#2 Salivary glands,swallowing and physiology of esophagus

This work includes the following lectures :

- Salivary glands,swallowing and physiology of esophagus (2nd lecture “girls”)
- Salivary secretion (2nd lecture “Boys”)
- Swallowing (3rd Extra lecture “Boys”)

objectives :

- Mastication and Chewing reflex
- The functions of secretory glands
- Anatomical types of glands
- Salivary glands
- Secretion of saliva and its characteristics
- Composition of saliva
- Lubricating and protective properties of mucus
- Secretory unit (salivon)
- Saliva and its flow rate
- Functions of saliva
- Control of secretion by sympathetic and parasympathetic nervous systems

Doctors’ notes

Extra

Important

Revised by

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Resources: 435 Boys’ & Girls’ slides | Guyton and Hall 12th & 13th edition

Editing file

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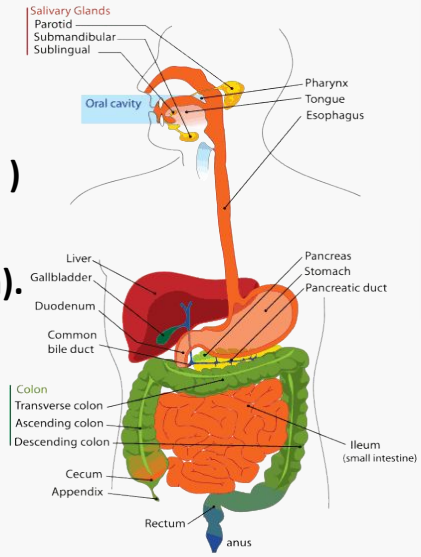
Structures and functions of gastrointestinal tract

STRUCTURE	Arranged linearly in following sequence	Mouth > pharynx > esophagus > stomach > small intestine > large intestine > anus.
	Other structures of GI tract (GLANDS)	Salivary glands - pancreas - liver - gallbladder.
FUNCTIONS 4 major activities of GI tract	Motility	Propel ingested food from mouth toward rectum
	Secretion	Aid in digestion and absorption
	Digestion	Food broken down into absorbable molecules
	Absorption	Nutrients, electrolytes, and water are absorbed

MOUTH :

- **ORAL CAVITY** : digestion (mechanical and chemical)
- **SALIVARY GLANDS** (saliva = mucus) : saliva lubricates food e.g. Salivary amylase (starch breakdown).
- **MASTICATION**: Teeth chew food



Digestion In The Mouth (Oral cavity)

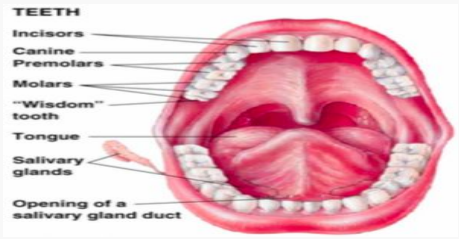
Two Types of Digestion:

Mechanical (Mastication or Chewing)	Chemical (Salivary Amylase)
- Teeth are designed for chewing. - Chewing muscles are innervated by 5th CN. - Chewing process is caused by a reflex (stretch reflex) (food bolus in the mouth initiate the reflex > by inhibiting muscles of mastication > drop of lower jaw > stretch of jaw muscles > leads to contraction > followed by inhibition of muscles of mastication). Cutting the food into small tiny pieces (Physically)	Starch digestion at PH OF 6.5 OR 7.0 , continues to digest for another 1 hour in the stomach , stomach acid inactivates it . *Starch (substrate) converted to Maltose (product) by Salivary amylase (enzyme) *more details in biochemistry lecture When the enzyymes work on the ingested food (at the molecular level).

Better explanation in the next slide

Mechanical Digestion in the mouth

Teeth organization:



- **Anterior teeth** : incisors, for cutting. القواطع
- **Posterior teeth** : molars, for grinding. الطواحن

Functions of mastication (Chewing)

1. To lubricate the bolus with salivary secretion
2. To breakdown the bolus to small particles
3. To begin digestion of carbohydrate (by α-amylase)

mastication (Chewing)

- Taste centers lie in the brainstem and Hypothalamus responsible about rhythmical chewing movements.
- Chewing process is controlled by nuclei in the brainstem.
- Much of the chewing process is caused by a chewing reflex & stretch reflex

Chewing reflex & stretch reflex mechanism:

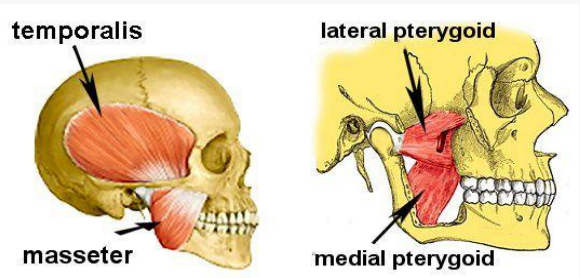
- Due to presence of a bolus of food in the mouth:

1. Firstly, this will initiates reflex inhibition of the muscles of mastication ⇒ the lower jaw to drop.
2. The drop in turn initiates a stretch reflex of the jaw muscles ⇒ rebound contraction.
3. This automatically raises the jaw to cause closure of the teeth, but it also compresses the bolus again against the linings of the mouth ⇒ inhibits the jaw muscles once again ⇒ the jaw to drop and rebound another time.

- This is repeated again and again.

