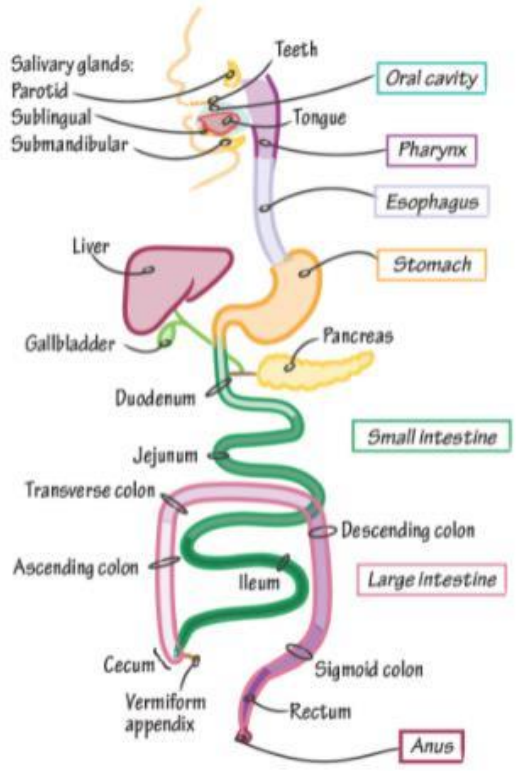
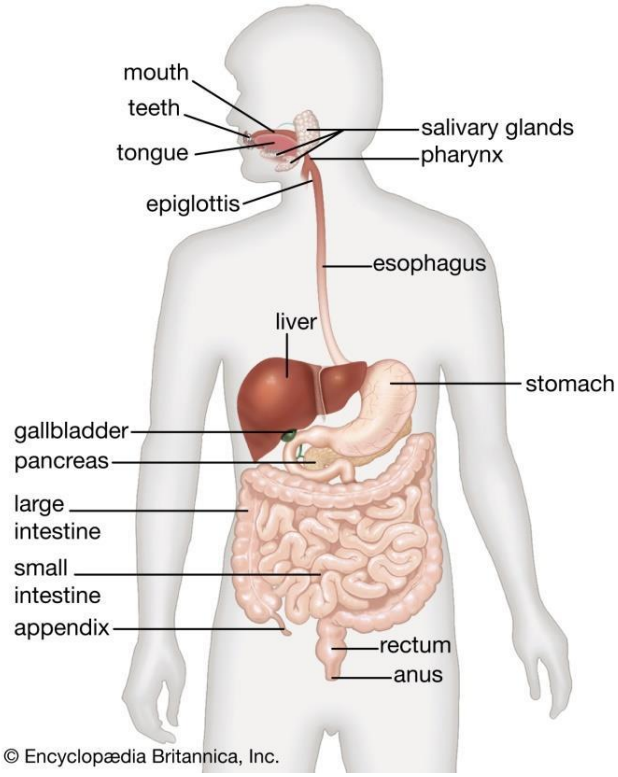
Gastrointestinal System

Introduction:

➢ **The GIT is arranged as:**

1. Gastrointestinal tract	2. Accessory digestive glands
• *It is a **continues tube** that extends from the mouth to the anus.*	• *Salivary glands.* • *Pancreas.* • *Liver & gall bladder.*





Functions of GIT:

1) **Motility** : **propels** the ingested food and **mixes** it with the secretions.

2) **Secretions** of the digestive juices and mucus.

3) **Digestion** of the ingested foods into absorbable molecules.

4) **Absorption** of the nutrients, electrolytes and water from intestinal lumen into blood stream.

