

Histology of GIT  
Connection between theoretical &  
practical sessions

---

**By: RAND ASSAF**

## General concepts in the GIT Histology

The structure is hollow tube Composed of a lumen surrounded by 4 layers

1<sup>st</sup> Mucosa having epithelial lining which differs between the organs, lamina propria which is loose connective tissue & muscularis mucosa usually inner circular & outer longitudinal of smooth muscle cells

2<sup>nd</sup> Submucosa composed of dense CT with blood & lymph vessels & Meissner's plexus

3<sup>rd</sup> Muscularis layer contains smooth muscle cells divided into inner circular( closer to the lumen) & outer longitudinal .Also, contains myenteric nerve plexus lying between the two muscle layers. In the CT between the two layers we find blood & lymph vessels.

4<sup>th</sup> Serosa which is thin loose CT rich in blood, lymph vessels & adipose tissue & a simple squamous covering epithelium (mesothelium)

→ The serosa is replaced by a thick adventitia in places where the digestive organ is bound to other organs/structures

→ **Adventitia is CT with vessels & nerves but without MESOTHELIUM**

**Mucosal forms in GIT** (further details will be discussed in each organ later)

**Protective** → stratified squamous epi. → found in oral cavity, pharynx, esophagus & anal canal

**Secretory** → the mucosa consists of a long packed tubular glands found in stomach

**Absorptive** → mucosa arranged in a fingerlike projections "villi" with intervening crypts → **typical for small intestine**. In the duodenum some crypts extend to the submucosa "Brunner's gland"

Absorptive/protective → packed tubular glands specialized for water absorption & mucous secreting goblet cells → lining the large intestine

---

Oral cavity is **keratinized** (for protection) in **gum & hard palate & non-keratinized in soft palate, lips, cheeks & the floor of the mouth**

The tongue is striated muscles (separated by CT) covered by a mucous membrane .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 we find lymphoid nodule & lingual tonsil (where the lymphoid nodules aggregate around crypts of the mucous membrane)

Circumvallate & foliate papillae have taste buds

## Oral Cavity

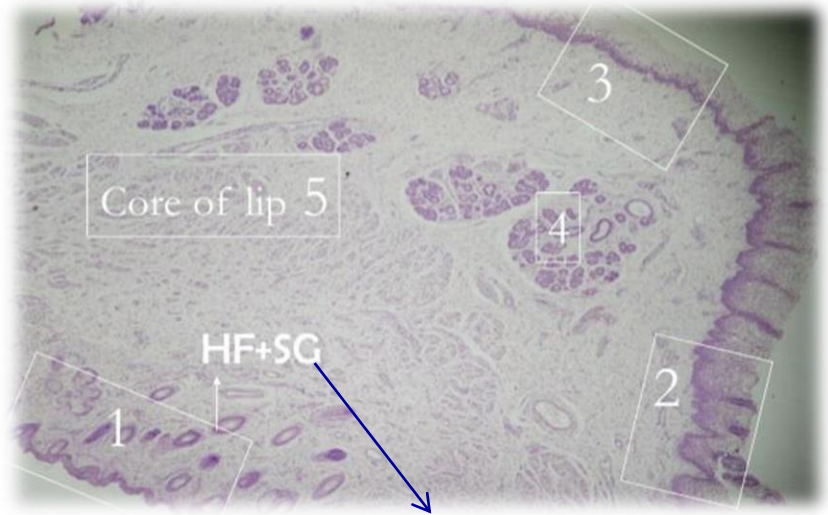
**1 → Skin stratified squamous**  
Keratinized

**2 → Vermilion (transitional) zone** Modified skin in contrast to the 1<sup>st</sup> part NO HF/SG  
Rich in blood vessels  
-The **sensory** part in the lip  
-Long **dermal papillae**  
LP invaginations through surface to give blood & nerve supply

**3 → Oral part (Mucous part) stratified squamous non-keratinized**

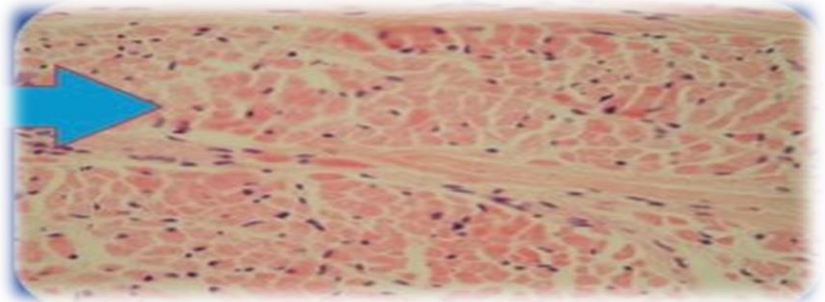
In lamina propria **rich in LABIAL Glands (4) → Mucous gland**

**5 → Core orbicularis oris (sphincter)**  
Striated Muscle

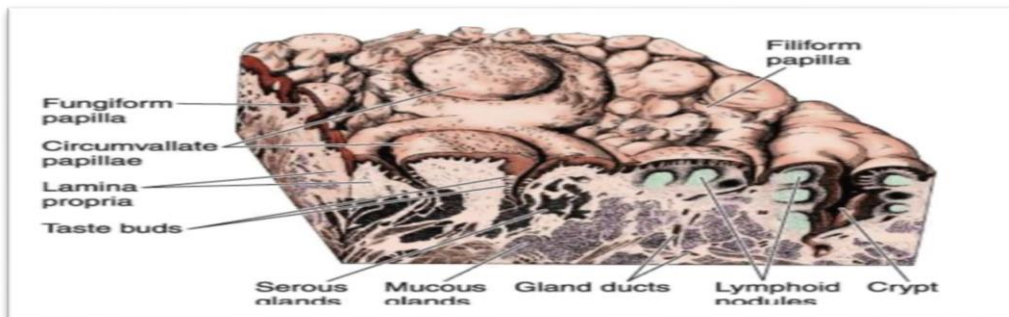


Contains hair follicle, sebaceous & sweat glands

→ Multiple Flatten Peripheral Nuclei "Striated"



## Tongue



Dorsal surface(Upper)

**Para-keratinized**

**Para-keratinized** when injured → don't return as before

-Contains *Lingual Papillae*( elevations in oral epithelium &LP) (4 types)

-contains projections → **filliform papillae( conical )** "NO taste buds

**Filliform covering epithelium is keratinized**

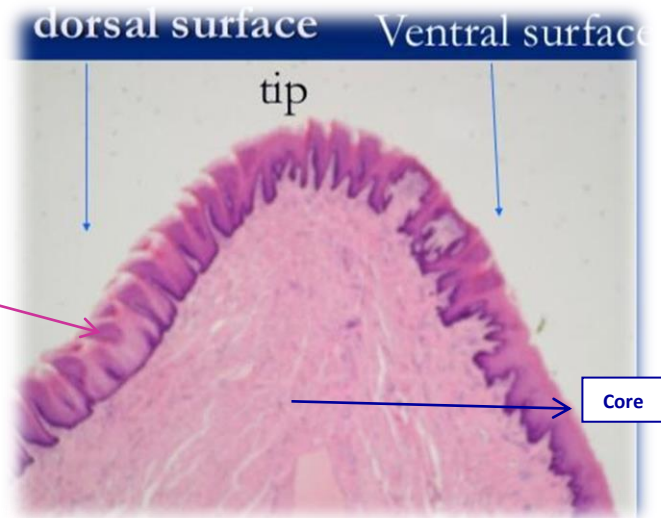
**Ventral surface(Lower)**

**stratified squamous non-keratinized mucous membrane is smooth**

**Core** → Striated muscles & Dermal papillae

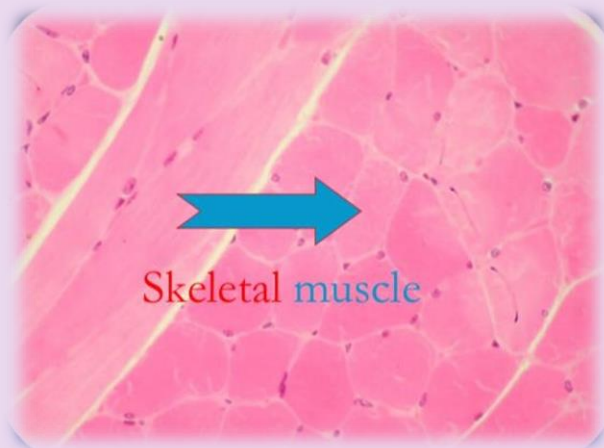
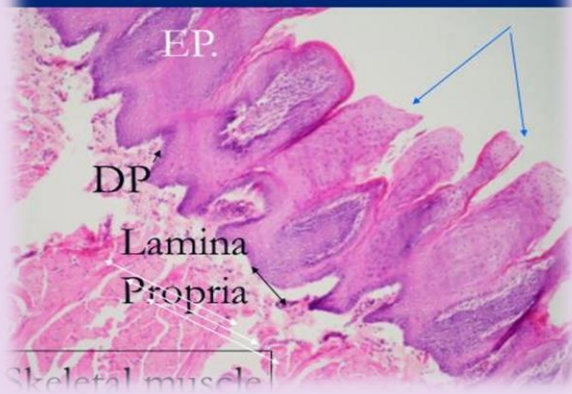
**Muscles directions differ**