Chewing muscles:

1. Masseter.
2. Temporalis.
3. Lateral Pterygoid.
4. Medial Pterygoid.



Chemical Digestion in the mouth

Anatomical Types of Glands			
Single-cell mucous glands (goblet cells)	**Crypts of Lieberkühn**	**Tubular glands**	**Salivary glands, pancreas, and liver**
Lie among the **epithelial** lining of **small intestines**, the **large intestine**	Lie **at the mucosal pits in small intestine.** ***# they represent invaginations of the epithelium into the submucosa.***	**Lie in the stomach**	**Lie outside the walls of GIT**
Mucus production	**Release several digestive enzymes.**	**acid and pepsinogen-secreting gland**	**contain millions of acini lined with secreting glandular cells** **# These acini feed into (drain into) a system of ducts that finally empty into the alimentary tract itself.**

Functions of Secretory Glands

1.**Secretion of digestive enzymes**

2.**Provide mucus for lubrication and protection**

ONLY in response to the presence of food in the alimentary tract:

1. **Most digestive secretions are formed.**
2. **The quantity secreted in each segment of the tract is almost exactly the amount needed for proper digestion.**

Mucus:

A thick secretion composed mainly of water, electrolytes, and glycoproteins

- **The mucus is an excellent lubricant and a protectant for the wall of the gut because of the following:**

1. **Adherent qualities that make it adhere tightly to the food**
2. **A low resistance for slippage.**
3. **Sufficient body that it coats the wall of the gut and prevents actual contact of most food with the mucosa.**
4. **Strongly resistant to digestion by the GI enzymes**
5. **The glycoproteins of mucus have amphoteric properties : (buffering small amounts of either acids or alkalies).**
6. **Causes fecal particles to adhere to one another.**

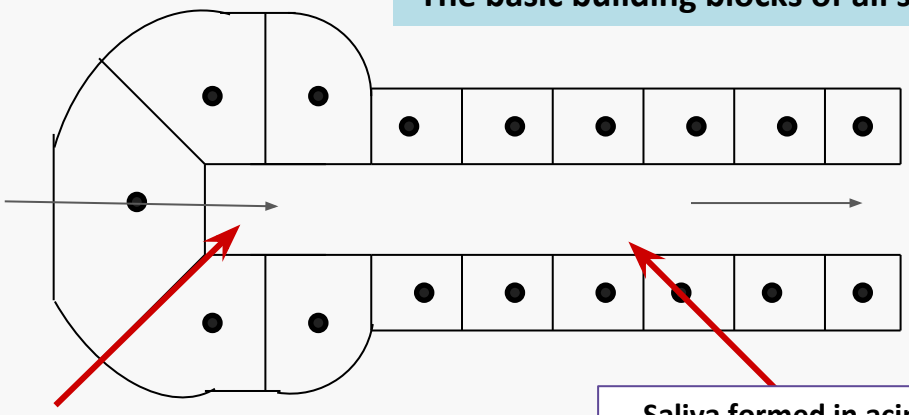
Why must food be digested?

- **Nutrients in food are large molecules which cannot pass through the cell membranes. They must be broken down into molecules that are small enough to pass through the cell membranes. This process is called *digestion*.**
- **So, digestion is the breaking down of large, complex food molecules into small , simpler molecules by producing complex proteins called Enzymes.**

إذاً عملية الهضم هدفها الأساسي هو تبسيط الأمور، تحول المركبات المعقدة إلى جزيئات صغيرة تدخل للخلايا ونستخلص منها المواد المغذية

The secretory unit "Salivon" :

The basic building blocks of all salivary glands.



ACINI – water and ions derived from plasma.

Saliva formed in acini flows down ducts to empty into the oral cavity.

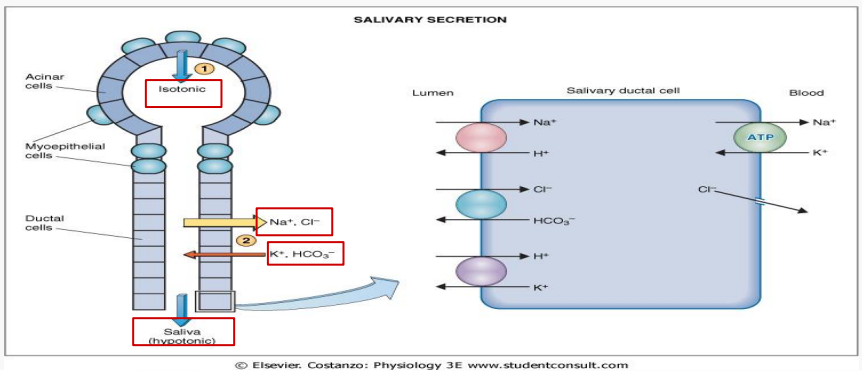
Formation of saliva:

- **The formation of saliva happens at 2 stages:**

1) Primary saliva. 2) Final saliva.

Stage	Primary saliva	Final saliva
Where?	**Acini**	**Ducts**
Type of solution	**Isotonic**	**Hypotonic** it become hypotonic due to: 1- Reabsorption of NaCl. 2- This duct is impermeable to water (no aquaporin-5 in duct)
Secretion	• **Ptyalin (α-amylase)** • **Mucus (musin)** • **ECF**	• **K+** • **$HCO3^-$** → neutralizes the acidity in the mouth and esophagus
Absorption The most imp. INITIATOR for this step is Na-K pump	-	• **Na+ (active)- ATP** • **Cl- (passive)**

- **Final salivary secretion is a hypotonic aqueous fluid**



Mechanism of salivary secretion :

Initial saliva is produced by acinar cells

↓

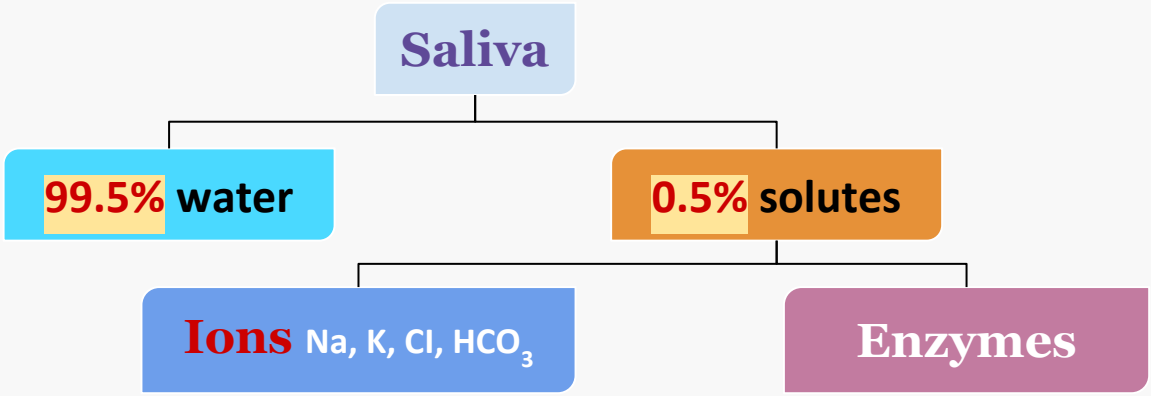
subsequently modified by ductal epithelial cells