Physiology of Salivation

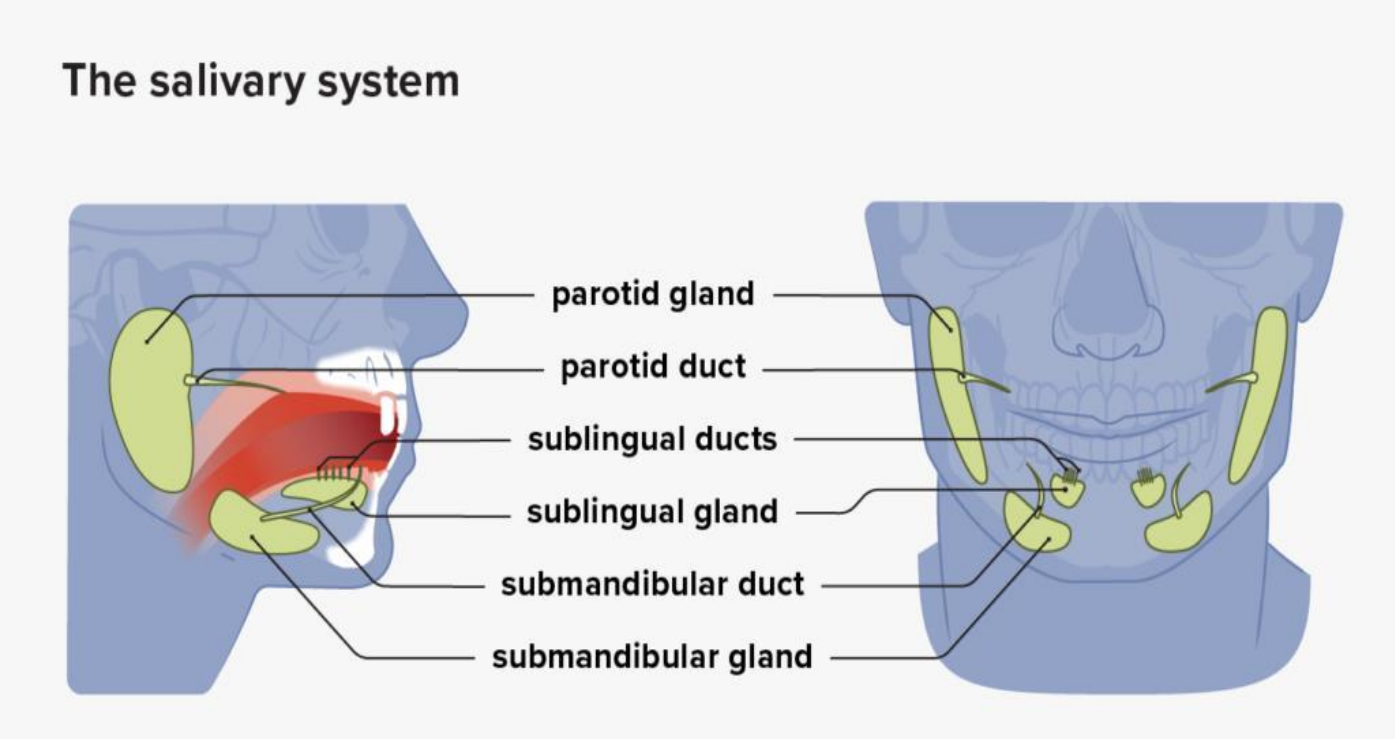
Salivary gland

- **Structure:**

The principal salivary glands	Small glands
• *Parotid.* • *Submandibular.* • *Sublingual glands.*	• *Are **scattered** in the mucous membrane of the **buccal cavity.***

- **Principal salivary glands:**

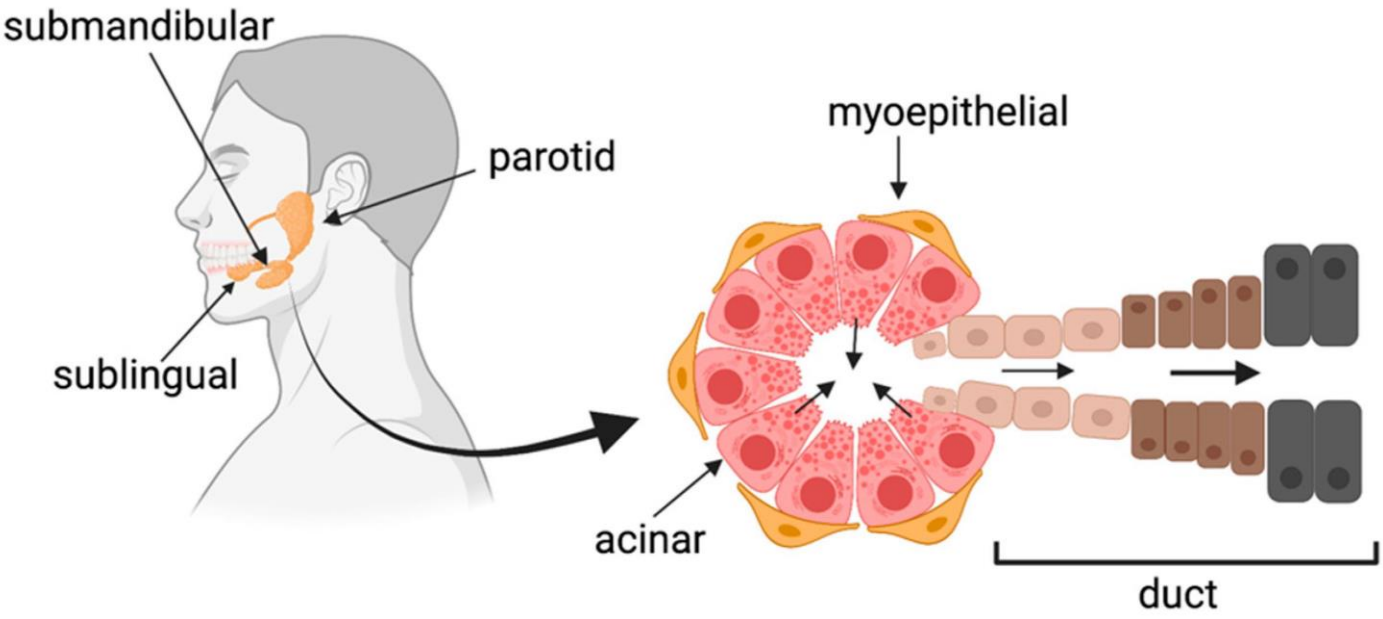
	Parotid gland	Sublingual gland	Submandibular gland
% of total secretion	25%	5%	70%
Cells	*mainly **serous** secreting cells*	*mainly **mucous** secreting cells.*	***serous and mucous** cells.*