**Longitudinal – Vertical – Horizontal**



Are the most abundant lingual papillae in the tongue

**Filiform Papillae**



**Fungiform Papillae "Mushroom shape "**  
**Para-keratinized str.squa.Epithilium**

Contains **taste buds (3 cell types)**

**Bipolar cell(taste) in the center**

**Supporting cells in periphery**  
**"Sustentacular cells"**

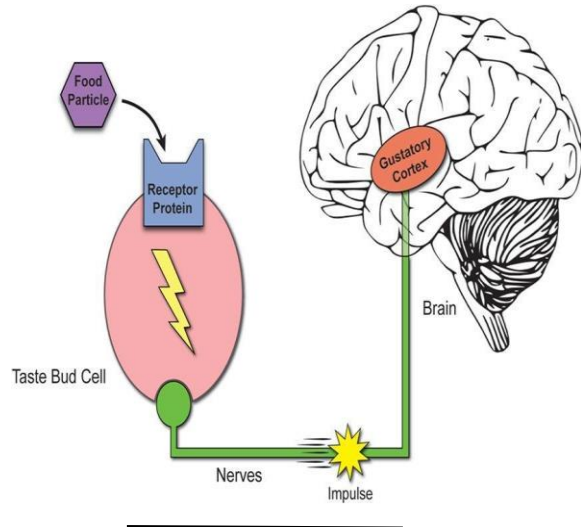
**Basal cells(stem)**





The dissolving material enters through the pore "taste hair" then the bipolar cell converts it to impulses reaching the bottom → chorda tympani of facial nerve to the brain

For further illustration



### Circumvallate Papillae

Vonlbnner's → Serous gland → it's duct opens in the bottom of sulcus

Rounded papillae surrounded by rounded groove (sulcus)

2 surfaces of the groove

-Medial → Having taste buds

Taste buds location → lateral surface of circumvallate papillae or medial surface of the sulcus

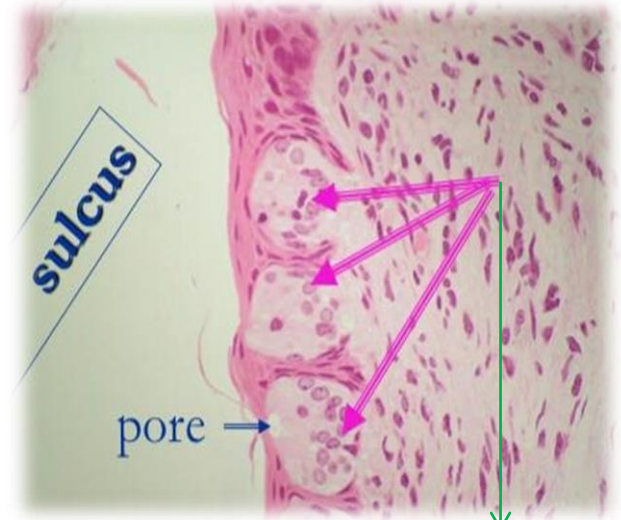
-Lateral → Str.Squa. Non-keratinized Epithilium

\*These papillae are located in the V region in the posterior portion of the tongue

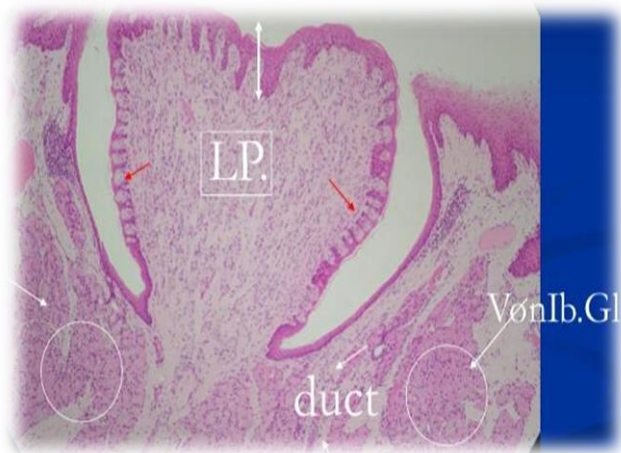
Undefined boundaries for serous acini

Basal & rounded nuclei

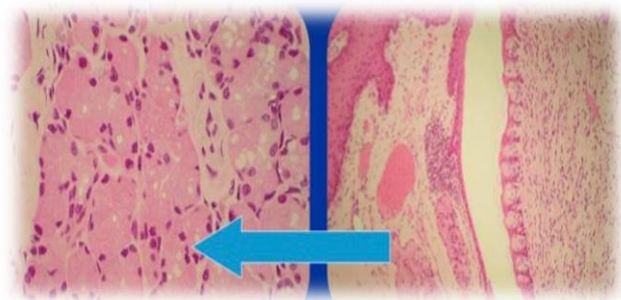
Providing continuous flow of fluid to the taste buds



Taste Buds



Von Ebner's = minor gland

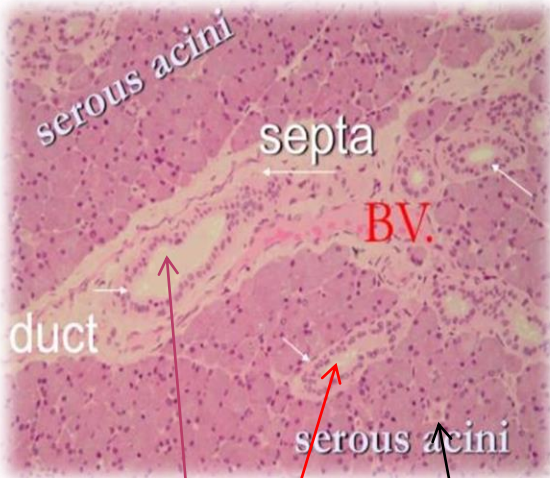


## Salivary Glands

Parotid – Submandibular – Sublingual

Compound tubuloacinar glands

**Parotid** → 2 capsules one from deep fascia of neck & other from CT which sends septa forming lobes & lobules



Inter-lobar duct

Striated

Intercalated

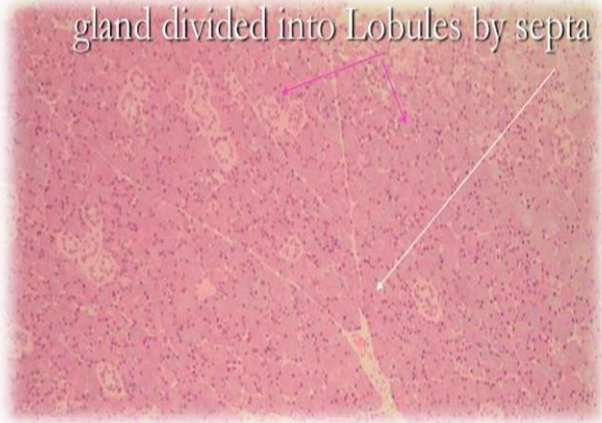


= Interlobar = excretory

**Very large duct**

Stratified cuboidal then stratified columnar until reaching parotid duct → Stratified squamous epithelium

## Parotid Gland



Serous gland only

Violet colour → Serous

White → Striated duct "Intratubular"

**Intralobular ducts 2 types (both are clear in parotid gland due to their length)**

1-Striated      2-Intercalated

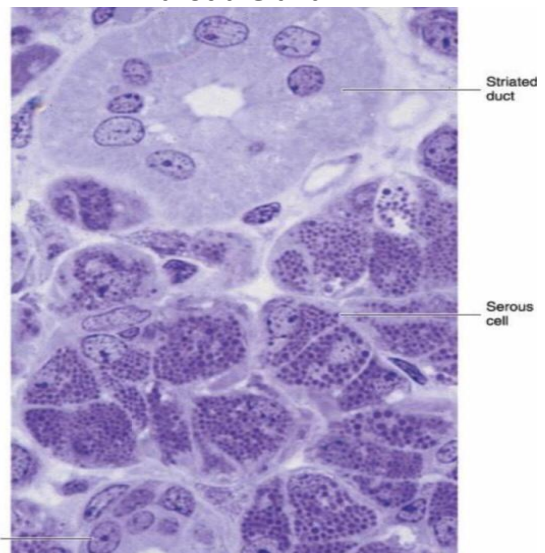
\* **bigger duct for striated than intercalated**

