L3
Swallowing (Deglutition)

MED 433 Teams

GIT

Objectives

1- Swallowing process and stages

2- Ingestion of Food .

3- Nervous initiation of pharyngeal stage of swallowing .

4- Effect of pharyngeal stage on respiration.

5- Function of lower esophageal sphincter

6- Prevention of esophageal reflux by valve like mechanism.

- Swallowing (Deglutition):

Swallowing is the ordered sequence of events that propel food from the mouth to the stomach

Swallowing is initiated voluntarily in the **mouth**, but thereafter is under involuntary or reflex control. This reflex inhibits respiration and prevents the entrance of food into the airway passages. The reflex portion is controlled by the **swallowing center** in the **medulla**

- Stages of Swallowing:

Oral stage (voluntary) → **Pharyngeal stage (involuntary)** → **Esophageal stage (involuntary)**

Stages of Swallowing:

Voluntary	Involuntary	
Oral stage	**Pharyngeal stage**	**Esophageal stage**
is initiated voluntarily when the tongue forces a bolus of food (upward and backward pressure against the palate) toward the pharynx.	the pharynx contains high density of somatosensory receptor , activation of these receptors initiates the involuntary swallowing reflex in the medulla. From here on, swallowing becomes entirely automatic and can not be stopped.	The esophagus is a conduit to move food rapidly from the pharynx to the stomach. Physiologically, esophagus is divided into three functionally distinct regions: 1- Upper esophageal sphincter (UES). 2- Esophageal body. 3- lower esophageal sphincter(LES). The esophageal stage is controlled partly by the swallowing reflex (vagus nerve) and partly by the enteric nervous system (ENS).
*Upper esophageal sphincter (UES)	1-The pharynx plays a role in respiration as well as swallowing. 2- swallowing center inhibits the respiratory center in the medulla which stops respiration during the swallowing cycle.	- When bolus of food passes through relaxed *UES, the swallowing reflex closes the sphincter so food cannot reflux into the pharynx.

Pharyngeal stage of Swallowing:

The bolus stimulates swallowing receptor areas around the pharynx opening and impulses pass to the swallowing center and initiate a series of autonomic pharyngeal muscle contractions as follows:

(1) The soft palate is pulled upward to close the posterior nares which prevents the food from entering the nasal cavities.

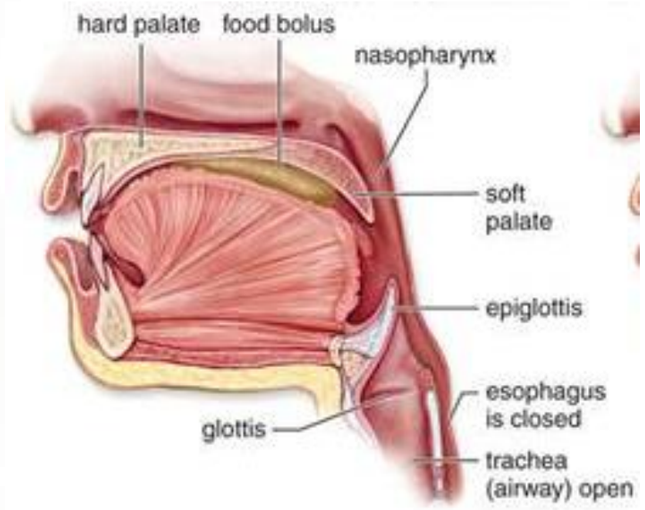
(2) The palatopharyngeal folds on each side of the pharynx are pulled medially to approximate each other. These folds form a sagittal slit through which food must pass into the posterior pharynx.

(3) The vocal cords of the larynx are strongly approximated and the larynx is pulled upward and anteriorly by the neck muscles. These actions and the ligaments that prevent the epiglottis from moving upward, cause the epiglottis to swing backward.