Remember that chloride follows sodium

Salivary glands : (more details in anatomy lecture)

SALIVA SECRETION	800 TO 1500 ml / day (this represents about 1/5 of the total plasma volume)(average 1000ml/day with pH=6-7) this fluid is NOT LOST as most of it is swallowed & reabsorbed by the GUT		
THERE ARE 3 PAIRS OF (MAJOR) SALIVARY GLANDS:	1- Parotid	2- Submandibular	3- Sublingual
There are many (minor) small Buccal Glands scattered in the mucosa of the mouth and pharynx that discharge their secretion into the mouth.			
2 TYPES OF CELLS IN THE ACINI	**SEROUS CELLS**	**MUCOUS CELLS (larger)**	
	Which contain granules and secrete electrolytes, water and the enzyme ptyalin (AMYLASE)	Which secrete mucus and protein called MUCIN	
AN ACINUS MAY BE :	PURELY SEROUS: Parotid Gland	MIXED: Submandibular & Sublingual glands	PURELY MUCOUS: Buccal Glands
THE EPITHELIAL CELLS		**MYOEPITHELIAL CELLS**	
Lining the Intralobular ducts are metabolically VERY ACTIVE and responsible for active transport of electrolytes.		Are found between the basement membrane and the cells lining the lumen of acini and intralobular ducts, they contract and increase salivary flow.*(contraction moves saliva, prevents development of back pressure)* Otherwise, secretions will stay in their place!	

Composition of saliva (More details) :



Enzymes : More details in biochemistry

- a-amylase (from parotid glands)

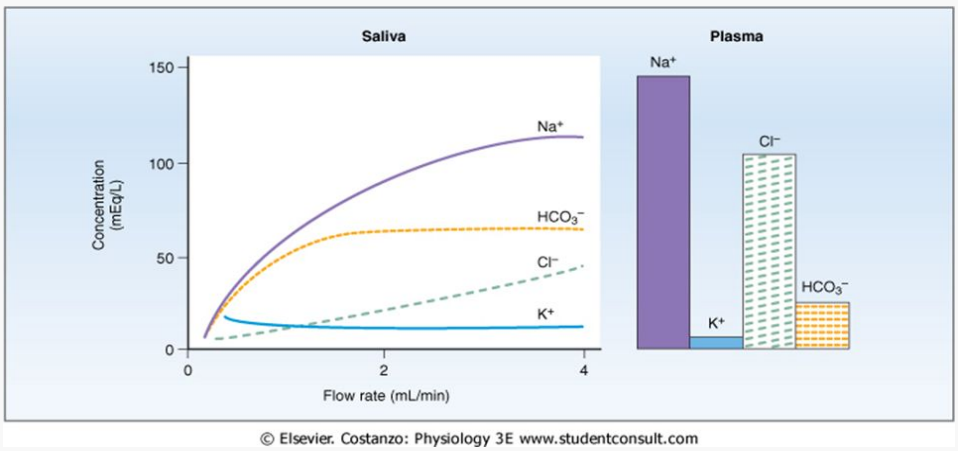
1. cleaves a -1 ,4-glycosidic bonds
2. The optimal pH for this enzyme to work properly is 7
3. Inactivated at pH 4 but continues to work for sometime in unmixed food in Orad portion of stomach

- Lingual lipase (hydrolyzes lipids) , continues working in the duodenum.
- Kallikrein (a protease from acinar cells, which is not secreted into the salivary secretion):

Catalyzes production of bradykinin (good vasodilator) from a2-globulin

(Bradykinin increases local blood flow)

Ions :



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- The concentrations of these ions are altered with altered flow rates.

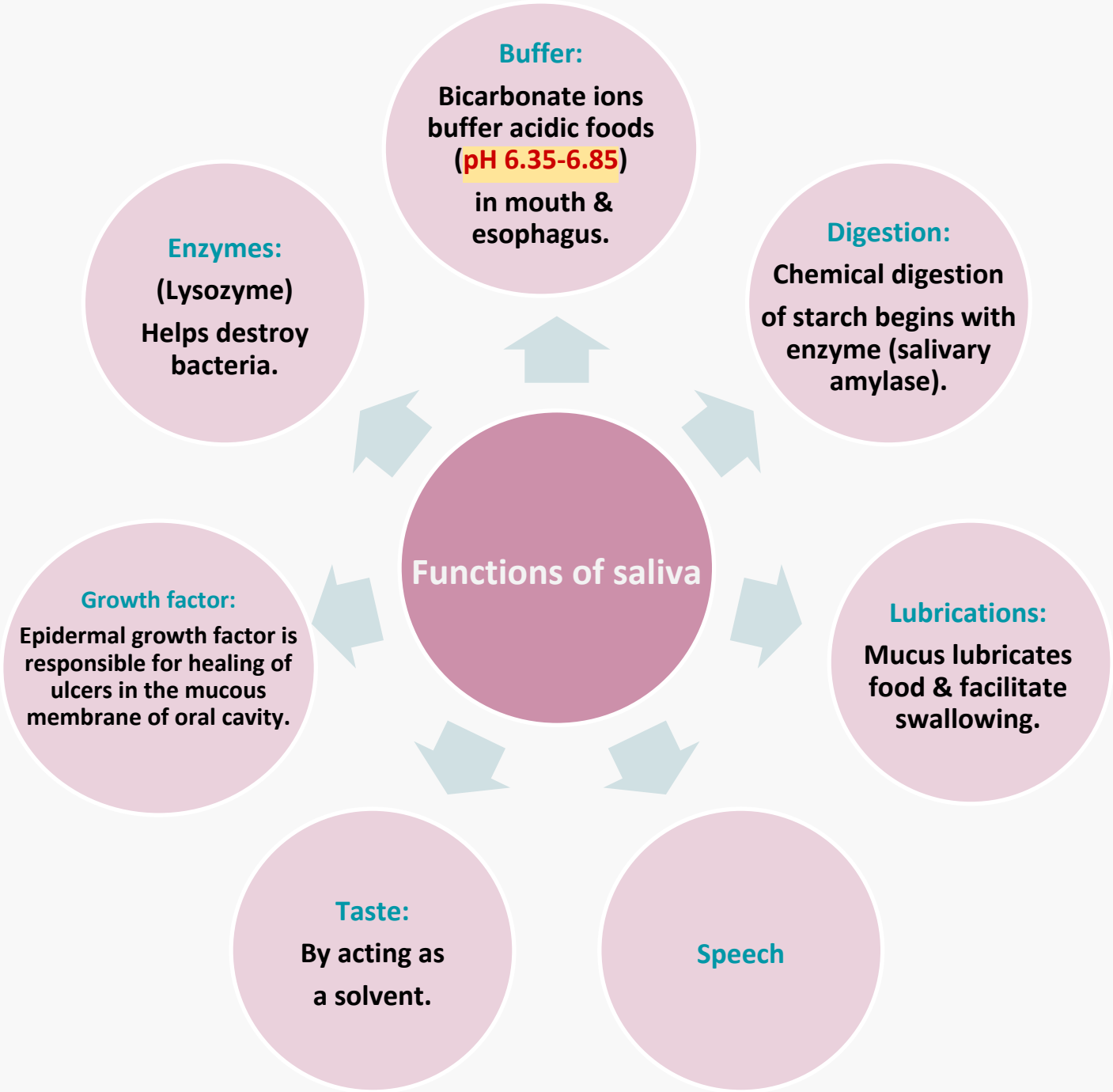
يعني زيادة الFlow rate معناه ما يخلي ال Salivary gland تتحكم بالكميات على كيفها، فاللي يبي يصير إنه بحالات الزيادة بالflow rate يبي يصير الصوديم والكلورايد أكثر من البوتاسيم (بعكس الحالات العادية)