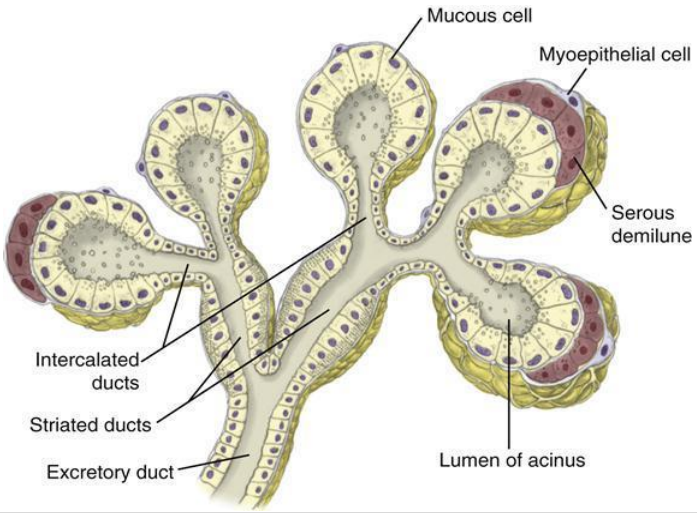


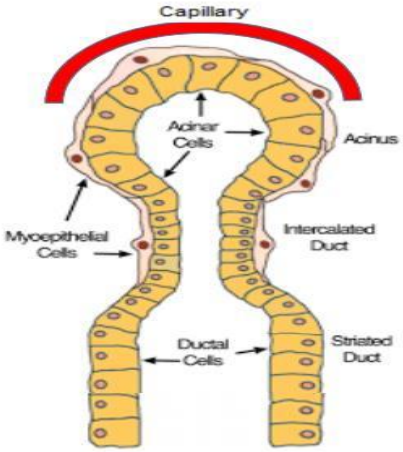
- ***Salivary Secretions:***
  - ***Two main types of protein secretion in saliva:***

	Serous secretion	Mucous secretion
Secreted from	*Serous cells*	*Mucous cells*
Contains	***Ptylaine (alpha amylase) enzyme*** *for digestion of starches*	***Mucin*** *for lubrication*

- ***Salivon:***
  - *a group of* ***secretory acini*** *and their* ***ducts*** *from which each gland is formed.*
  - *The acinar cells empty into the* ***intercalated duct*** *which empties into the* ***striated duct.***







- ## Composition of saliva:

  - **Volume:** *800-1500 ml/day.*
  - **PH:** *Slightly above 7 during rest.*
  - ***Saliva is composed of:***

