conducted to the oral cavity by short ducts, with little modification of its content
- Although variations exist, minor salivary glands are usually mucous
- The small serous glands present in the posterior region of the tongue (von Ebner's glands) are the only exception
- Lymphocyte aggregates are commonly observed within minor salivary glands, associated with IgA secretion.

For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			

Additional Resources:

رسالة من الفريق العلمي:

Reference Used:

1. Junqueira's basic histology 15th edition; ch. 15 & 16

"اللهم لاتدع لنا ذنبا الا غفرته ولا هماً الا فرجته ولا ميتا الا رحمته ولا مريضا الا شـفيته ولا دينا الا قضيته برحمتك ياارحم الراحمين"