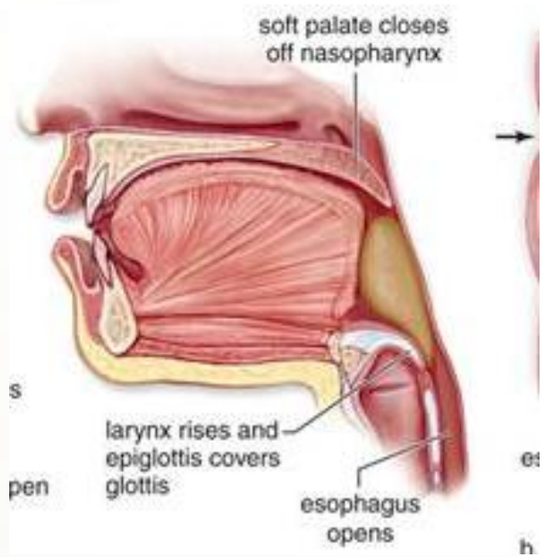
(4) The upward movement of the larynx pulls up and enlarges the opening to the esophagus.

(5)- The upper esophagealsphincter(thepharyngoesophagealsphincter) relaxes and allows food to move freely from the posterior larynx into the upper esophagus.

(6) Once the larynx is raised and the pharyngoesophageal sphincter relaxes, the entire muscular wall of the pharynx contracts (superior, middle, then inferior parts) propelling the food by peristalsis into the esophagus.



a. Swallowing



Nervous initiation of the pharyngeal stage

Receptors

The most sensitive areas for initiating the pharyngeal stage of swallowing are located in a ring around the pharyngeal opening including the tonsillar pillars

Sensory nerves

Sensory impulses from the mouth are received by the nucleus *tractus solitarius* (NTS) via the medulla oblongata through the trigeminal *and* *glossopharyngeal* nerves .

Center

automatically initiated by neuronal areas of the reticular substance of the medulla and lower portion of the pons (collectively called the deglutition or swallowing center)

Motor nerves

The motor impulses to the pharynx and upper esophagus are transmitted from the swallowing center by the 5th, 9th, 10th, and 12th cranial nerves and few of the superior cervical nerves.

Esophageal Stage (Nerve control):

1- The musculature of the pharyngeal wall and upper 1/3 of esophagus (striated muscle) innervated by vagus (10th cranial) & glossopharyngeal nerves (9th cranial).

2- Vagus nerve innervates the lower 2/3 of the esophagus through connections with the esophageal myenteric nervous system .

3- In case of vagotomy (Cutting of the vagus nerve) enteric nervous system takes over (in paralyzed patient > esophageal swallowing is intact) .

- Esophageal Stage has two types of peristaltic movements:

primary peristaltic :

- continuation of the peristaltic wave that begins in the pharynx and spreads into the esophagus during the pharyngeal stage of swallowing

-A primary peristaltic wave is coordinated by the swallowing reflex.

- Cannot occur after vagotomy striated muscle.

secondary peristaltic :

- If this primary peristaltic wave fails to move the food to the stomach, then the distention in the esophagus caused by the food will initiate secondary peristaltic wave which will continue until all the food is emptied into the stomach.

secondary peristaltic wave (if food is not cleared) is initiated by ENS in response to distention.

ENS and swallowing center are both involved

Can occur after vagotomy (smooth muscle).

Esophageal sphincters

The lower esophageal sphincter (LES):

It is formed by circular muscle located in an area of ~ 3 cm upward of the junction with the stomach.

*** With initiation of esophageal peristalsis, LES opens mediated by impulses in vagus nerve.**

*** In absence of esoph. peristalsis, the sphincter remains tightly closed to prevent reflux of gastric contents into esophagus.**

The upper esophageal sphincter (UES):

- **It prevents entry of air into esophagus.**
- **It relaxes during swallowing for about 1 second allowing the bolus to be forced through the relaxed UES.**

Functions of LES :

- The principle function of the LES is to prevent reflux of stomach contents into the esophagus.
- It normally remains tonically constricted.
- When a peristaltic wave of swallowing passes down the esophagus, it relaxes the LES (for 7-10 sec.) and allows easy propulsion of the swallowed food into the stomach.

It is necessary to have a barrier at the gastroesophageal junction (why?)

- Pressure in the esophagus is the same as the intrathoracic pressure i.e. mostly –ve (except for a short intra-abdominal segment).
- So that pressure in the stomach is always higher than the esophagus.