\* **5-6 nuclei for intercalated (smaller cells)**

\* **Up to 10 nuclei for striated**

\* **both simple cuboidal cells**

## Parotid Gland





**Submandibular**

→ **complicated striated duct (Mainly striated)**

→ intercalated duct not obvious

Mixed → **both serous & mucous (mainly serous)**

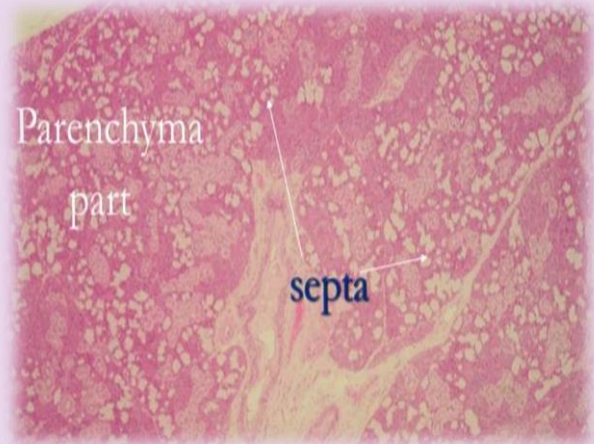
Mucous in contrast to serous cells

**Well-defined boundaries** between acinar cells

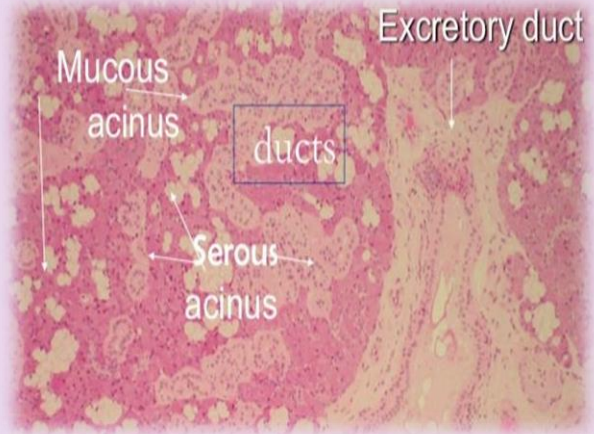
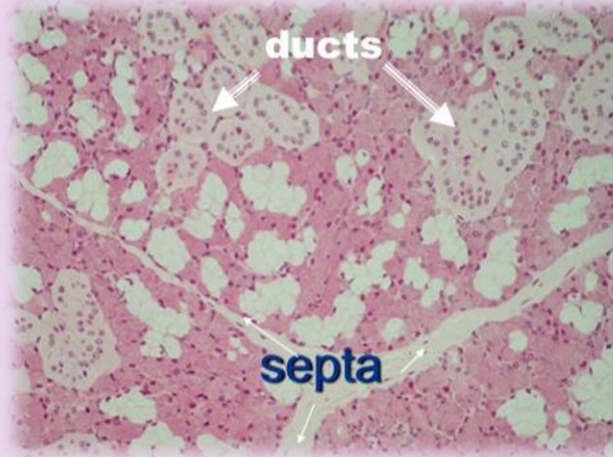
**Large lumen**

**Basal & flattened nuclei** \*while serous is rounded nuclei with basophilic cytoplasm\*

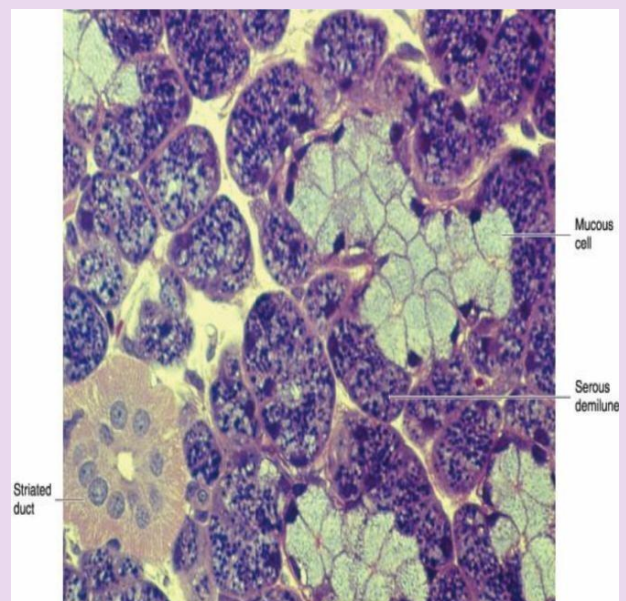
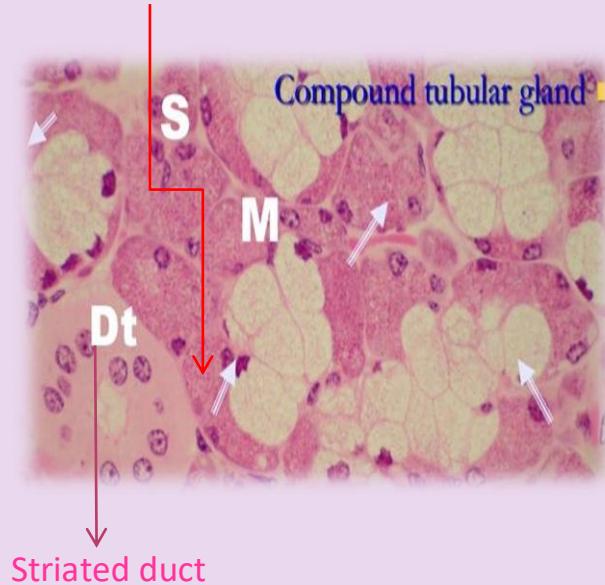
**Vacuolated**



\*covered by one CT capsule converting the gland to lobes & lobules



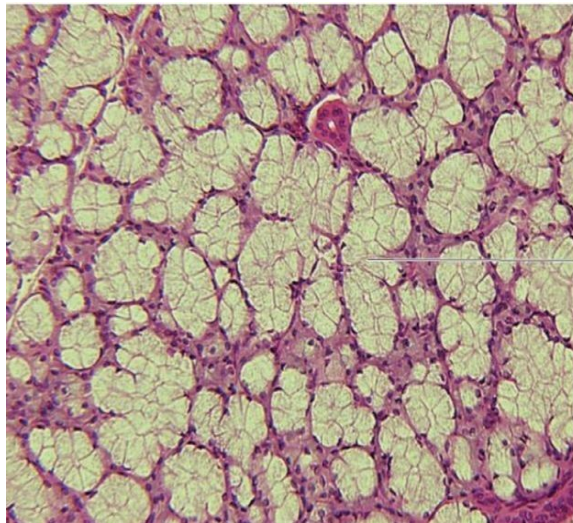
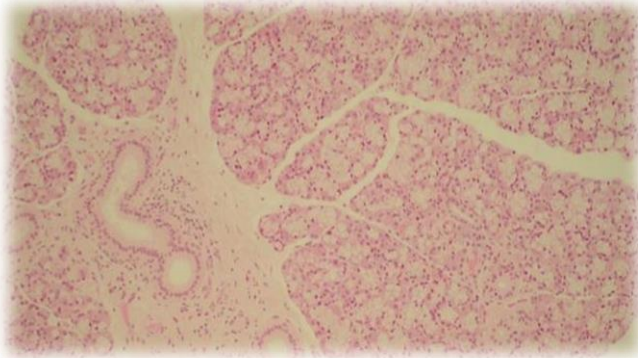
Serous demilunes → serous acini surrounding the mucous acini "like a cap around it"  
demilunes cells secrete lysozyme as in submandibular



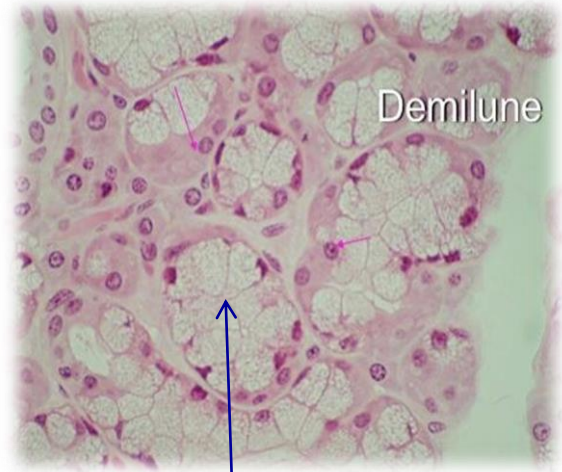


**Sublingual** → covered by one capsule CT converting the gland to lobes & lobules

- Also contains serous demilunes
- Mostly mucous secreting gland

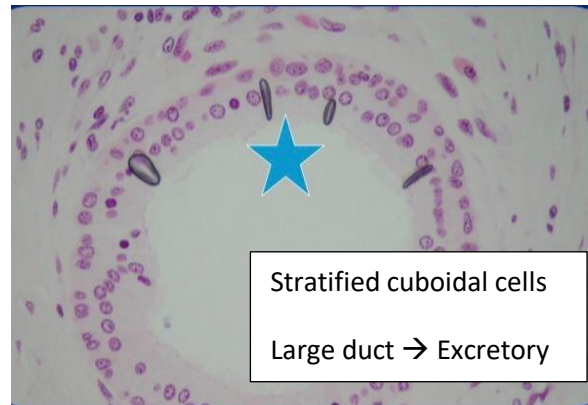


Mucous tubule



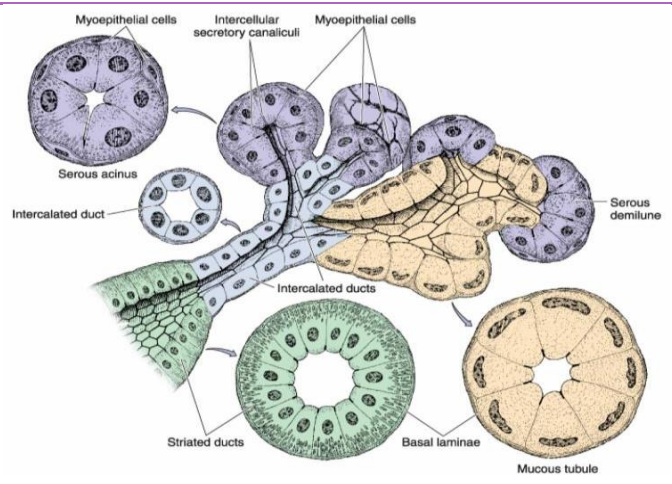
Demilune

Wide lumen



Stratified cuboidal cells  
Large duct → Excretory

Secretory end pieces present secretory cells & non secretory cells (myoepithelial)  
 Serous cells are **pyramidal** in shape with a broad base resting on the basal lamina & narrow apical surface with microvilli facing the lumen  
 Mucous cells are **cuboidal to columnar** in shape, their nuclei are oval & pressed toward the base. Organized as tubules  
 -Myoepithelial cells forming **secretory end pieces (basket cells)** & to lesser extent forming **intercalated ducts** (well developed branched spindle shaped cells) which form the initial portion of the





duct system. Cell contractility accelerates saliva secretion. They prevent end piece distention during secretion  
 →secretory end empty into the intercalated ducts lined by cuboidal epi.  
 These cells have the ability to differentiate into secretory or ductal cells  
 →Intercalated ducts join forming **striated ducts**→ radial striations that extend from the bases of the cells to central nuclei  
 Intercalated & striated are also called **intralobular ducts (within the lobule)**  
 →the striations having infoldings of basal plasma membrane with mitochondria that is **characteristic of ion transporting cells**

