

Digestive System

University of Jordan
Faculty of Medicine
Batch of 2013-2019



Slide Sheet Handout Other

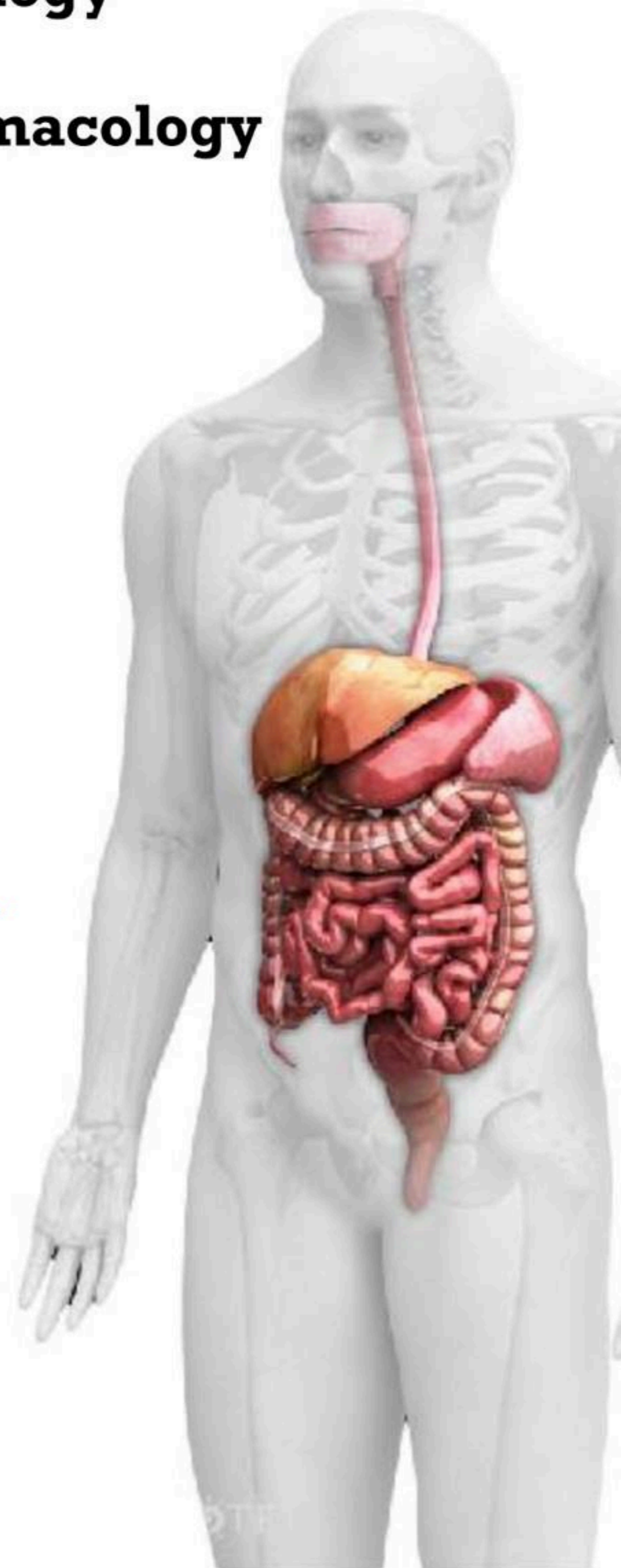
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Sheet #: 4

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Price:





Secretion of gastrointestinal tract

Today we are going to talk about secretion of GI ,, this is an easy lecture ,, I hope that you'll enjoy it ☺