- At low flow rate (under resting condition), the salivary secretions have:

1. High K^+ (7 times as great as in plasma) and HCO_3 (2-3 times that of plasma).
2. Low Na^+ and Cl^- (1/7 or 1/10 their concentrations in plasma)

Saliva : [Composition: 99.5% water and 0.5% solutes.]

- Water (0.5 L saliva/day)



- **LINDA corner :** How does saliva, which was initially isotonic, become hypotonic as it flows through the ducts? The answer lies in the relative **water impermeability of the ductal cells.**

Control of salivary secretion :

❖ **Salivary secretion is controlled exclusively by nervous mechanism through:**

Unconditioned reflex	Conditioned reflex
• **The presence of food in the mouth stimulates general receptors and especially taste receptors.** • **Impulses travel along afferent nerves to the salivatory nuclei in brainstem.** • **Efferent impulses travel along autonomic nerves to salivary glands to stimulate salivary secretion.** • **This reflex is innate and is not acquired by learning.**	• **Seeing, smelling, hearing or even thinking about appetizing food can result in secretion of saliva.** • **Initial impulses arise in the parts of the brain concerned with these special sensations and stimulates the salivatory centers.** • **In humans, mouth watering on seeing or thinking of food provides evidence of this psychic reflex.** مثال : تعويد الكلب على أنه يحصل على الطعام عند دق الجرس، في حال دقينا الجرس بدون مانحط قدامه أكل هنا بيبدأ إفراز اللعاب عنده بكميات كبيرة نظراً لأننا عودناه على هذا النظام المرء (أو الكلب في المثال) على ما اعتاد عليه يحدث نتيجة لرؤية الطعام، شم رائحته أو مجرد الاستماع لوصف أحدهم لطعام معين (بيتزا يتمطط منها الجبن، مثلاً) أو حتى التفكير بالطعام اللذيذ يؤدي إلى زيادة إفراز اللعاب

Basic Mechanisms of Stimulation of the Alimentary Tract Glands :

1. Enteric Nervous Stimuli (Effect of Contact of Food with the Epithelium)

The mechanical presence of food in a particular segment of the GIT usually causes the glands to secrete moderate to large quantities of juices.

❖ Types of stimuli that do this are :

1. Tactile stimulation. 2. Chemical irritation. 3.Distention of the gut wall.

2. Autonomic Stimulation of Secretion.

Parasympathetic Stimulation	Sympathetic stimulation
• Increases the rates of GI secretion (especially in the upper portion of the tract: salivary glands, esophageal glands, gastric glands, pancreas, Brunner's glands in the duodenum and the distal portion of the large intestine). • Secretion in the remainder of the small intestine and in the first two thirds of the large intestine occurs mainly in response to local neural and hormonal stimuli in each segment of the gut.	• have a dual effect: 1. First, alone usually slightly increases secretion. 2. second, if parasympathetic or hormonal stimulation is already causing copious secretion by the glands, superimposed sympathetic stimulation usually reduces the secretion, sometimes significantly because of *vasoconstrictive reduction of the blood supply.*

3. Regulation of Glandular Secretion by Hormones.

- Several *GI hormones* help regulate the volume and character of the secretions In the stomach and intestine. They are liberated from the GI mucosa in response to the presence of food in the lumen of the gut.
- The hormones then are absorbed into the blood ⇒ glands ⇒ stimulate secretion.

❖ Basic Mechanism of Secretion by Glandular Cells:

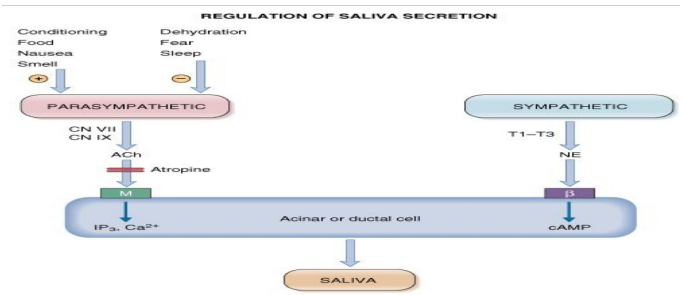
1. Needed nutrient material to form secretion must first diffuse or be actively transported by the blood in the capillaries into the base of the glandular cell.
2. Mitochondria use oxidative energy to form ATP.
3. ATP Energy with appropriate substrates used to synthesize the organic secretory substances in the *endoplasmic reticulum* and *Golgi complex.*
4. In the Golgi complex, the materials are modified, added to, concentrated, and discharged into the cytoplasm in the form of *secretory vesicles.*
5. These vesicles remain stored until nervous or hormonal control signals cause the cells to extrude the vesicular contents through the cell's surface, exocytosis.