The striated ducts drain into ducts of CT septae separating the lobules →**becoming interlobular or excretory ducts initially lined by stratified cuboidal epi but more distally lined with stratified columnar epi**

**The main duct of each major salivary glands empties into the oral cavity & lined by non-keratinized stratified squamous epi**

Rich vascular & nerve plexuses surrounds the secretory & ductal components of each lobule

Large salivary glands contains plasma cells that secrete IgA → **secretory complex released in the saliva is resistant to enzymatic digestion & managing immunological defense in the saliva**

## ESOPHAGUS

After the esophagus pass through diaphragm we call the 4<sup>th</sup> layer Serosa "simple squa.epi"

Submucosa

Lining epithelium stratified squa.epi

Muscularis externa inner circular

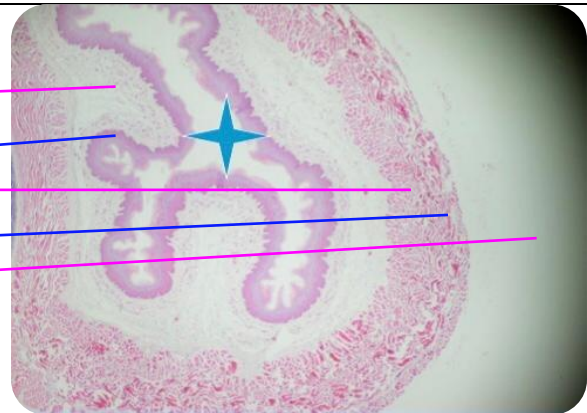
Muscularis externa outer longitudinal

Serosa/Adventitia (CT)

Serosa covering the portion in the peritoneal cavity

The rest is covered by adventitia

★ → Lumen



Depending on the 2 layers of **muscularis externa** we divide esophagus into

1) Lower third

**Both layers are smooth muscle**

2) Upper third

**Both layers are striated**

3) Middle third

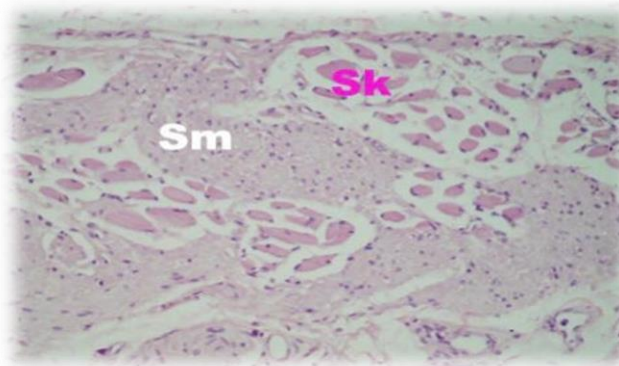
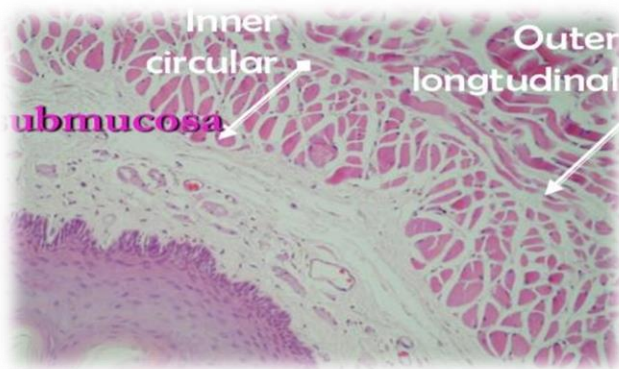
Having both striated & smooth muscle cells

**Skeletal mus.**

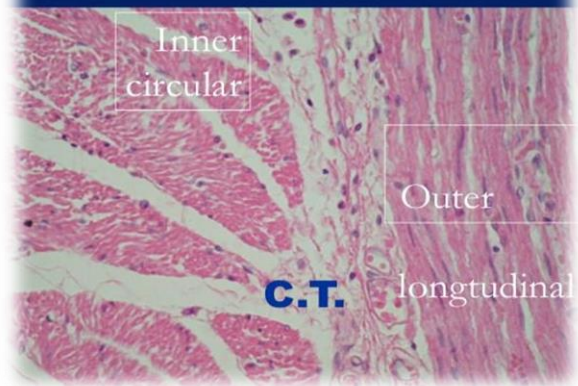


Upper third

Notice how the nuclei is peripheral & flatten in both inner & outer ME layers

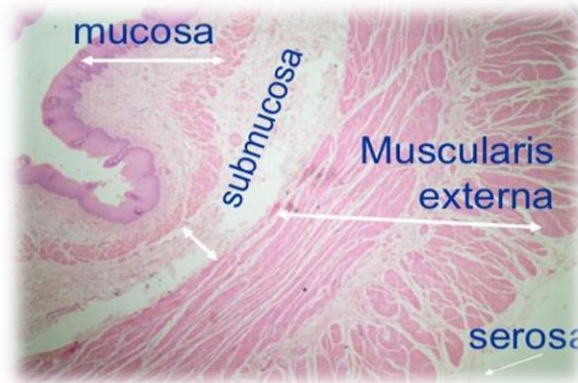


**Lower third (smooth muscle)**

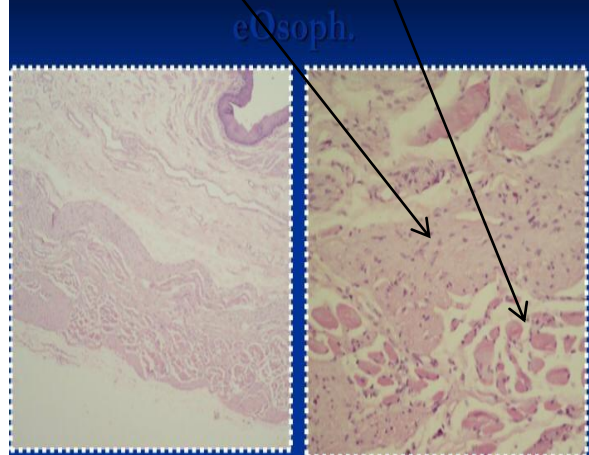


Lower third

Notice how the nuclei is central & the muscle fibers is spindle in shape in both layers



**Mixed smooth & skeletal in mid.**



Important to differentiate between smooth & skeletal cells

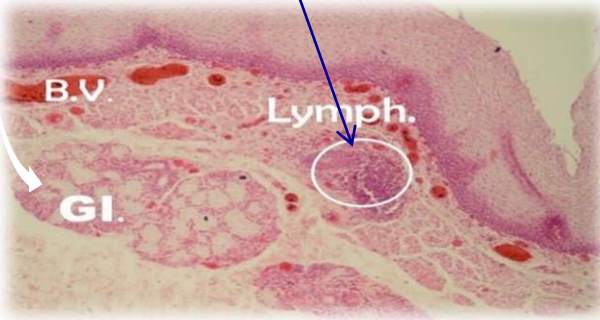


Glands type in esophagus:

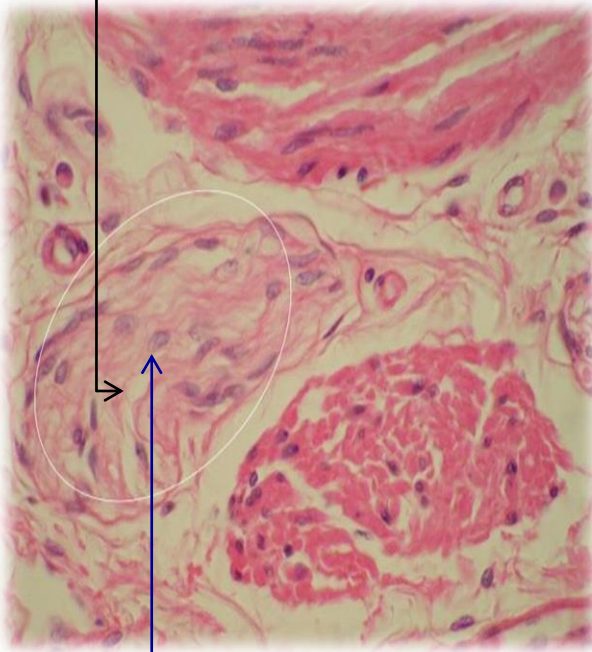
In the lamina propria → Cardiac glands (mucous)

In the submucosa → Esophageal proper glands (mucous secreting gland)