الدكتور تأخر عن المحاضرة ربع ساعة , لهيك الشيت راح تكون قصيرة وسهلة

- Amount of secreted fluids from different organs

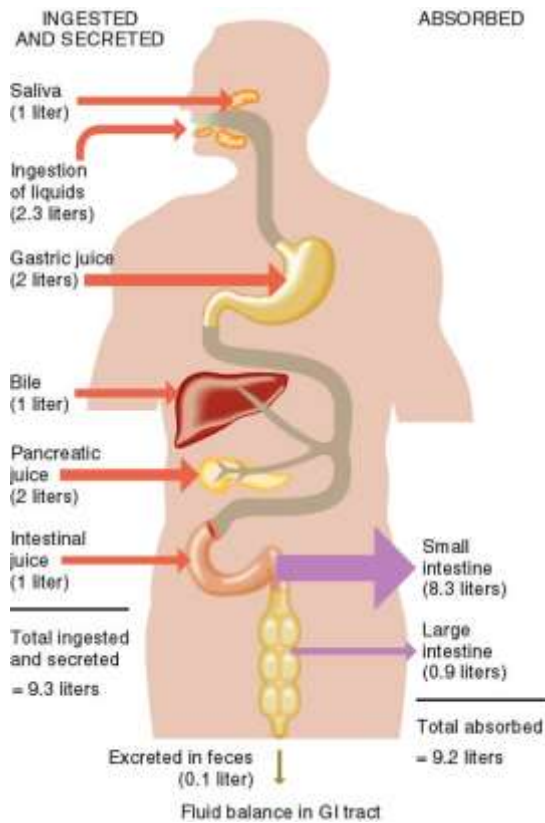
- You know that there are a lot of organ forming the GI tract and we have a bulk of secretions by these organs starting from oral cavity about 1-1.5 liter per day of saliva, also we are ingesting a lot of fluids about 2 liters plus or minus, stomach is also releasing 2 liters of gastric juice per day, liver is releasing 1 liter of bile per day, pancreas is releasing 2 liters of pancreatic juice per day, intestine releases 1 liter per day so the total is about 9.3 liters

Some of them found as cells within tube of GI and some of them found as accessory organs outside the GI tract.

source	Amount of Fluid that produced
Salivary glands in mouth	1 liter of saliva
Ingestion of food	2.3 liters of liquid
stomach	2 liters of gastric juice
liver	1 liter of bile
pancreas	2 liters of pancreatic juice
intestine	1 liter of intestinal juice
TOTAL	9.3 LITERS

After that this fluid pass through intestine large amount of it is reabsorbed about 9.2 is reabsorbed.

Most of this reabsorption is taking place at the level of small intestines about 85%, and colon is responsible of final removal of water and electrolytes and what's remaining stool, we lose about 100 milliliter in stool of these fluids.



-function of secretions

There are a lot of functions of secretions:

1) Digestive enzymes :

There are several enzymes with specific functions produced by different organs (mainly stomach) that help in digestion of food .

2)) Lubrication & protection of mucosa :

By mucus that is produced mainly by certain organ (ex. Esophagus & colon)

Types of secretory structures

We have certain organization of secretion cells :

We start from:

1) single cells dispersed all over the mucosa (called goblet cells)



2) Pits (more cell group together to form pit which is simple gland still found within mucosa)

3)) complex gland :

the simple glands grouped together to form complex gland (compound gland) for example,, glands that are found in submucosa.

4)) organs:

(Grouped of more cells) found outside the whole tubular structure of GI.

For example ,, salivary gland / pancreas/ liver.

-control of secretion (neural controlled)

All of secretory processes are very well controlled .

By : neural control

***ENS**

***ANS:**

1))Sympathetic: ^{}(main effect: reduce secretion by indirect way)**

Actually , sympathetic increase the vesicular transport of mucous in general.

*when its moderate increase in sympathetic stimulus, lead to increase secretion .but

*when its bulk increase(stress) in sympathetic stimulus , lead to decrease secretion (Because it leads to vasoconstrictor, and the secretory cells becoming not available for secretion).

2))Parasympathetic:^{}(main effect: increase secretion by direct way)**

By causing release of vasodilator, so the secretory cell becoming available for secretion.

***Hormonal Regulation**

Some hormones are secreted by presence of food or other local change in digestive organs.

-salivary gland secretions

When you Look to the table below , you note that :

1)) **submandibular glands:** mainly release mucous & serous (mixed) .
It forms 70% of all salivary secretions.

Mucous contains high amount of mucin , which is glycoprotein

Serous contains water and electrolytes

2)) **parotid gland:** mainly release serous (water).