Nerve supply to salivary glands : More details

	Sympathetic nerves	Parasympathetic nerves
Origin To help you memo: connect them to the letter S	• **Originate in the Superior cervical ganglion and reach the 3 pairs of salivary glands through blood vessels.** Sympathetic = Superior Cervical stimulation of sympathetic from t1-t3 and it'll secrete NE > act on beta receptors > increase cAMP	• **Originate in the superior and inferior salivary nuclei in the brain stem.** • **Fibers from the superior salivary nucleus leave in VII CN supply both submandibular and sublingual glands.** Superior salivary N = Submandibular & Sublingual. • **Fibers from the inferior salivary nucleus leave the medulla in IX CN supply the parotid gland.** stimulation of parasympathetic will travel through CN 7 & 9 > it will release Ach. > act on muscarinic receptors > send second messenger.
Function	• **Act on mucous cells and produce small amount of viscous (thick) secretion.** • **Cause vasoconstriction.** →Which will decrease the presence of Blood & Plasma resulting in thick secretions	• **Increase the synthesis and secretion of salivary amylase and mucin producing watery secretion (they act on serous cells).** • **Enhances the transport activities of ductal epithelium.** • **Increase blood flow due to marked vasodilatation (via release of kallikrin enzyme from active gland tissue) which cause conversion of A2 globulin into bradykinine, a potent vasodilator.** • **Stimulates glandular growth and metabolism.**

❖ **Stimulation of both sympathetic and parasympathetic nerves cause contraction of myoepithelial cells that empty the acinar contents into the ducts, thus augments the salivary secretion.**

➔ Sympathetic & Parasympathetic usually antagonize each other, in this case we have an exception both secrete saliva but the difference is in the quantity and thickness. S: little amount & thick / PS: A lot & thin



- stimulation of sympathetic from t1-t3 and it'll secrete NE > act on beta receptors > increase cAMP
- stimulation of parasympathetic will travel through CN 7 & 9 > it will release Ach. > act on muscarinic receptors > send second messenger.

Nervous Regulation of Salivary Secretion (EXTRA)

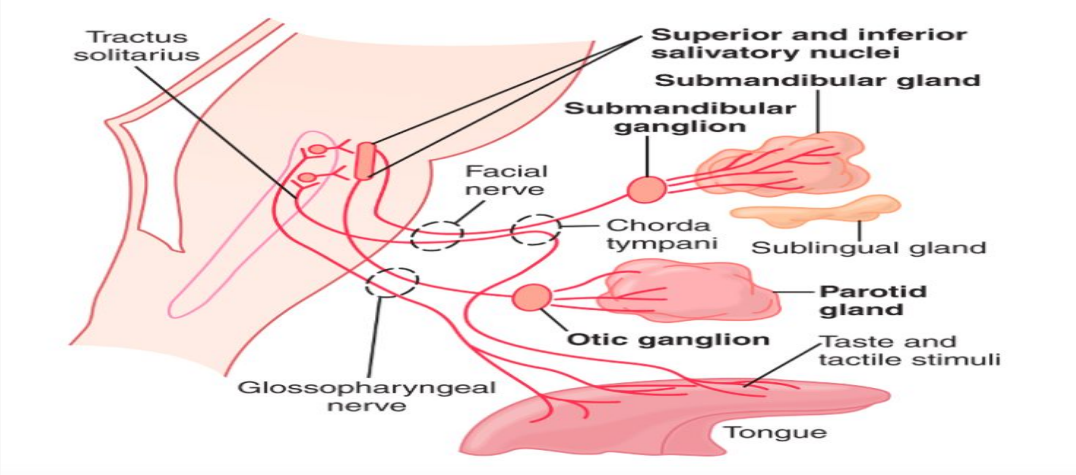


Figure 64-3

- **Guyton corner :**

Figure 64-3 shows the parasympathetic nervous pathways for regulating salivation, demonstrating that the **salivary** glands are controlled mainly by *parasympathetic nervous signals* all the way from the *superior* and *inferior salivatory nuclei* in the brain stem.

The salivatory nuclei are located approximately at the juncture of the medulla and pons and are excited by both taste and tactile stimuli from the tongue and other areas of the mouth and pharynx. Many taste stimuli, especially the sour taste (caused by acids), elicit copious secretion of saliva—often 8 to 20 times the basal rate of secretion. Also, certain tactile stimuli, such as the presence of smooth objects in the mouth (e.g., a pebble), cause marked salivation, whereas rough objects cause less salivation and occasionally even inhibit salivation.

Salivation can also be stimulated or inhibited by nervous signals arriving in the salivatory nuclei from higher centers of the central nervous system. For instance, when a person smells or eats favorite foods, salivation is greater than when disliked food is smelled or eaten. The *appetite area* of the brain, which partially regulates these effects, is located in proximity to the parasympathetic centers of the anterior hypothalamus, and it functions to a great extent in response to signals from the taste and smell areas of the cerebral cortex or amygdala.

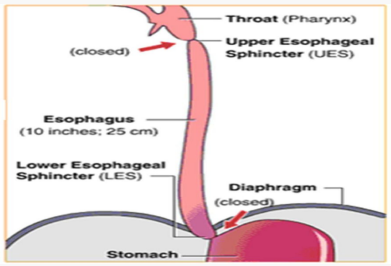
Salivation also occurs in response to reflexes originating in the stomach and upper small intestines—particularly when irritating foods are swallowed or when a person is nauseated because of some gastrointestinal abnormality. The saliva, when swallowed, helps to remove the irritating factor in the gastrointestinal tract by diluting or neutralizing the irritant substances.