\*We also can find lymphoid nodule in lamina propria



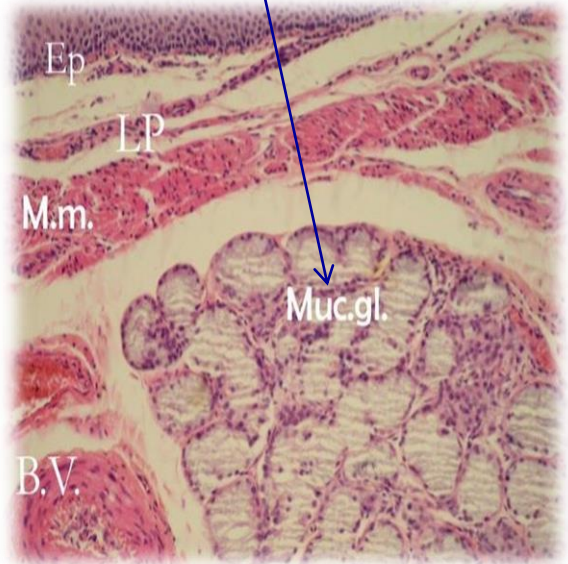
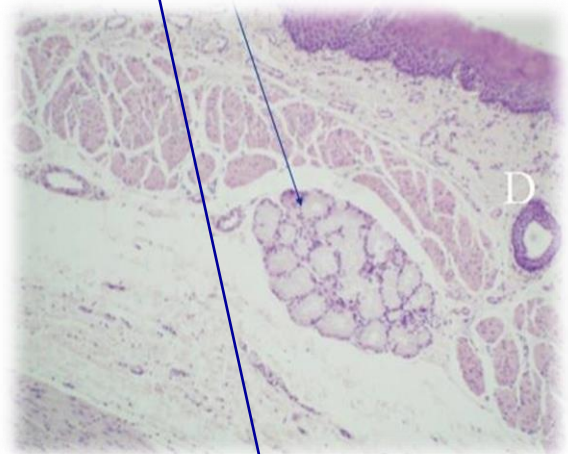
Nerve axons going to myenteric plexus (between 2 layers of muscularis externa)



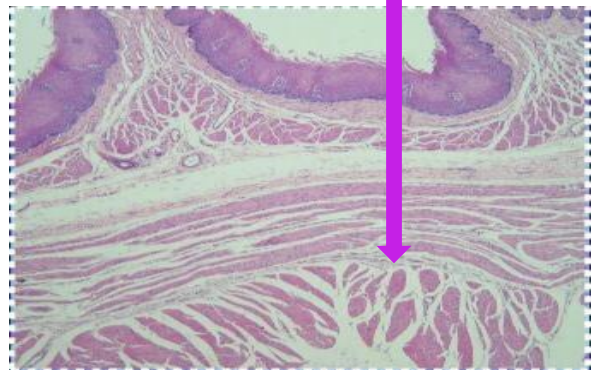
Schwann cell nuclei

Myenteric plexus have both sympathetic & parasympathetic

Esophageal proper glands

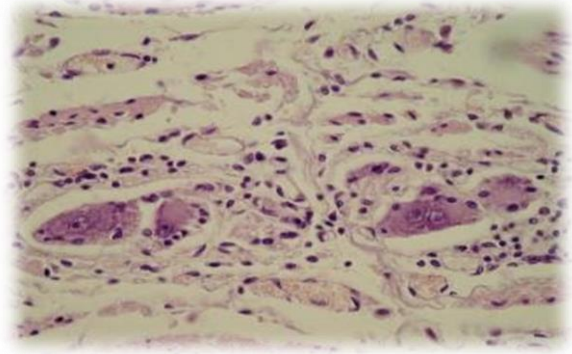


Myenteric plexus



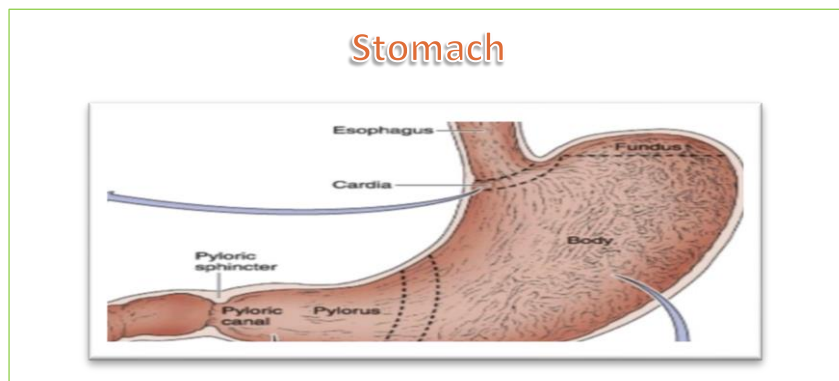
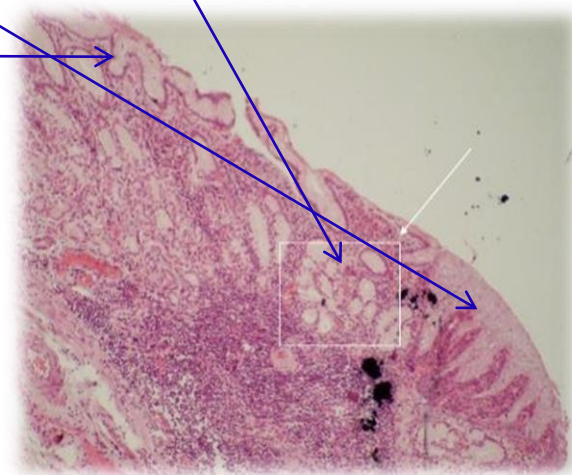


**Myenteric plexus & ganglia** → nerve cells having in the center nucleus & nucleolus it's parasympathetic ganglia (synapsing) surrounding it nerve fibers having schwann cells  
**What we find inside the ganglia** → only parasympathetic



**Str.squa.non-keratinized for esophagus**  
**Simple columnar epithelium without goblet cells**

**Cardiac gland in the junction between esophagus & stomach**



Gastric gland found in lamina propria in the body/fundus having 3 regions → distribution of epithelial cells isn't uniform in gastric glands

Isthmus → stem cell & parietal

Neck → around it we found mucous & parietal cells → below neck stem cells exist

Basal → we have chief cells (zymogenic)

Muscularis externa in stomach **3** Layers except the pylorus

Outer **longitudinal**

Inner (middle) **circular**

Inner-most **Oblique**

\*Mucous – Parietal – Chief cells are the only cells seen in light microscope

\*4<sup>th</sup> layer is serosa because the stomach is intraperitoneal →stomach serosa type is simple squa.epi

\* Don't get confused between mucous cells that are located between parietal cells in the neck of gastric gland & surface epithelial mucous cells( remember we have higher protection in the stomach due to high acidity so we have 2 mucous secreting type cells)→ both having foamy like appearance

\*Secretions of gastric gland reach the surface through **GASTRIC PITS**(small ducts) **simple branched tubular glands**( surface epi. Of mucosa invaginates into the lamina propria)

Rugae → longitudinal folds of submucosa ( pink arrow in the upper right image) through mucosa (white arrow)

Mucous cells → vacuolated for dissolving mucous

Parietal cells → acidophilic (pale)

Chief cell → basophilic

We can find **lymphoid tissue** in **LP** (**bluish color**) loose CT

In LP we also find smooth

**Muscularis mucos** in stomach → **very thin layer of smooth muscle**

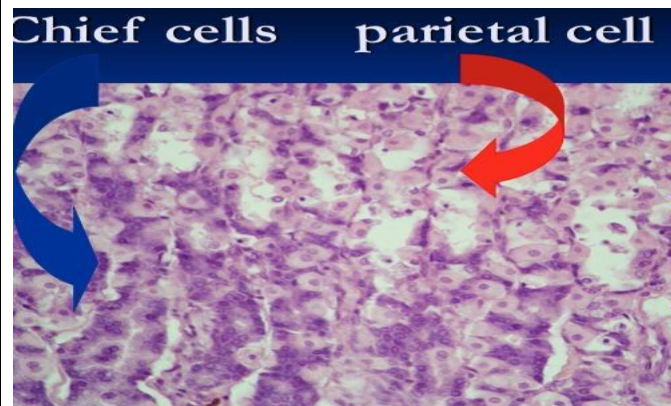
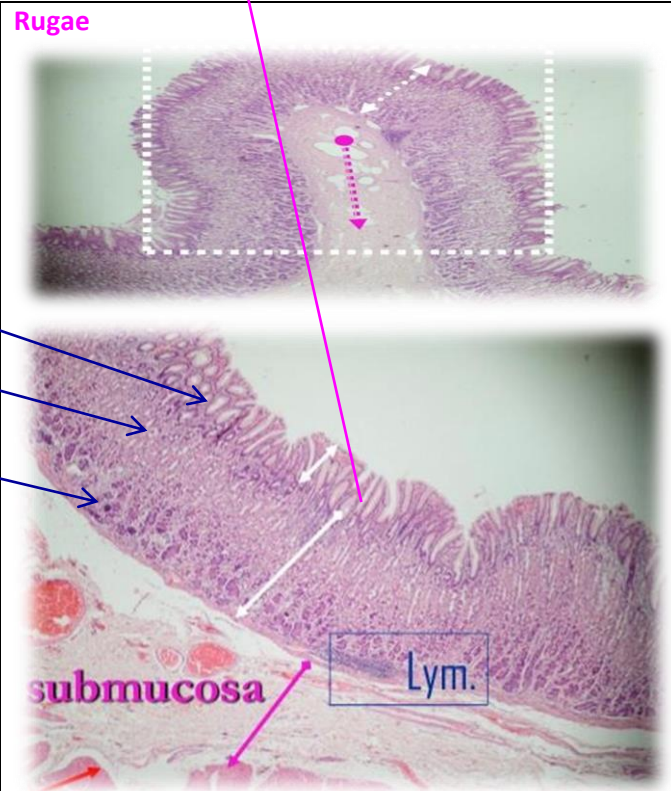
Submucosa is dense CT containing blood & lymph vessels , infiltrated by lymphoid cells & macrophages