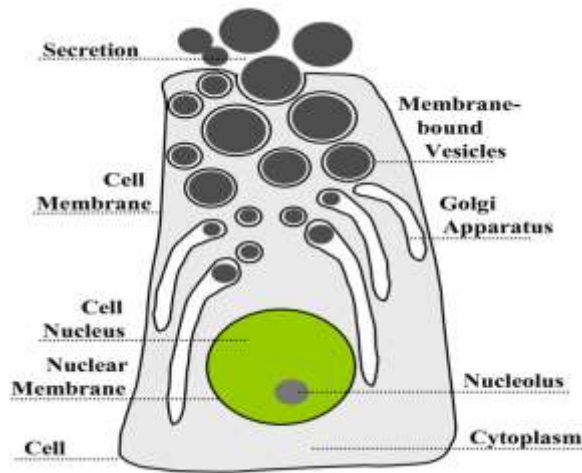
It forms 25% of all salivary secretions.

3)) **sublingual gland:** mainly release mucous (glycoprotein)
it form 5% of all salivary secretions.

Salivary Glands

Name of Gland	Type of Saliva	% of Total Saliva Secreted
Submandibular	Mucous-serous	70
Parotid	Serous	25
Sublingual	Mucous	5

Typical cell release mucous



This is a cell which is producing mucos

What we are seeing in this cell are:

**High conc. of vesicles. (This means that these cells are specialized in releasing protein, but mucus is glycoprotein "modified protein with sugars")

**High conc. of ER.

When you see large conc. of vesicular contents in cell, this mean that this cell is specialize in protein secretion or modified proteins (ex. mucous which is glycoprotein).

Salivary gland has two types of cells that forming it:

1)) acinar cells forming parnchym of the gland : (release saliva)

Transport saliva by vesicular transport toward apical part of membrane (lumen of gland) secreted by exocytosis.

>Then saliva go along the duct (that lined by other type of cell called duct cells).

2)) duct cells : (release water &electrolytes)

These cells help in modification the primary saliva (that's secreted by acinar cells)

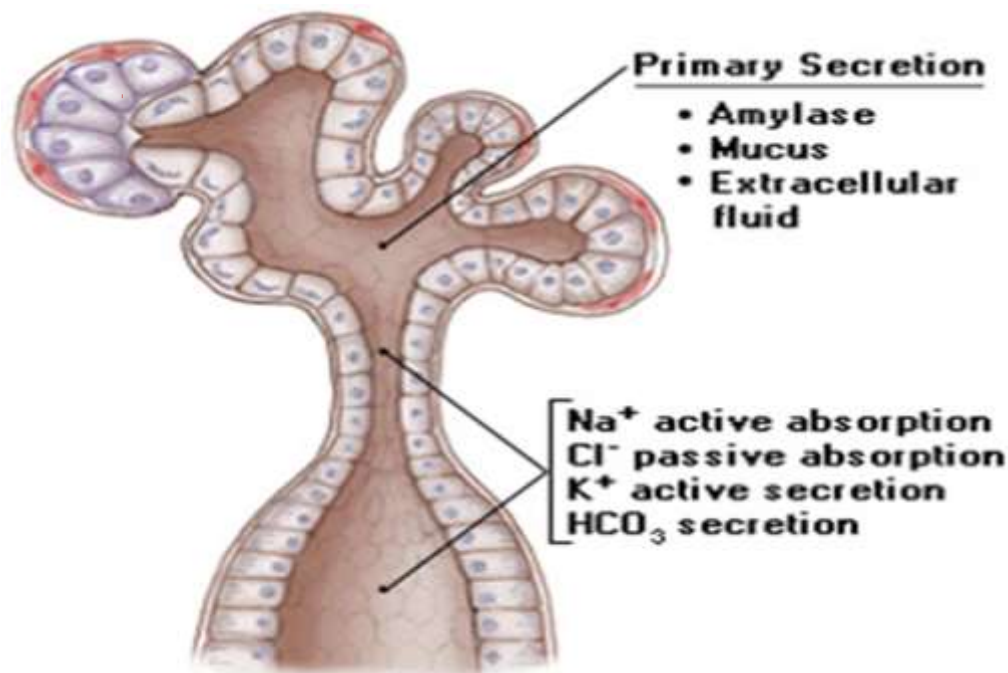
** sometime dispersed between these cells (between these duct cells)

we find some cells release mucous.