Competence and the antireflux functions of the LES is due to:-

1- Its resting pressure (15-30 mmHg).
2- Flutter-valve closure of the distal end of the esophagus is exposed to +ve intra-abdominal pressure.
This prevents the high pressure in the stomach from forcing its contents into the esophagus.
3- Contraction of the crura of the diaphragm that wrap around the esoph. at the level of LES helps to increase the pressure in the LES with each inspiration.

Control of LES functions :

*** Contraction of the circular musculature of the sphincter is regulated by nerves,(extrinsic & intrinsic), hormones and neuromodulators.**

*** Between swallows, tonic vagal cholinergicimpulses maintain contraction to keep the sphincter closed.**

***Stimulation of sympathetic nerves to the sphincter also causes the LES to contract.**

During swallowing, efferent impulses in the vagus are inhibitory causing the sphincter to relax.

The transmitter probably being nitric oxide or vasoactive intestinal peptide (VIP).

*** The hormone gastrin, released from the stomach by food, contracts LES.**

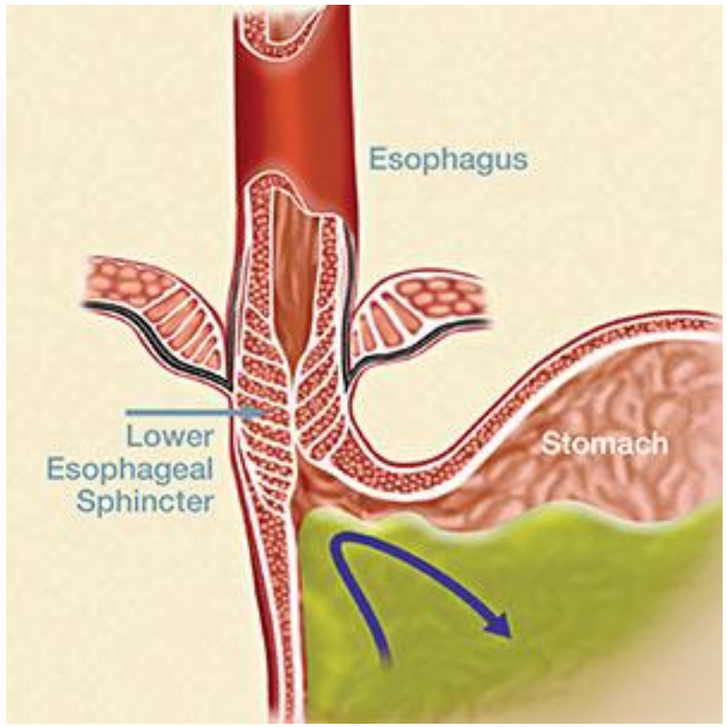
*** Secretin and cholecystokinine (CCK) released from the upper intestine relax the LES.**

Function of Esophagogastric Sphincter:

The sphincter is normally closed.

Closure of the sphincter due to prevent the acidity and protolytic enzyme from ascending upward and cause harmful effect.

When the contraction of the mid-esophagus reaches the sphincter, the sphincter will relax (RECEPTIVE RELAXATION)