Important to distinguish between parietal & chief cells

Parietal → rounded central nucleus  
→ may present as bi-nucleated cell

Chief → basal & basophilic as mentioned before

Chief cell contains pepsinogen & also produces lipase



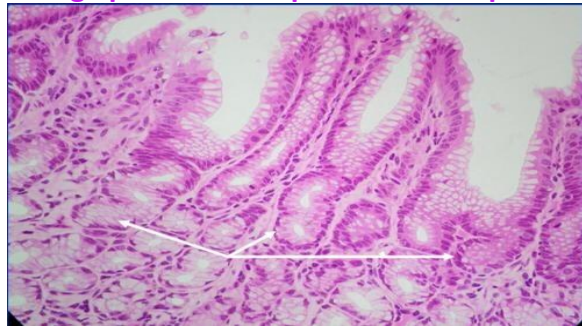
All sections above for stomach is from **BODY**

If we compare the body & Pylorus  
The body → has short pits & high thickness of gastric glands

- Pylorus** → Large & narrow pits
- thickness of gastric gland is short
- No parietal nor chief cells
- The only cells present is mucous cells (LM)
- Having lymphatic nodule related to **MALT**
- Muscularis propria 2 layers  
inner circular “making pyloric sphincter”  
outer longitudinal

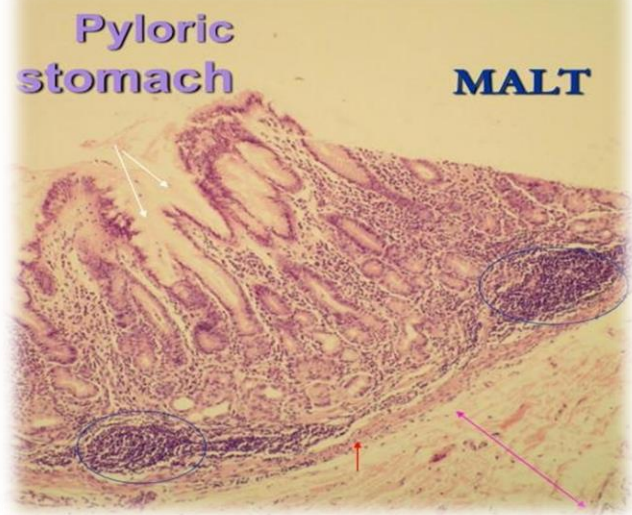
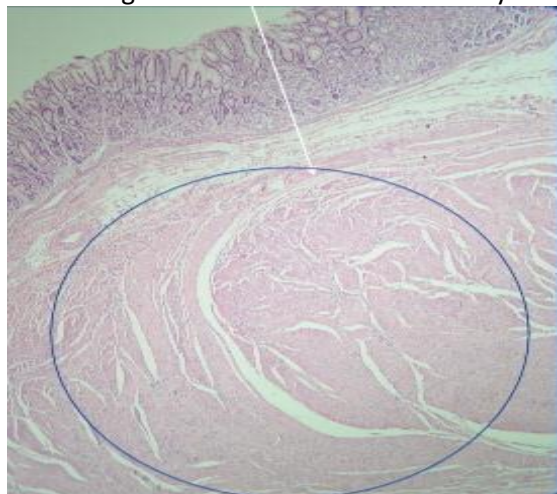
Also what differentiate pylorus from the body **Coiling** simple branched tubular glands

**Lining epithelium simple columnar epi**



### **Pyloric Sphincter**

Thickening in the inner smooth muscle layer



**Enteroendocrine cells**(not seen in LM) in the pylorus are G-cells producing **gastrin** & D- cells producing **somatostatin**(secreted for counterbalancing the acid secretion)

Some notes about stomach

Cardia → most secretory cells produce mucous & lysozyme & few parietal cells secreting HCL

-Compared with the glands in the **cardiac** region The pyloric glands have longer pits with shorter coiled secretory portions

-Parietal cells activated → Forming intracellular canaliculus (invagination of apical plasma membrane)  
-Enteroendocrine cells are found in the neck & bases of gastric glands

→ in the fundus it produces serotonin

→ in the pylorus G-cells produce gastrin



# Small Intestine

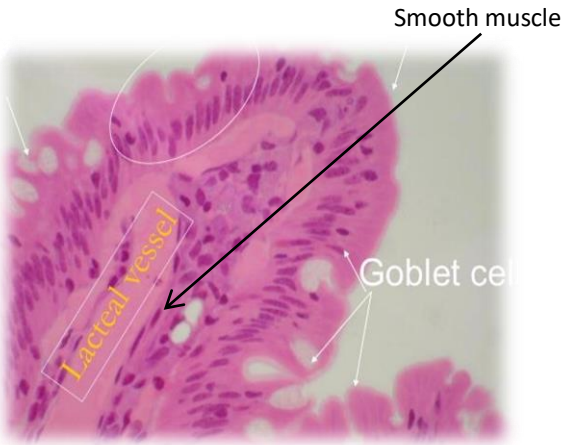
**Mucosa**  
 Finger-like projections  
 "leaf-like projection in the duodenum"  
 → simple columnar with goblet cells

Intestinal glands in the LP → Crypt of **Lieberkuhn**

Muscularis externa → 2 layers outer longitudinal inner circular

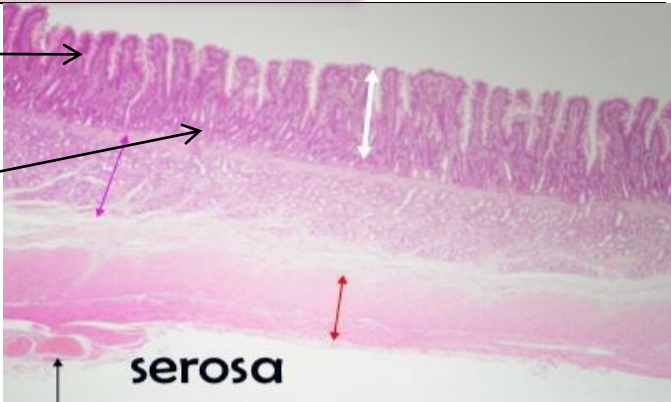
Serosa → ileum, jejunum anterior surface of jejunum only  
 → posterior Adventitia

- Microvilli very obvious in duodenum
- Paneth cells are more clear in jejunum than duodenum & are found **in the gland not in the villi**
- Brunner's glands "Branched tubular glands" secrete alkaline material

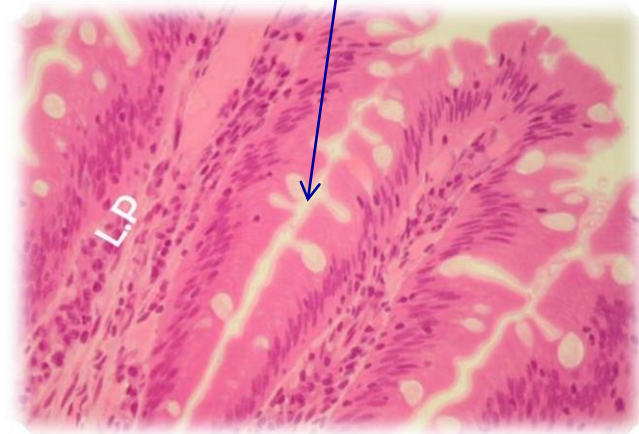
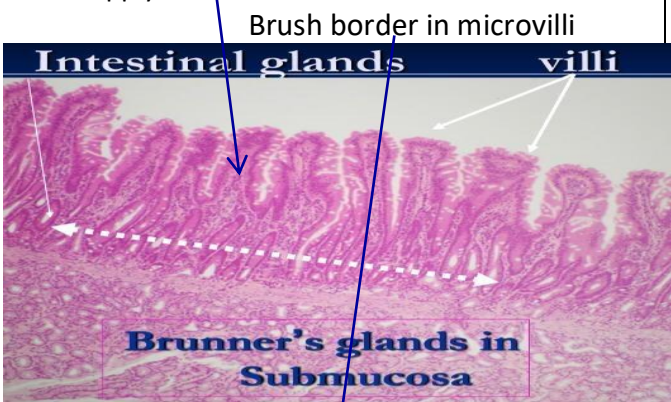


- **Goblet cells** are increasing in number as we go distally → in **jejunum more than duodenum** & in **ileum more than jejunum**
- Small intestinal glands contain stem, goblet absorptive, paneth & enteroendocrine cells

**No plicae circulares in the duodenum**  
 Villi = epithelium + LP projecting into the lumen  
 → the epithelium of the villi is continuous with that of the glands



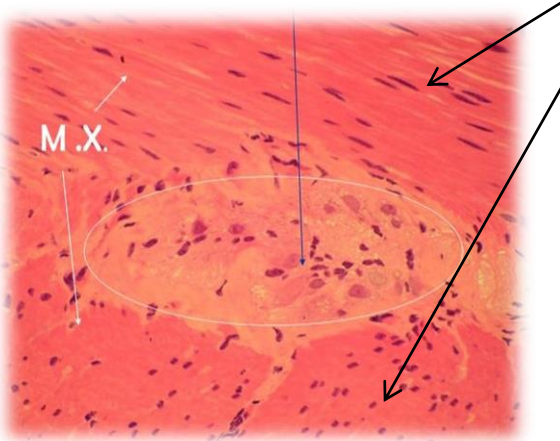
Simple columnar epithelial cells → Absorptive cells between them **goblet cells**  
 Invaginations of **LP** through epithelium to provide blood supply & lacteal



The brush border is found in the apex of absorptive cell

Intrinsic innervation (by meissner & myenteric) responsible for intestinal contractions even in the total absence of extrinsic innervation