Sympathetic stimulation can also increase salivation a slight amount, much less so than does parasympathetic stimulation. The sympathetic nerves originate from the superior cervical ganglia and travel along the surfaces of the blood vessel walls to the **salivary** glands.

A secondary factor that also affects **salivary** secretion is the *blood supply to the glands* because secretion always requires adequate nutrients from the blood. The parasympathetic nerve signals that induce copious salivation also moderately dilate the blood vessels. In addition, salivation itself directly dilates the blood vessels, thus providing increased salivatory gland nutrition as needed by the secreting cells. Part of this additional vasodilator effect is caused by *kallikrein* secreted by the activated **salivary** cells, which in turn acts as an enzyme to split one of the blood proteins, an alpha2-globulin, to form *bradykinin,* a strong vasodilator.

Esophagus :

- Is a collapsible muscular tube that conveys food from pharynx to stomach (10 inches long).
- It consist of 2 layers of muscles : Inner circular & Outer longitudinal muscle.
- Food passes through it quickly because of peristalsis.



Physiological division of the esophagus :

- Upper esophageal sphincter,
- Esophageal body,
- Lower esophageal sphincter.

- **Guyton corner : Esophageal Secretion**

The esophageal secretions are entirely mucous and mainly provide lubrication for swallowing. The main body of the esophagus is lined with many *simple mucous glands.* At the gastric end and to a lesser extent in the initial portion of the esophagus, there are also many *compound mucous glands.* The mucus secreted by the compound glands in the upper esophagus prevents mucosal excoriation by newly entering food, whereas the compound glands located near the esophagogastric junction protect the esophageal wall from digestion by acidic gastric juices that often reflux from the stomach back into the lower esophagus. Despite this protection, a peptic ulcer at times can still occur at the gastric end of the esophagus.

Swallowing (deglutition):

Physiology of the Swallowing :

Buccal phase (voluntary phase):	• Upper esophageal sphincter is contracted, • Tongue presses food against the hard palate pushing the bolus to the back of the oral cavity
Pharyngeal-esophageal phase (involuntary phase):	• Breathing stops + airways are closed, • Nasopharynx is closed by rising the uvula + soft palate " in order to prevent the passage of food to the respiratory pathway" • Vocal cord are closed • To allow food passage the Upper esophageal sphincter will be relaxed then after the passage it will recontract. (involuntary due to the control by the ANS).
Esophageal phase	• Peristalsis movements push the food to the stomach, ○ Circular fibers contraction behind the bolus (ring like). ○ Longitudinal fibres contraction in front of the bolus; to shorten the distance of travel. (4-8sec ~ solid ,1sec ~ liquid) ○ The gastroesophageal "lower" sphincter relaxed , food enter the stomach.

شرح مختصر

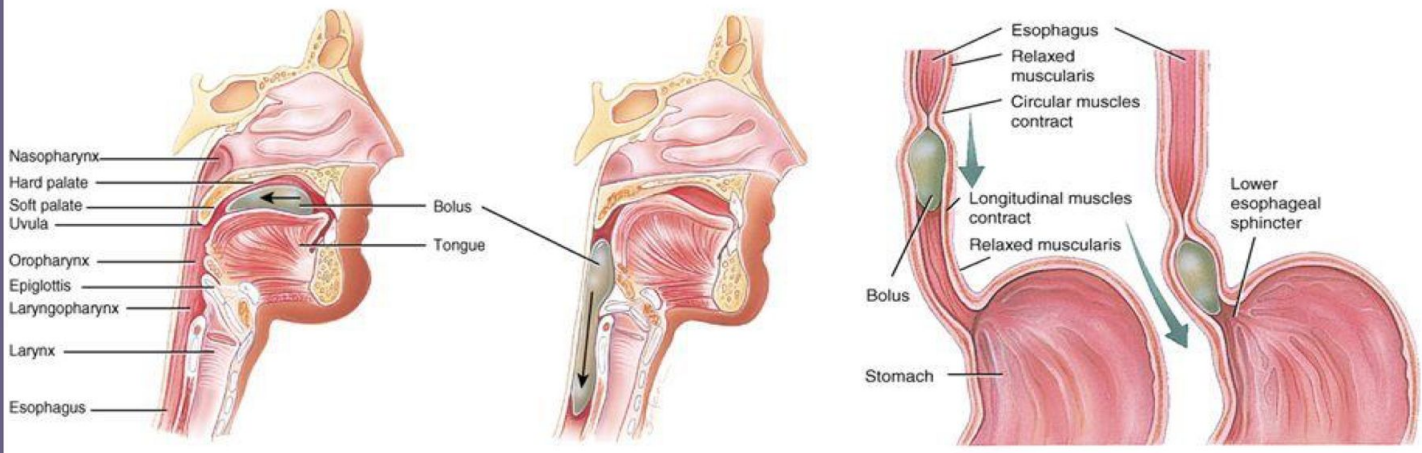
فيه ثلاث مراحل للبلع:

١- لما تكون اللقمة في الفم، نقدر نتحكم فيها عن طريق اللسان إما نبلع أو نطلعها

٢- لما تدخل البلعوم. هنا ما نقدر نتحكم فيها. الاعصاب تقوم بدورها

(تسكر مجرى التنفس)ANS

٣- لما تدخل المريء. تنزل للمعدة عن طريق حركة العضلاتperistalsis



Nervous initiation of pharyngeal stage of swallowing:

- Impulses transmitted from pharyngeal opening (greatest sensitivity at tonsillar pillars),
- Sensory nerves in 5^{th} & 9^{th} CN carry impulses to swallowing center in medulla and lower pons.
- Motor impulses transmitted by 5^{th} ,9^{th},10^{th} and 12^{th} CN to pharynx and upper esophagus.
- Swallowing center inhibit Respiratory center during swallowing.

When food is inside the mouth the upper esophageal sphincter is normally closed, why? To prevent air from entering the GIT and when it opens the respiratory airway closes. So in both cases air does not enter

Function of lower esophageal sphincter:

- Also known as gastroesophageal sphincter, it extends 3cm above its junction with stomach and it's formed by circular muscles.
- It normally remains tonically constricted and it relaxes ahead of esophageal peristaltic wave. It helps to prevent reflux of gastric juice.
- The valve-like mechanism of short portion of esophagus that extend slightly into the stomach also helps in preventing reflux.