<table>
<tr><td>Water:</td><td colspan="2">• 99%</td></tr>
<tr><td rowspan="3">Solids</td><td colspan="2">• 1%.
• <u>Divided into:</u></td></tr>
<tr><td>Organic</td><td>Inorganic</td></tr>
<tr><td>• Lysozymes which attack bacteria wall
• Lactoferrin which binds iron
• enzymes (Alpha amylase and lingual lipase).
• Mucin
• Proline-rich proteins that protect tooth enamel
• Ig A</td><td>• Na
• K
• Cl
• HCO3
• Thiocyanate ions which kill bacteria</td></tr>
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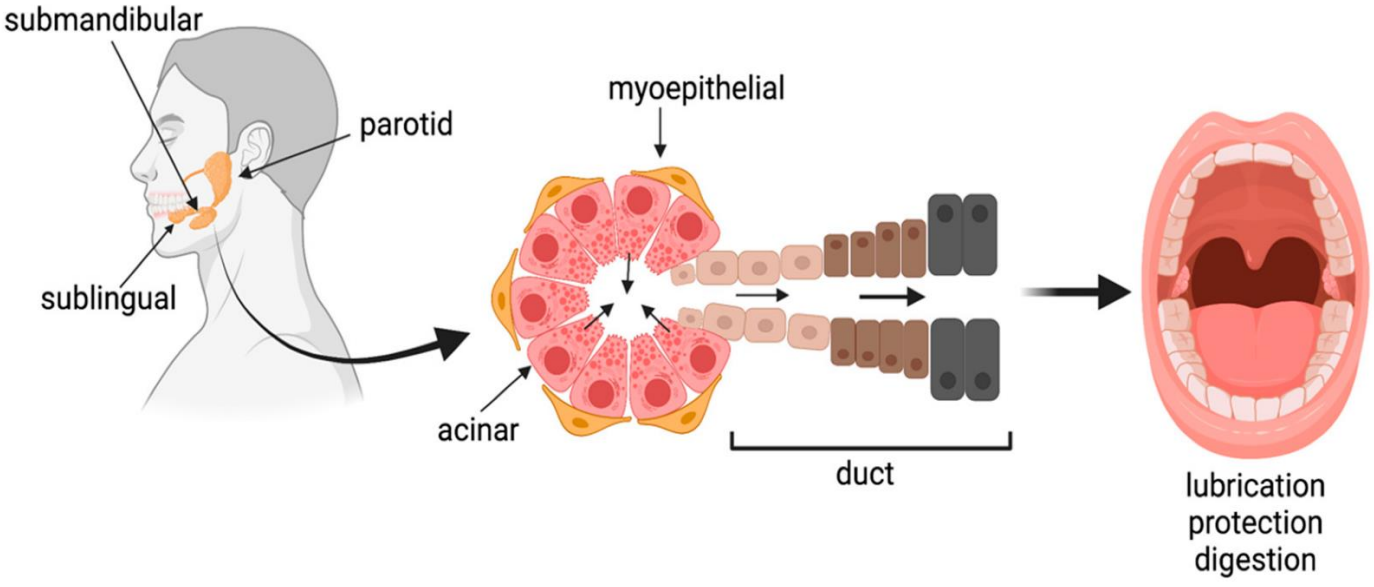
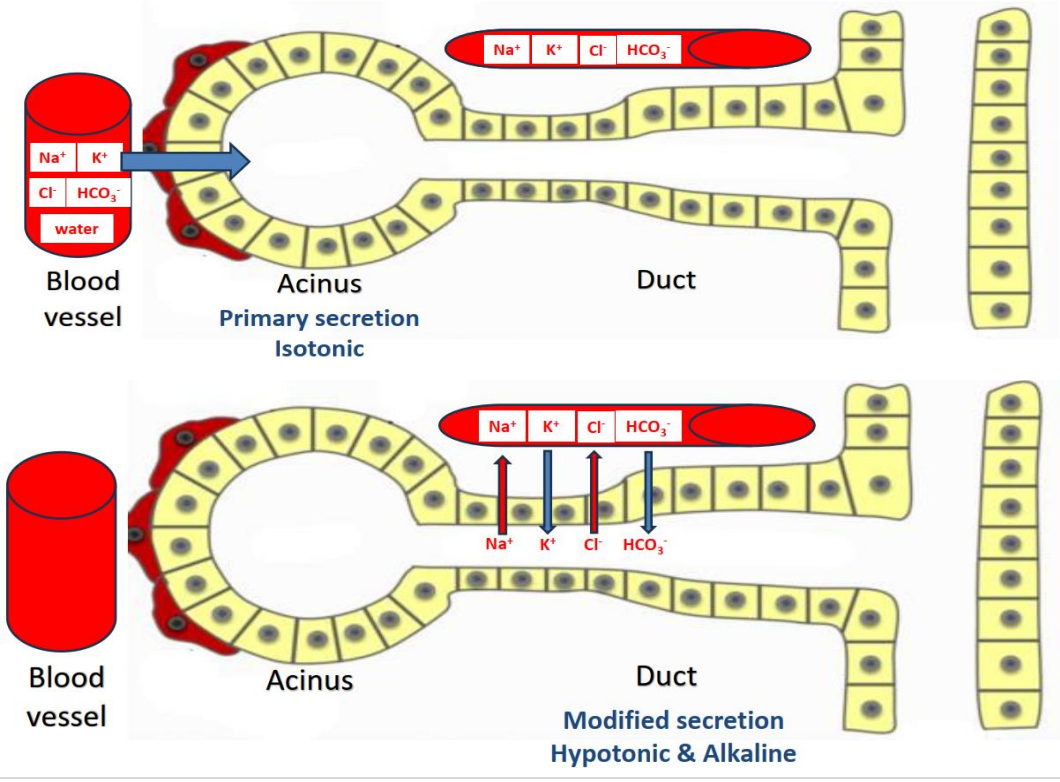