Once we have released saliva we have first primary saliva and along these duct cells we have modification of primary saliva so function of these duct cells is to modify primary saliva.

From internet ☺ ::

Acinar cells are cells of tiny lobules of a compound gland or similar saclike structure, such as an alveolus.



Mechanism of secretion

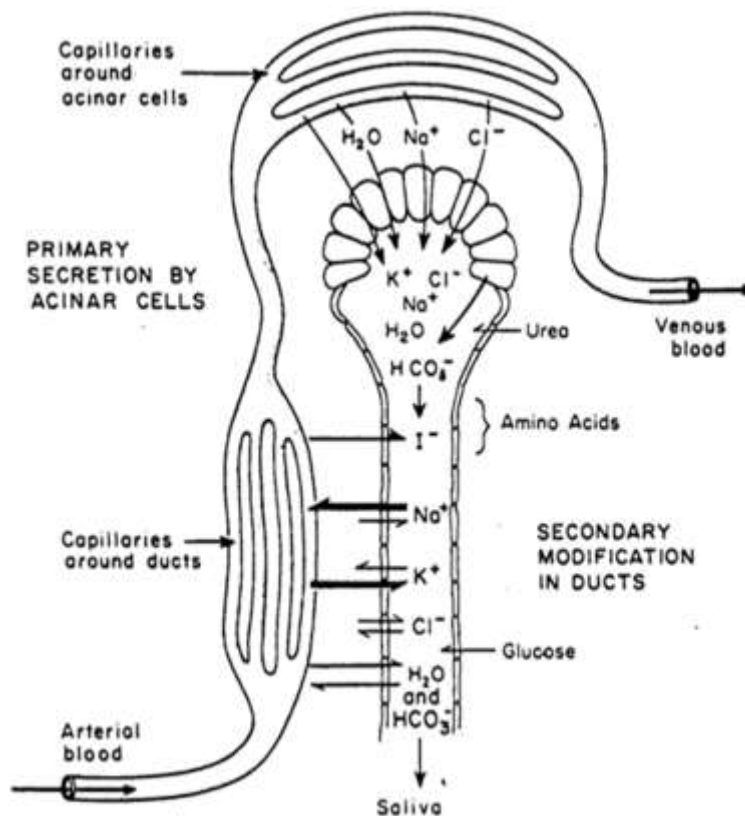
At the basolateral membrane of acinar cells, we have Active transport of(Cl⁻) chloride ions .so the polarity of the cell becomes more negative inside (there will be more negative charges inside cells).

This negativity of membrane potential will attract the positive ions (mainly Na⁺) from interstitial fluid

This lead to move sodium from interstitial fluid into cells (inside cells)

So this result in increase osmolarity inside cells ,, and that will pull water inside cells. (The cells must be enlarge in size logically, but this does not occur, because its trapped in small area .)

>>> SO it leads to minor rupture in apical part of membrane> and that's lead to flushing contents (primary saliva that's rich in Cl^- & Na^+) into luminal part of gland. The contents of Primary saliva very close to the contents of interstitial fluid (not exactly)



When primary saliva go within the duct of gland it will has some modifications take place by duct cells , as we mentioned before.

These modifications that take place along duct :

**reabsorption of (Na^+)

Net result is a change in the ionic compositions of saliva by :

Decreasing (Na^+)&(Cl^-) conc. to the 1/10 of their plasma conc.

Increasing (K^+) conc. by 7 folds .

Increase (HCO_3^-)By 2-3 folds.



**excretion of(K^+)

** reabsorption of(Cl^-)

So at the end , saliva will increase its contents of (K^+) & (HCO_3^-)

And will decrease its contents of (Na^+)& (Cl^-)

>>actually these compositions are vary according to rate of secretions .

In one line: active transport of Chloride which attracts sodium then attracting water then minor rupture at the apical membrane then flushing of saliva in the lumen.