**Auerbach's "Myenteric plexus"**



Circular muscle fibers are cut **longitudinally**

Longitudinal muscle fibers are cut in **cross section (transversely)**

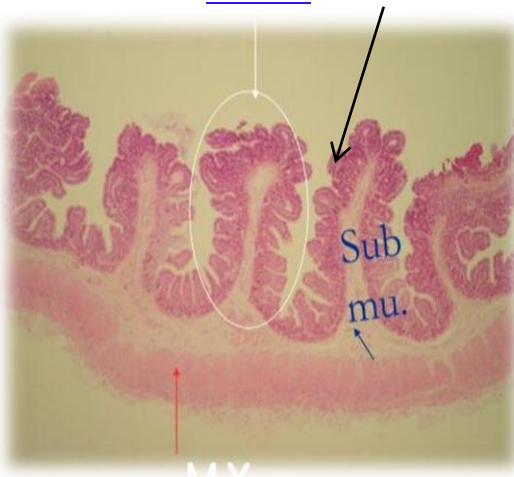
The plexus contains sympathetic & parasympathetic axons around them schwann cells (the dark cells in the image)

Nerve cells (rounded & central nucleus with faint cytoplasm) are found inside the parasympathetic myenteric ganglia → parasympathetic do synapse in it (sympathetic without)

Section in the **jejunum**

**Plicae circulares**

**Villi**



Plicae also increases absorption

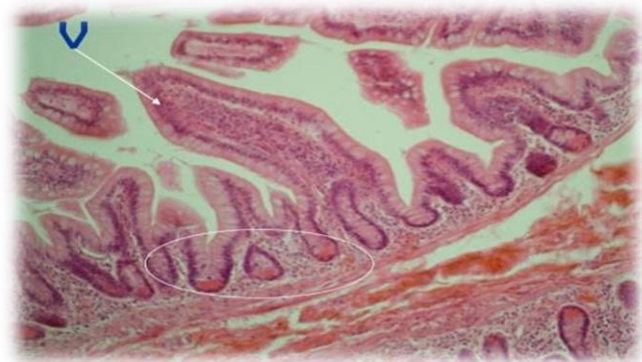
Same histology as duodenum → lining epithelium simple columnar with goblet cells → also the villi having LP, capillaries & lacteal

→ **No glands** in the **submucosa** as the duodenum

4<sup>th</sup> layer → Serosa simple squa.epi

\* **Paneth cell (bactericidal → secret lysozyme) are very prominent in jejunum Lieberkuhn**

**Apex is acidophilic (accumulation of secretion) but the base is basophilic "see the image below"**



Section in the **ileum** (there is **plicae circulares** but more in the jejunum)

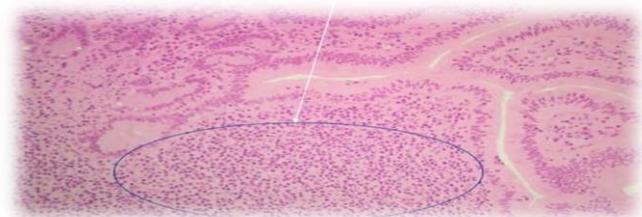
- Instead of absorptive cells, Peyer's Patch covering epithelium consists of M cells" endocytosis cells" → immunological system
- GALT → antibody secreting plasma cells, macrophages & a lot of lymphocytes

\*LP of Small Intestine composed of **loose connective tissue** with blood & lymph vessels, nerve fibers & smooth muscle cells

Same histology as duodenum & jejunum

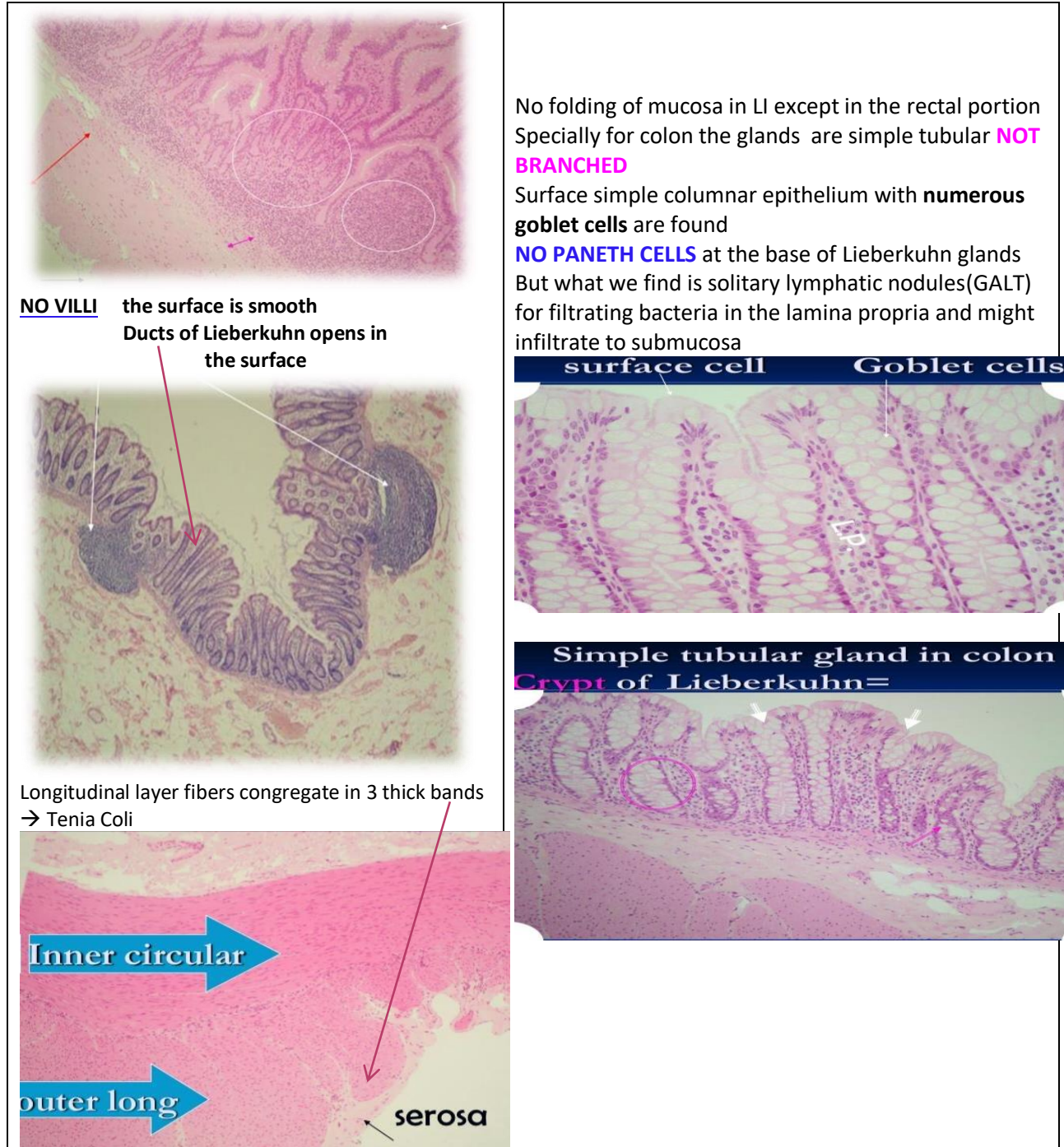
**Peyer's patch (component of GALT)** differentiate it from them

Accumulation of lymphocytes in **LP & Submucosa**





# Large Intestine



**NO VILLI** the surface is smooth  
Ducts of Lieberkuhn opens in the surface

Longitudinal layer fibers congregate in 3 thick bands  
→ Tenia Coli

Inner circular  
outer long  
serosa

surface cell  
Goblet cells

Simple tubular gland in colon  
Crypt of Lieberkuhn=

No folding of mucosa in LI except in the rectal portion  
Specially for colon the glands are simple tubular **NOT BRANCHED**

Surface simple columnar epithelium with **numerous goblet cells** are found

**NO PANETH CELLS** at the base of Lieberkuhn glands  
But what we find is solitary lymphatic nodules(GALT) for filtrating bacteria in the lamina propria and might infiltrate to submucosa

In intraperitoneal portion of the colon the serosa has protuberances composed of adipose tissue → **Appendices epiploicae**

In Anal region → Mucous membrane forms longitudinal folds → Rectal **columns** of Morgagni that connect to the anal orifice forming valves & sinuses

Anal sphincter formed by muscularis layer

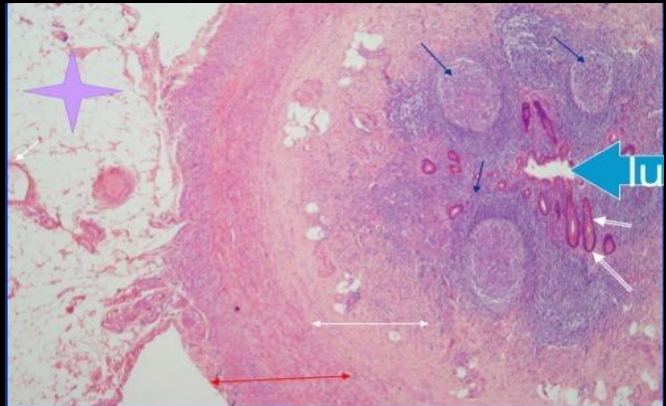
Comparison between SI& LI → In the large intestine



- the mucosa is thicker with more goblet cells
- the crypts are longer without paneth cells
- Muscularis layer is well developed
- LP is reduced & contains solitary lymph nodes