- ***Formation of saliva:***

  - *The formation of saliva is* ***an active secretory process.***
  - ***It occurs in two stages:***

	a) First stage	b) Second stage
Site	*It occurs in* ***acini.***	*It occurs in the* ***salivary duct.***
Changes that occur	• *That means, the concentrations of Na+, K+, Cl-, and HCO3- are* ***close to*** *those in plasma.*	• ***Ducts modify the initial saliva by the following processes:*** ***1) Reabsorb Na+ actively and Cl- passively:*** *so, concentrations are lower than plasma.* ***2) Secrete K+ actively and HCO3-:*** *so, concentrations are higher than plasma.*
Osmolarity	• *The acini secrete primary secretion which is* ***isotonic.***	• ***Modified secretion*** *Hypotonic & Alkaline*



- ***What happen if:***

There is high flow rate of the saliva	*There is low flow rate of the saliva*
• *Saliva is **like** the primary secretion from acinus.*	• *Saliva is **like** the modified secretion in the duct.*
• ***High** Na+ and Cl–concentrations.* • ***low** K+ concentration.*	• ***Low** Na+ and Cl– concentrations.* • ***high** K+ concentration.*

- ***Mechanism of salivary secretion:***

  ➢ *Salivary secretion is **a rapid process**, so it is under nervous control **only**.*

	Parasympathetic stimulation	*Sympathetic stimulation*
Effect	***Both increase** salivary secretion*	
Dominance	***Dominant***	----------
Origin	*Cranial nerves VII and IX*	*T1 – T3*
Nature of secretion	***True secretion*** *(Watery and little in enzymes)*	***Trophic secretion*** *(Little in amount, rich in enzymes)*

- ***Phases of salivary secretion:***

  a) *Cephalic phase*

  b) *Buccal phase*

  c) *Gastrointestinal Phase*

	A) Cephalic phase	B) Buccal phase	C) Gastrointestinal Phase
Time:	• Occurs ***before*** *food enters mouth*	• Occurs ***when*** *food enters mouth*	• Occurs by ***Irritation of the lower end of the esophagus & stomach or upper intestine***
Nature:	***Conditioned reflex*** • ***Acquired*** *not inherent.* • *Needs* ***training.*** • ***New connections*** *develop between centers in cerebral cortex & salivary nuclei.*	***Unconditioned reflex*** • ***Inherent*** *not acquired* • ***doesn't*** *need training* • ***doesn't*** *need intact cerebral cortex.*	***Unconditioned reflex*** • *Esophageo - salivary reflex* • *gastro – salivary reflex*

Functions of saliva:

1) *Keeps the buccal cavity wet, which aids speech and facilitate movements of lips and tongue.*
2) *Acts as solvent for the food particles, to stimulate taste receptors.*
3) *Acts as **diluting medium** for irritating substances.*
4) *Starts the Digestion of the **starch.***
5) *A **lubricant** which facilitates swallowing.*

6) ***It keeps the PH of the mouth about 7:***
   - *To **preserves Calcium** in the teeth.*
   - ***Acidity of the buccal cavity** (e.g., By bacterial action on food remnant) will cause **dissolution of Ca++** from teeth → **Dental caries.***

7) ***Role of saliva in oral Hygiene:***
   - ***A.** It contains **Lysozymes** which destroy bacteria.*
   - ***B.** It contains **IgA** → immunological defense against bacteria and viruses.*
   - ***C. Thiocyanate ions**, which are bactericidal.*
   - ***D. F**low of saliva **wash away** the pathogenic bacteria and the food particles.*

Physiology of Swallowing

Mastication = Chewing

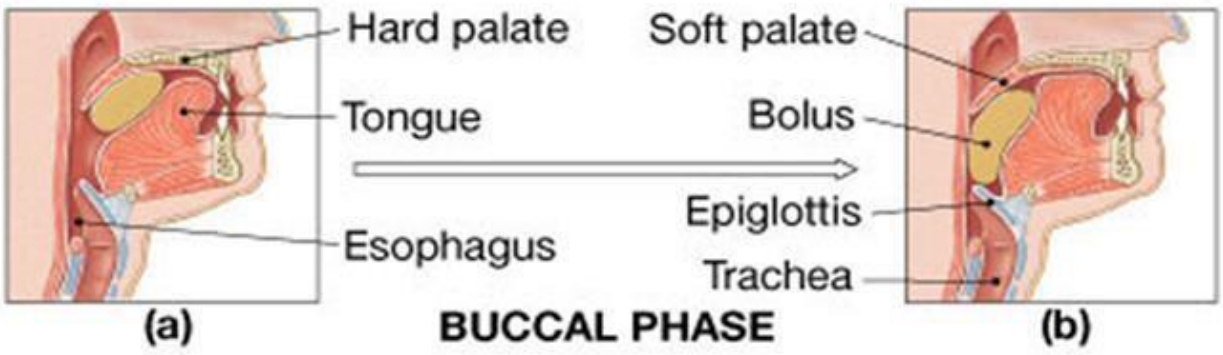
Def:	• *food is broken down into **small particles** to be swallowed easily.*
Mechanism:	• ***<u>It is a reflex</u>*** *1) **Presence of food** in the mouth causes reflex **inhibition** of mastication muscles → **drop** of the lower jaw.* *2) The jaw drop initiates **stretch reflex** of the jaw muscles → **Rebound contraction** of these muscles → Elevation of the jaw and closure of the mouth.* *3) The bolus of food is **compressed against** the linings of the mouth → inhibits the **jaw muscles** → drop the jaw, and the process is repeated again and again.*
Functions:	*1. **Breakdown of the food into small particles** → easy swallowing, decrease the mechanical damage of the mucosa.* *2. **It stimulates salivary secretion*** ***3. It stimulate taste and smell receptors.*** *4. **Help digestion, especially fruits and vegetables** which contain undigestible cellulose*