- LES is highly constricted to prevent acidic juice reflux. Why? Because the esophagus is not prepared to tolerate the acidity, with time it causes inflammation and may change the surface cells and develop cancer
- valve-like mech: when the esophagus enter the stomach, its muscles join the muscles of the stomach. So, when the stomach contracts it'll close the lower part of esophagus which its muscles are embedded within it.

Function of the Lower Esophageal Sphincter (Gastroesophageal Sphincter) :

Function of the Lower Esophageal Sphincter (LES) :

- The esophageal sphincter is formed by the esophageal circular muscle located in an area of ~ 3 cm upward of the junction with the stomach.

- This sphincter remains **tonically constricted** (protects the esophagus from the stomach acidic juices) until the peristaltic swallowing wave passes down the esophagus and causes a "receptive relaxation" of the sphincter and the emptying of the propelled food into the stomach. Failure of the sphincter to relax will result in **achalasia**

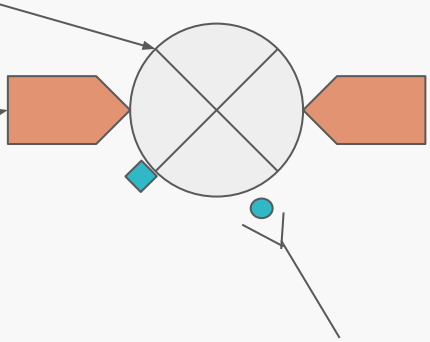
Regulation of the LES

Valve-like closure mechanism

Diaphragm helping mechanism

Hormonal and neuronal mechanism

Just trying to simplify :)



Valve-like closure mechanism

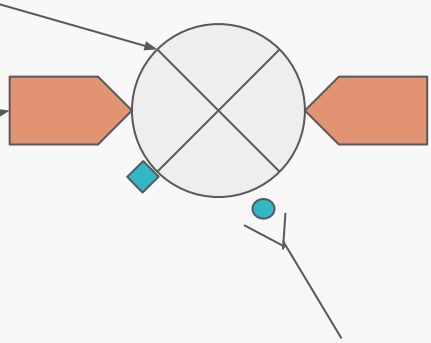
- This mechanism involves a short portion of the esophagus that extends slightly into the stomach and that caves the esophagus inward in response to increased intra-abdominal pressure.
- Resting pressure of the valve is **(15-30 mmHg)**.
- A valve like mechanism of the distal end of the esophagus that lies immediately beneath the diaphragm and is exposed to +ve intra-abdominal pressure. لان نهاية الايسوفقس تحت الدايفرام اكيد يبي يكون معرض للضغط اللي بالابدومين
- the increased intra-abdominal pressure = This flutter-valve closure = prevents the high pressure in the stomach from forcing its contents into the esophagus.

Valve-like closure mechanism

Diaphragm helping mechanism

Hormonal and neuronal mechanism

Just trying to simplify :)



Diaphragm helping mechanism

- The diaphragm wraps around the esophagus at the level of lower esophageal sphincter (LES), contraction of the diaphragm helps to increase the pressure at the LES during inspiration.

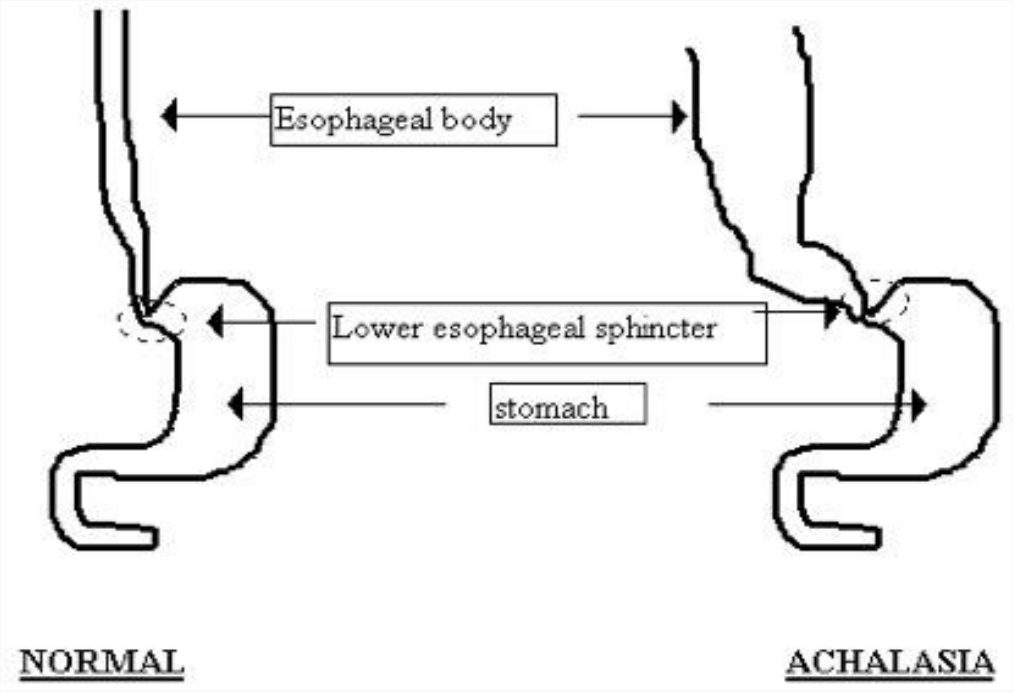
In short = inspiration = closure of the valve

Hormonal and neuronal mechanism

- Contraction of the circular musculature of the sphincter is regulated by nerves, (extrinsic & intrinsic), hormones and neurotransmitter.
- Between swallows: (tonic vagal cholinergic impulses) maintain contraction to keep the sphincter closed.
- During swallowing: (efferent inhibitory impulses from vagus nerve) cause the sphincter to relax. The transmitter probably being nitric oxide (NO) or vasoactive intestinal peptide (VIP).
- The gastrin hormone: released from the stomach by food, contracts LES.
- Secretin and cholecystokinine (CCK), are released from the upper small intestine, relax the LES.