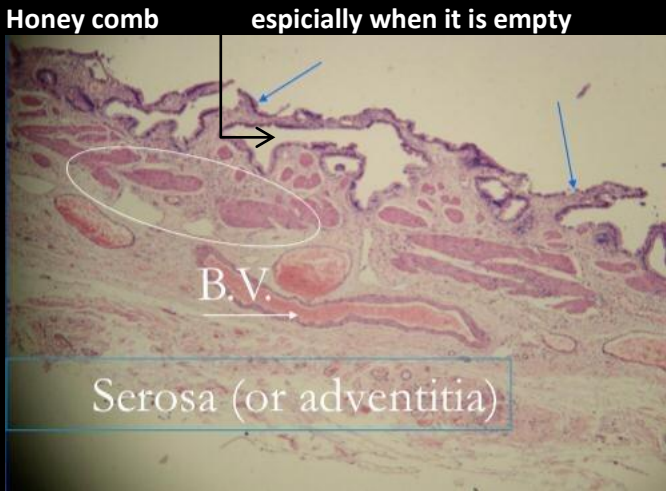
## Appendix

Very narrow lumen ( Light blue arrow in the image)  
 Lining epithelium simple columnar with few goblet cells  
 Few Lieberkuhn's glands (white arrow)  
 Abundant lymphoid nodules in LP & submucosa (dark blue arrow)  
 Serosa → mesoappendix ★  
 Having appendicular artery inside it & fat



## Gallbladder

Simple columnar epi. Without goblet cells  
 Abundant foldings → Honey comb  
 No muscularis mucosa or submucosa  
 Muscle layer (externa) → Patches of smooth muscle (irregular) surrounding the LP  
 Serosa Anterior surface / Adventitia Posterior surface "attached to lower surface of liver"

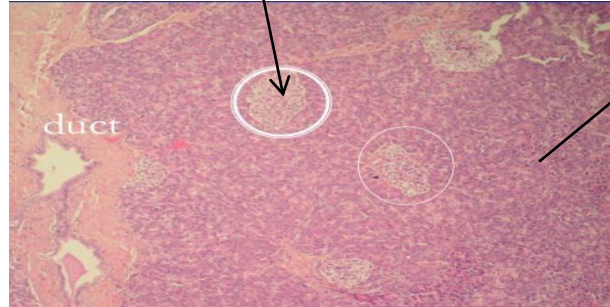


- \* Sometimes microvilli can be presented in the surface
- \* epithelial cells are capable of secreting small amounts of mucous
- Tubuloacinar mucous glands near the cystic duct
- Produce most of the mucous in the bile

# PANCREAS

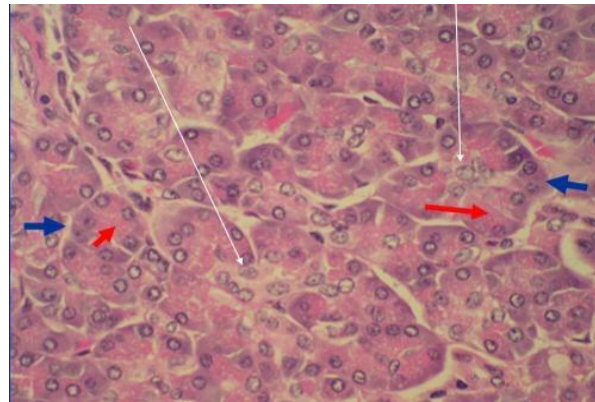
## MIXED GLAND

Islets of Langerhans endocrine where hormones are synthesized



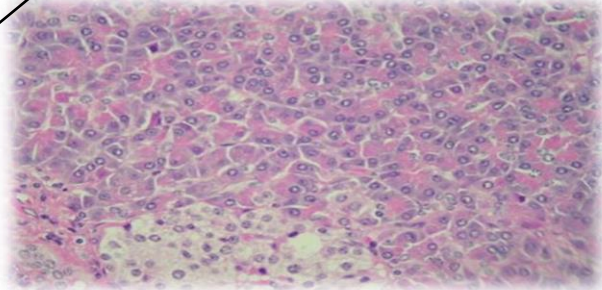
Inter calated ducts (left white arrow) but **WITHOUT STRIATION**

**Centroacinar cell**



It's cytoplasm is pale. These cells constitute the intraacinar portion of the intercalated ducts.

Exocrine "Acini" storing & secreting enzymes  
→ several serous cells  
→ similar to parotid gland



In the figure above notice Pancreatic Acini **POLARITY**

Base → rounded nucleus & **basophilic**  
Apex → **acidophilic** (secretion aggregation)  
zymogenic granules

Differences between the parotid & pancreas glands

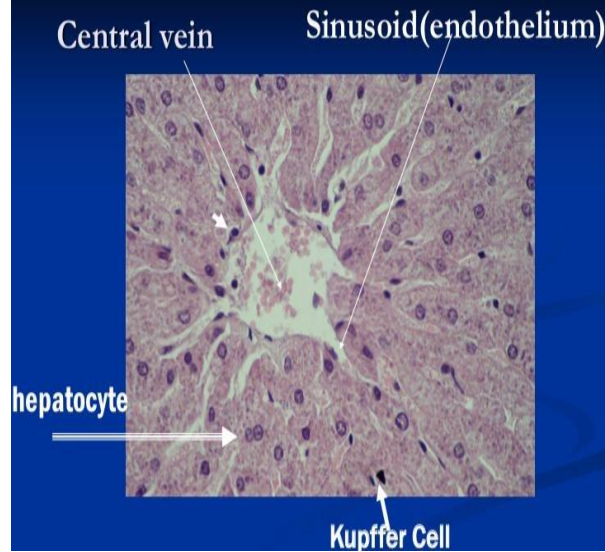
- Absence of striated ducts & the presence of the islets of Langerhans in the pancreas
- Presence of Centroacinar cell
- portions of intercalated ducts penetrate the lumens of the acini in the pancreas

The majority of enzymes are stored as proenzymes in the secretory granules of acinar cells being activated in the SI lumen after secretion  
Pancreatic secretions is controlled by secretin & CCK produced by enteroendocrine cells of Intestinal mucosa ( duodenum & jejunum)

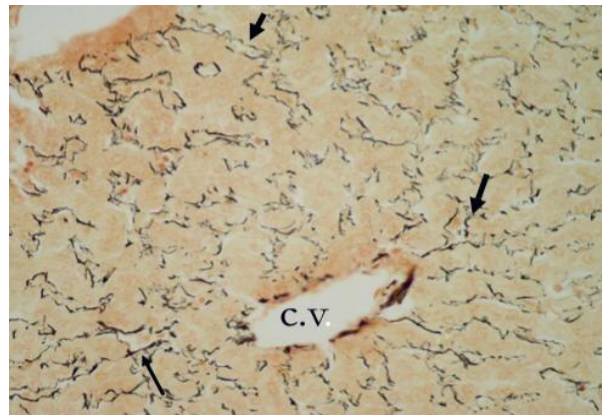
\*Rich capillary network for the secretory process



# LIVER

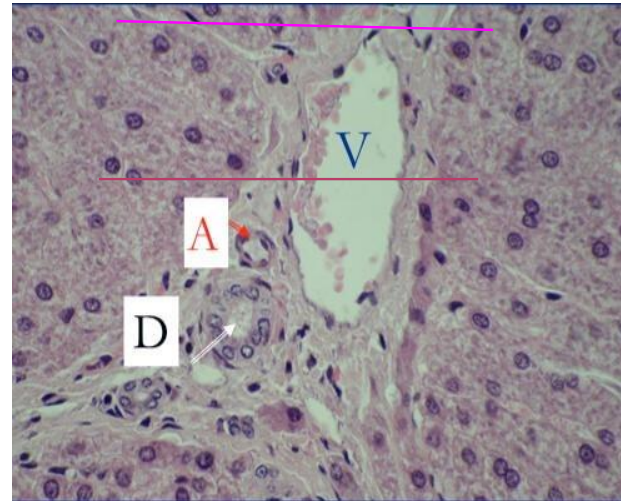


Reticular fibers are found around central vein around hepatocytes, between hepatocytes & IN **PORTAL TRIAD**  
**Silver impregnation** specific stain for reticular fibers



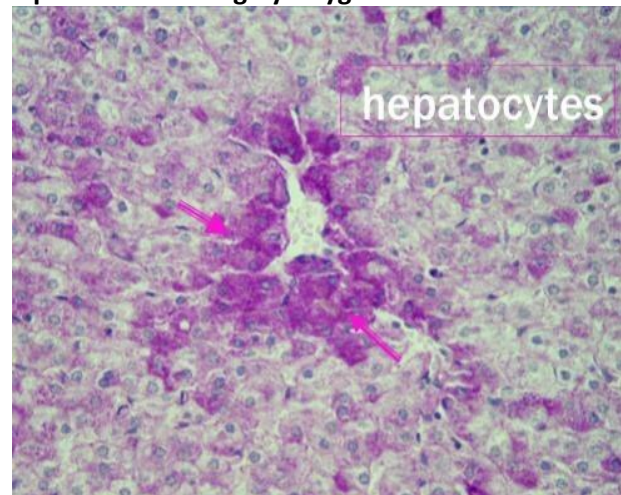
In human liver it's difficult to differentiate the exact limit between the lobules

Hexagonal shape  
 The hepatocytes arranged radially from central vein  
 Their nucleus is rounded & can be binucleated  
 Kupffer cell a macrophage cell in the liver( very dark)



Portal Triad  
 Larger part → portal vein  
 Artery → thick wall & small  
 Bile duct → Simple cuboidal epithelial cells

**PAS** special stain for **glycogen**  
**Glycogen accumulate in liver mainly in central vein & portal triad** → Highly Oxygenated



# BEST OF LUCK