Deglutition = Swallowing

- **Def:**
  - *The act by which food is transferred from the **mouth cavity** to the **stomach.***
- **It is divided into 3 phases:**

A) Buccal (voluntary) phase

- *The tongue moves **upward and backward** against the palate → push food into the pharynx.*
- *Once the food reaches the pharynx, the process of swallowing becomes entirely **automatic** and cannot be stopped.*



B) Pharyngeal (involuntary) phase

- ***Involuntary phase (reflex in nature in which):***

Stimulus	• ***Presence of food** at the back of mouth.*
Receptor	• ***Swallowing receptor area** around pharyngeal opening.*
Center	• ***Swallowing center** in brain (at medulla oblongata)*
Efferent	• ***5th, 9th, 10th, 12th cranial nerves.***
Effect	• *It initiates **series of muscular contractions** as below:*

- ***Initiate series of muscular contractions:***

1- Prevent food entrance to the nose through:

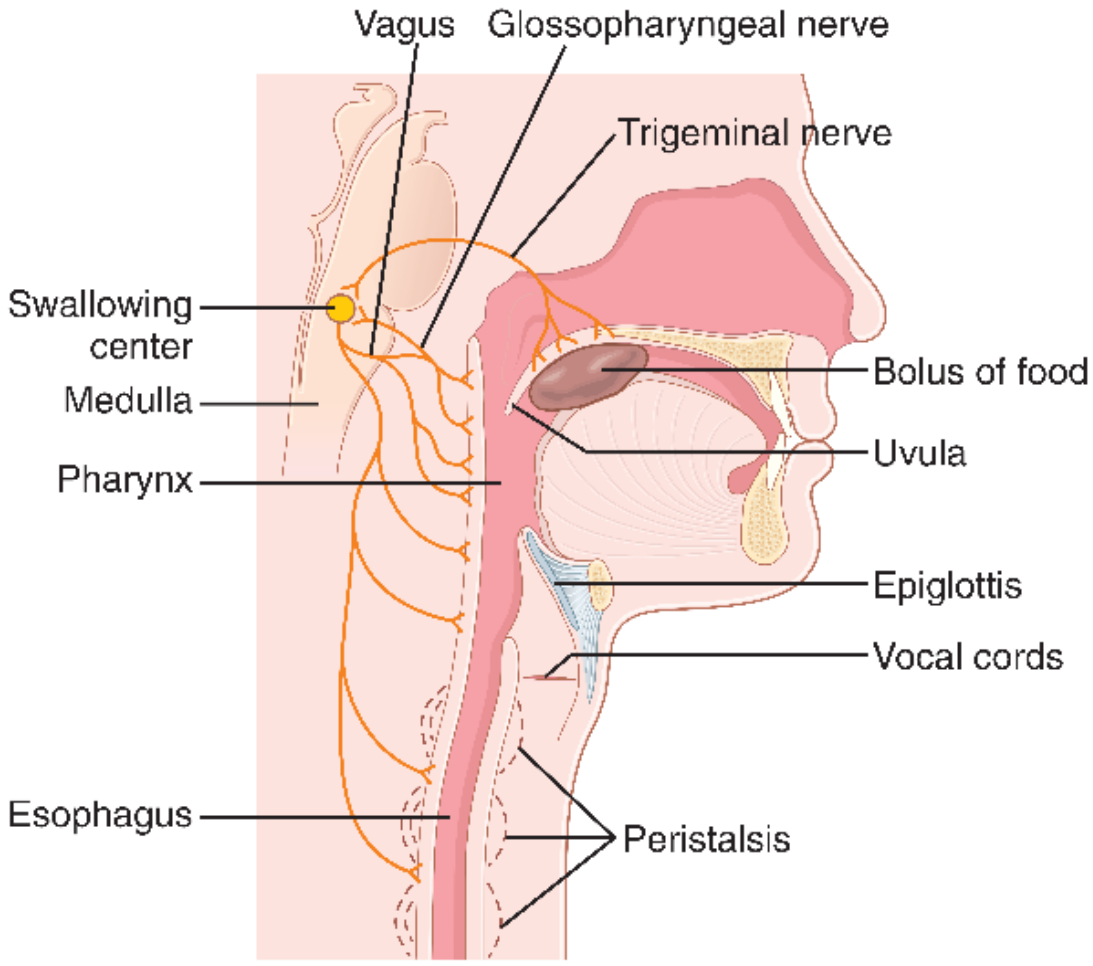
- *Pulling the **soft palate** upward to close the **posterior nasal cavity**.*