Achalasia :

- **A condition due to high resting pressure at the LES that fails to relax during swallowing. As a result, food transmission from the esophagus into the stomach is prevented.**
- **Physiological basis of this condition is either pathology of or absence of the myenteric plexus containing VIP & NO in the lower third of esophagus.**
- **The musculature of the lower esophagus instead remains contracted and the myenteric plexus has lost the ability to transmit a signal to cause relaxation of the LES.**



- **Guyton corner :**

Achalasia is a condition in which the lower esophageal sphincter fails to relax during swallowing. As a result, food swallowed into the esophagus then fails to pass from the esophagus into the stomach. Pathological studies have shown damage in the neural network of the myenteric plexus in the lower two thirds of the esophagus. As a result, the musculature of the lower esophagus remains spastically contracted and the myenteric plexus has lost its ability to transmit a signal to cause "receptive relaxation" of the gastroesophageal sphincter as food approaches this sphincter during swallowing.
When **achalasia** becomes severe, the esophagus often cannot empty the swallowed food into the stomach for many hours, instead of the few seconds that is the normal time. Over months and years, the esophagus becomes tremendously enlarged until it often can hold as much as 1 liter of food, which often becomes putridly infected during the long periods of esophageal stasis. The infection may also cause ulceration of the esophageal mucosa, sometimes leading to severe substernal pain or even rupture and death. Considerable benefit can be achieved by stretching the lower end of the esophagus by means of a balloon inflated on the end of a swallowed esophageal tube. Antispasmotic drugs (drugs that relax smooth muscle) can also be helpful.

SUMMARY

❖ Mouth " 2 types of digestion :

1- **Mechanical :** by mastication , chewing muscles are innervated by 5th CN and the process is caused by stretch reflex.

2- **Chemical :** Enzymatic.

❖ Saliva is formed in 2 stages :

1- **Primary saliva :** in acini , isotonic

2- **Final saliva :** in ducts , hypotonic

❖ Functions of saliva :

1-Buffer 2- digestion 3- lubrication 4- speech 5- taste 6- help destroying bacteria

❖ Control of secretion :

1-Unconditioned → present of food in mouth

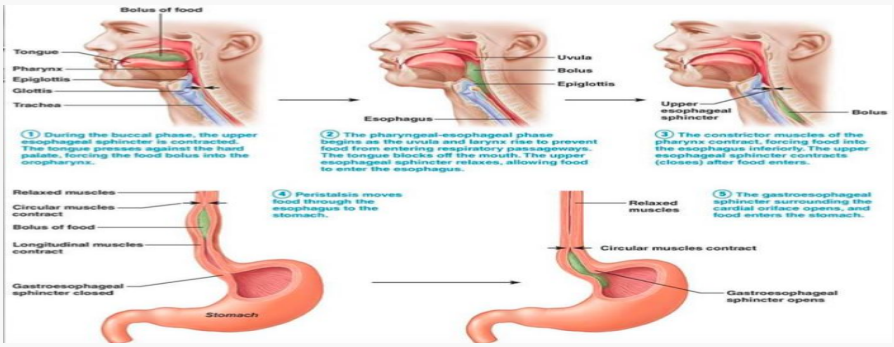
2-Conditioned → smelling seeing or thinking about food

❖ Swallowing :

1- Buccal phase " voluntary "

2- Pharyngeal – esophageal phase " involuntary "

3- Esophageal phase "Peristalsis movements push the food to the stomach"



❖ Nervous initiation of pharyngeal stage :

Impulses from pharyngeal opening → 5 and 9 CN carry impulses to swallowing centers in medulla and lower pons →motor impulses by 5,9,10,12 CN to pharynx and upper esophagus . swallowing centers inhibit respiration centers .

MCQs

1- Which phenomenon in salivary ducts explains why the final salivary secretion is hypotonic relative to the primary secretion of the acinar cells?
A. Secretion of water
B. Absorption of water
C. Absorption of more solutes than water
D. Secretion of more solute than water

2- Food in oral cavity undergoes what kind of digestion?
A. Mechanical
B. Chemical
C. Radiation
D. Both A & B

3- Which ONE of the following is most correct about sympathetic stimulation over salivary glands?
A. Decreases salivary secretion initially
B. Increase watery secretion of saliva
C. Decreases salivary secretion when vasoconstriction superimposes
D. Increases salivary secretion

4-The estimated amount of saliva secreted a day is normally about:
A. 800 to 1500 ml
B. 700 to 800 ml
C. 800 to 1500 l
D. 8 to 15 ml

5- The process of mastication is initiated by:
A. Stretch reflex
B. Jaw drop
C. Food bolus inhibiting jaw muscles
D. Jaw muscles contraction

6- Which ONE of the following is not a function of saliva?
A. Buffer
B. Speech
C. Antioxidant
D. Immunity

7- Which of the following is a mechanism that keeps the valve (of the gastroesophageal sphincter) closed?
A. Valve-like Closure mechanism.
B. Diaphragm helping mechanism.
C. Hormonal and neural mechanism.
D. All of the above

answer key: 1.C, 2.D, 3.C, 4.A, 5.C, 6.C & 7.D

خولة العمَّاري
نجود الحيدري
نورة الطويل
لولوة الصغير
لجين السواط
رزان السبتي
ربى السليمي
ديما الفارس
خولة العريني
ملاك الشريف
منيرة الحسيني
مروج الحربي
أفنان المالكي
دلال الحزيمي
رناد القحطاني
سارة الخليفة
فرح مندوزا
مي العقيل
نورة الخراز
سارة الخليفة
نورة الخيال
رغد النفيسة
منيرة السلولي
نوف العبدالكريم
سها العنزي
نورة القحطاني

عمر آل سليمان
عبدالعزيز الحماد
عبدالرحمن السياري
محمد أبونيان
عبدالرحمن البركه
إبراهيم النفيسه
محمد البشر
عمر العتيبي
حمزة الفعر
عبدالله الجعفر
عبدالله الضحيان
حسن البلادي
حسن الشماسي
عبدالله الضبيب
محمد الفواز
محمد السحيباني
وائل العود
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عمر الشهري