Changes: decrease in sodium and chloride about one tenth of their initial concentration in primary saliva, we are increasing potassium conc. about 7 times and increase bicarbonate conc. about 2 to 3 times by these duct cells

This composition can change according to the rate of secretion, if you have high rate of secretion (stimulation of salivation), do you have that time to exchange of these components (sodium, potassium or bicarbonate)? No. so the composition of that saliva can vary according to the rate of secretion or salivation

Take an example :

effects of PH of saliva

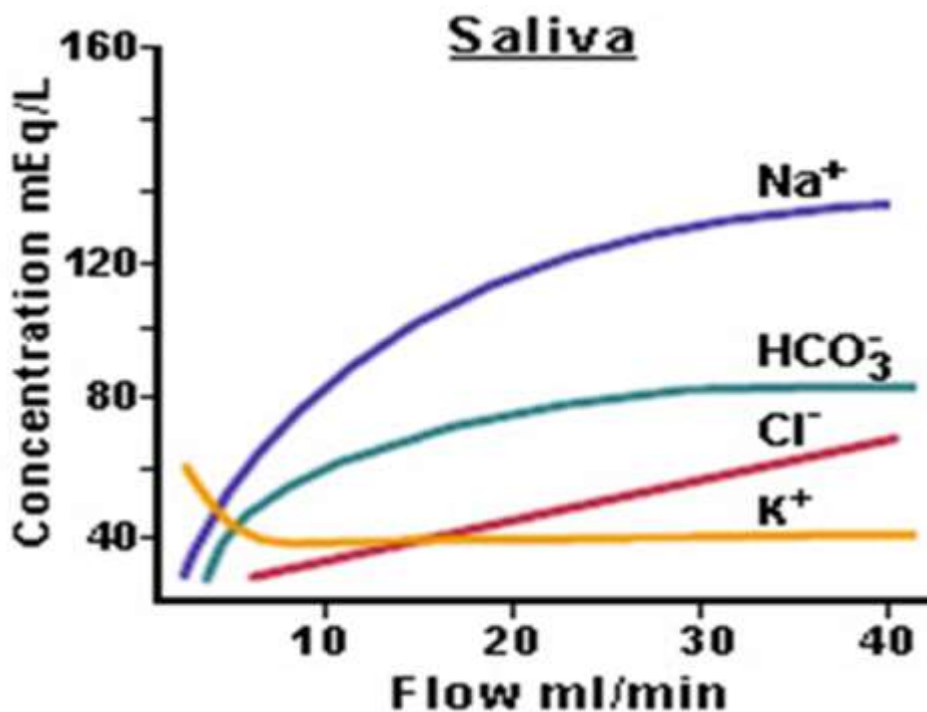
>> in basal rate of secretion , where no stimulation of salivation processes,, the PH=7

>> when you stimulate the salivation ,, PH changes into 8.

That because we stimulate formation more amount of (HCO_3^-)

>> stimulation of salivation processes >>> saliva becomes more alkaline by forming and releasing (HCO_3^-)

How do we form (HCO_3^-)? By water, CO_2 to get formation of carbonic acid, bicarbonate is released toward the lumen while the proton is reabsorbed back to interstitial fluid



When you look to this picture, you notice that :

1 >> at low rate of secretion :

** (K^+) content can be higher

(because we have time to absorb (Na^+) and release (K^+))

2 >> at high rate of secretion :



** (Na^+) content can be higher

(no time to get reabsorption of that (Na^+)

3 >> when you move to right (increase rate of secretion):

*Will increase amount of (HCO_3^-) synthesis & release .

*Will increase (Cl^-) content , because of no time to reabsorb (Cl^-) at high rate .

They produce (HCO_3^-) by themselves :

Take (H_2O) with (CO_2) to formation carbonic acid .

This carbonic acid will dissociate to :

1# (HCO_3^-) >> which go to lumen .

2# (H^+) >> which reabsorption back to interstitial fluid .

Some lectures said that there are counter transport of (Cl^-)

That lead to increase absorption of chloride ions .