2- Prevent food entrance to the trachea through:

- ***The vocal cord** are approximated strongly (the most important).*
- ***The epiglottis** swings to close the laryngeal opening.*
- *Inhibition of the **respiratory center** → deglutition apnea*

3- Allow passage of food to the stomach through:

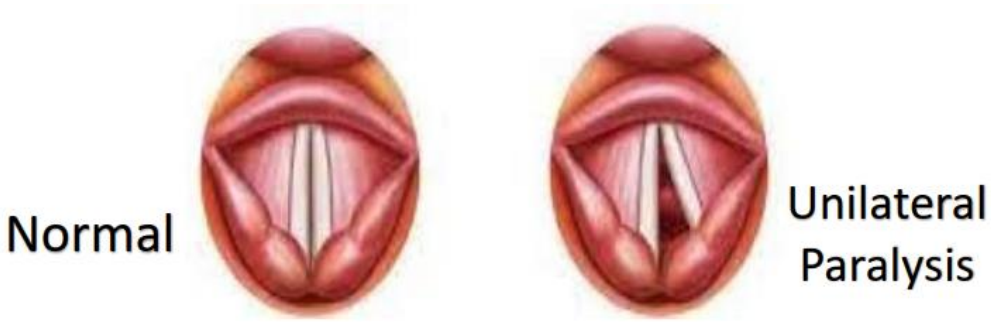
- *Contraction of the **superior constrictor muscle** of the pharynx.*
- *This contraction **spreads downward** as a rapid peristalsis along the esophagus.*



NB:

- ***Vocal cords paralysis*** *may be caused by damage of the supplying laryngeal nerves as during* ***neck surgery*** *→* ***Aspiration*** *(food and drink going into the airway) →* ***Pneumonia and lung infections.***

- *Large volumes of* ***vomitus*** *is expelled from the stomach into the pharynx in* ***some surgical operations.***
- ***Paralysis of the swallowing mechanism*** *occurs when patients are in a state of* ***deep anesthesia.***
- *As a result, some patients* ***may choke*** *on their own vomitus.*



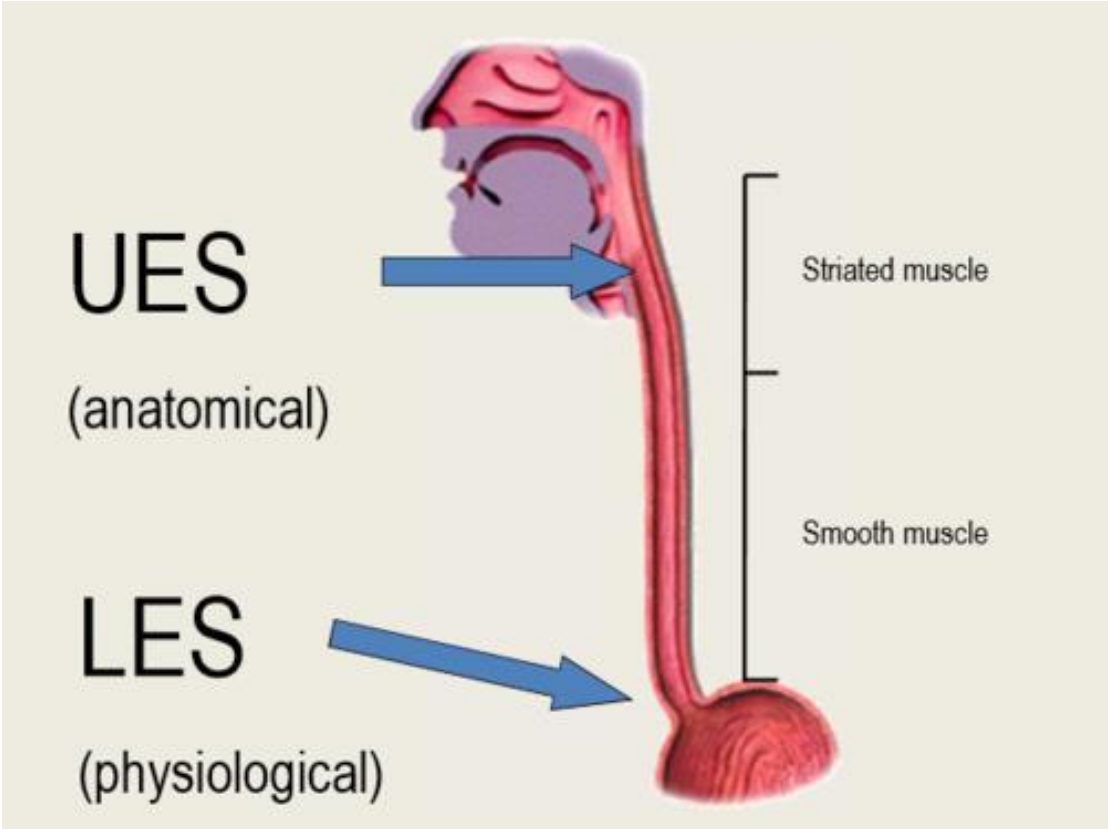
C) Esophageal stage:

- *Esophagus conduct food from the pharynx to the stomach.*
- *It is a muscular tube about 20cm long.*
- ***The esophagus has two types of peristaltic movements:***

1- Primary peristalsis:	*2- Secondary peristalsis:*
• *Continuation of the contraction of the* ***superior constrictor muscle*** *of the pharynx.* • *it's coordinated by* ***vagus***	• *Caused by presence of food in esophagus due to* ***failure of*** *primary peristalsis to move all food.* • *Caused by stimulation of* ***enteric nervous system***

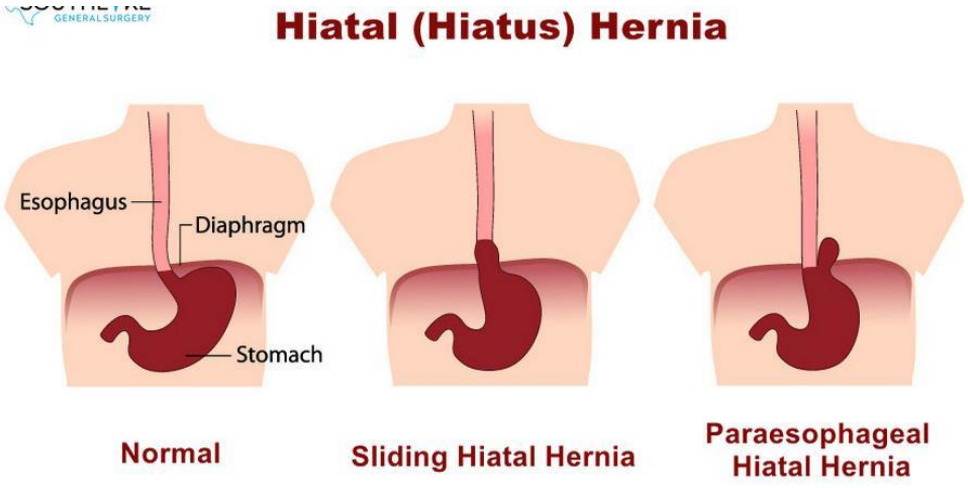
- ***Esophageal sphincters:***

	Upper esophageal sphincter (UES)	*Lower esophageal sphincter (LES)*
During rest	***Contracted*** → *prevents entrance of* ***air*** *into the stomach during breathing.*	***Contracted*** → *to prevent regurgitation of the* ***gastric acid*** *into the lower end of the esophagus.*
During swallowing	***Relaxed*** → *until food passes then it contracts.*	***Relaxed*** → *to pass food into the stomach.*



Gastro-osophygeal reflux dse (GERD)

- ***Decrease*** *The tone of LES →* ***GERD***
- ***Causes:***
  - ***Food:*** *e.g. Fat, tea, coffee, chocolate.*
  - ***Abnormal position of the sphincter:***
    - *As in case of Hiatus hernia, in which the LES is present* ***intra-thoracic*** *(Normally in the* ***abdominal cavity****).*



Achalasia of the cardia

- ***Increase*** *The tone of LES →* ***Achalasia*** *of the cardia.*

Causes:	• *LES* ***doesn't relax*** *during swallowing & food accumulates in esophagus.*
Symptoms:	• ***Dysphagia*** *to both liquid and solid food.*
Treatment:	• ***Ballon dilatation.*** • ***Myotomy.*** • *injection of* ***botulinum toxin*** *into the LES.*