4 >> at the beginning (low rate) the release of (K^+) in exchange of (Na^+) reabsorption.

5 >> at high rate of secretion , (K^+) content is low

because of no time to get more secretion of (K^+) at that rate .

So secretion very will control by (ANS) ,,, not by enteric system or hormones

aldosterone effects

Some lecturers said that generally in all cells , neighboring the reabsorption of (Na⁺) or secretion of (K⁺)

** it has general effects ,, but not controller of salivary gland secretions .the main effect of aldosterone is over renal tubules

>>> so ,, salivation increased by : in both cases we are activating parasympathetic system

1)) **unconditioned salivary reflex (dental procedure) : salivation increases by mechanical stimulation**

*no frequent stimulation.

2)) **conditioned salivary reflex (learned response)**

That if you see or smell or thinking or tasting delicious food :p :p

>>>> you will increase salivation

*must have previous experience about this food . if you do not have that experience you should go back to unconditioned reflex to increase salivation

Functions of saliva

We know that in our mouth we have enzyme (amylase)

Optimal acting of it at alkaline PH .

When this enzyme reaches the stomach (acidic condition) , no more function of that enzyme

So this enzyme is not the main one in digestion, its help in start digestion .(not main function in complete digestion)

>>> after eating ,, some remnants of food will left in mouth ,, so its responsible for clearing ,, not bulk digestion of carbohydrate .



Functions of saliva

****1** facilitate swallowing :**

THERE ARE a lot of mucous released in saliva help in moisture the food and slipping of bolus of food along esophagus. Mixig food with saliva, give lubrication of bolus and protection the wall of esophagus mucosa .

****2** Antibacterial action:**

Lysosomal enzyme help in lyses or destroy certain bacteria .

****3** oral hygiene**

Due to presence of saliva in your mouth all over the time .

****4** Saliva rich in immunoglobulin**

That's important in protection and neutralization and destroy bacteria .

****5** Consider as Solvent**

Help in tasting different things that stimulate the taste buds that found over the tongue.

****6** Important in Speech**

Without it , you can't talk well.

****7** neutralize the acidity By bicarbonate and prevent teeth caries .**



Esophageal secretion

We know that esophagus crypt with some glands :

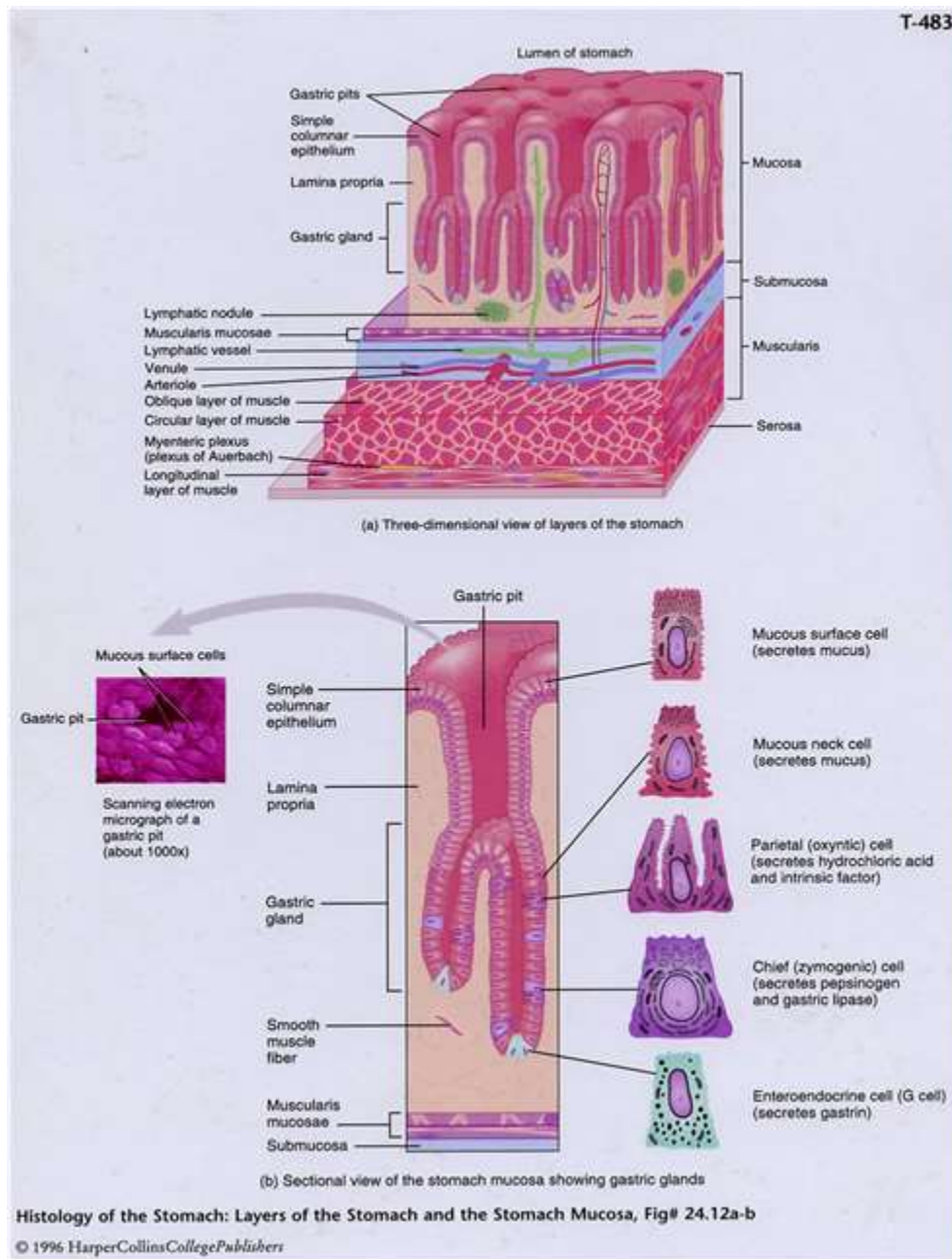
- 1)) **upper part of esophagus (has simple mucous glands)**
- 2)) **lower part of esophagus (has compound glands)**

*lower part important to protection from acidity that's produced by gastric reflux (reflex stomach juice back toward esophagus) by producing high amounts of mucos

There are lots of mucous released by esophagus secretory cells ,, and the PH of mucous is neutral toward alkaline PH ,, help to neutralize and prevent the effect of these acids by neutralization

(buffer system).

Gastric secretio





That's the mucosa of the stomach

There are a lot of glands (simple glands called gastric pits) in mucosa ,, mainly in the lower part of stomach .

the cells that forming this gland :

****1** Mucous surface cells (found on the surface of gland)**

that secret mucous.

****2** Mucous neck cells (found on the neck of gland)**

That's secret mucous also .

****3** Parietal (oxyntic) cells (found within the duct of gland)**

That's secret hydrochloric acid & intrinsic factor.

Intrinsic factor

Important in absorption
vitamin B12

In luminal membrane there are invagination in cell membrane toward the nucleus forming what called canalicoli .

So we get secretion from canalicoli which is connected with lumen of gland that is connected to lumen of stomach so we are reaching the lumen of the stomach.

****4** Chief (Zymogenic or peptic) cells(found within the duct of gland**

That secret pepsinogen & gastric lipases .

Pepsinogen is inactive form of pepsin,, when it becomes active it's called (pepsin) it's activated in lumen of stomach

pepsin is involved in proteins digestion

we start digestion of proteins in stomach but do not finish it in stomach, the main function of stomach is not to digest actually

****5** endocrine cells (G cells) (found in the base of duct)**

That secrete gastrin .

يعطيكم ألف عافية . وكل التوفيق للجميع وما تنسوني من صالح دعائكم ☺ ☺ ☺

DON'T wait for the perfect moment,, take the moment and make it perfect ☺

SO DON'T GIVE UP ,, JUST SAY "YA RUB"

Special dedication to my father .



And dedication to Ghaida Khresat ☺ Esraa Odeh Alsalamini ☺ Salam alkhresha ☺
Farah Abu Abood ☺ Tasneem Abu Yameen ☺ Hana Haimor

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