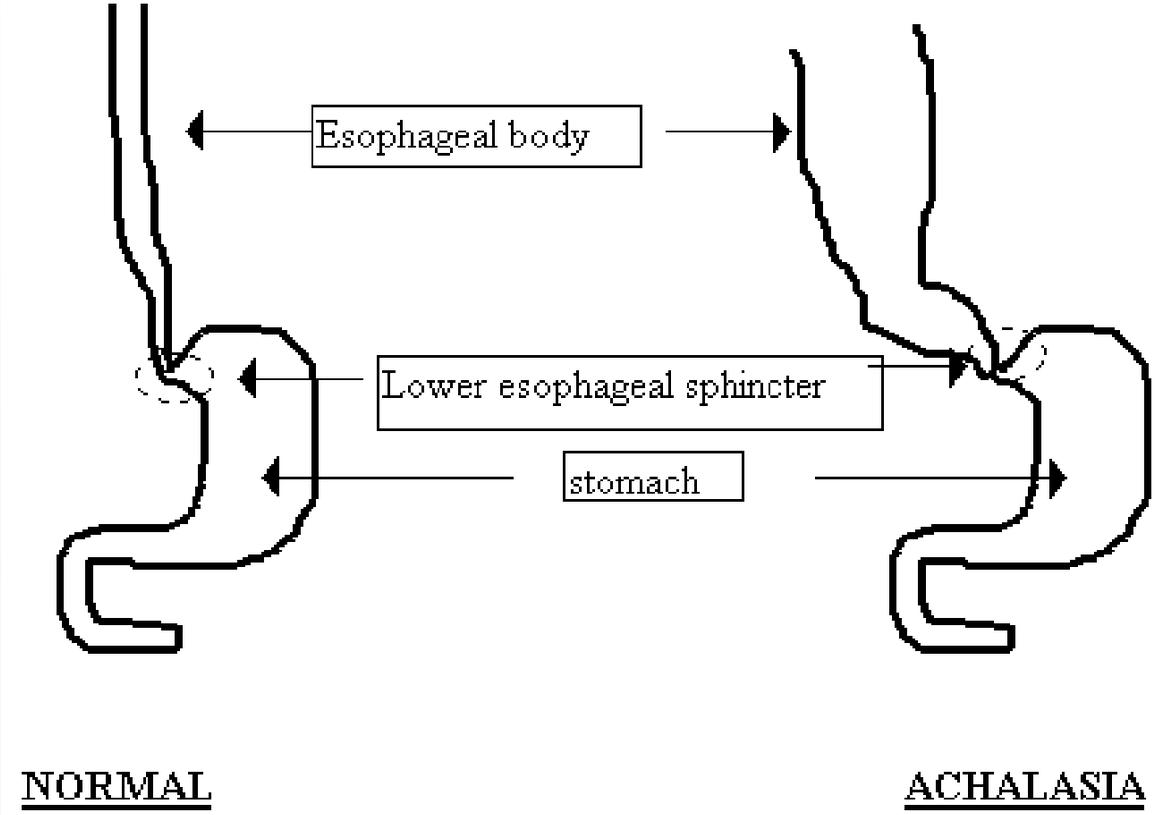


There is additional prevention of esophagus reflux, which is **Valvelike** closure of the distal part of the esophagus. It helps to prevent the intra-abdominal pressure from forcing stomach contents into the esophagus.

Achalasia

- **Achalasia means when the Food transmission from the esophagus into the stomach is impeded or prevented.**
- **This condition due to high resting pressure at the Lower Esophageal Sphincter that fails to relax during swallowing.**
- **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**

* the Lower Esophageal Sphincter

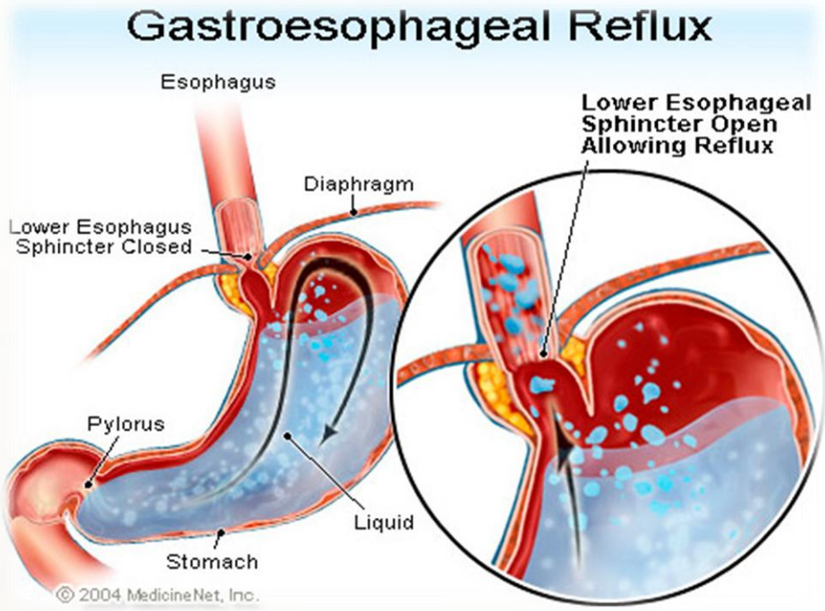


Incompetence of the LES

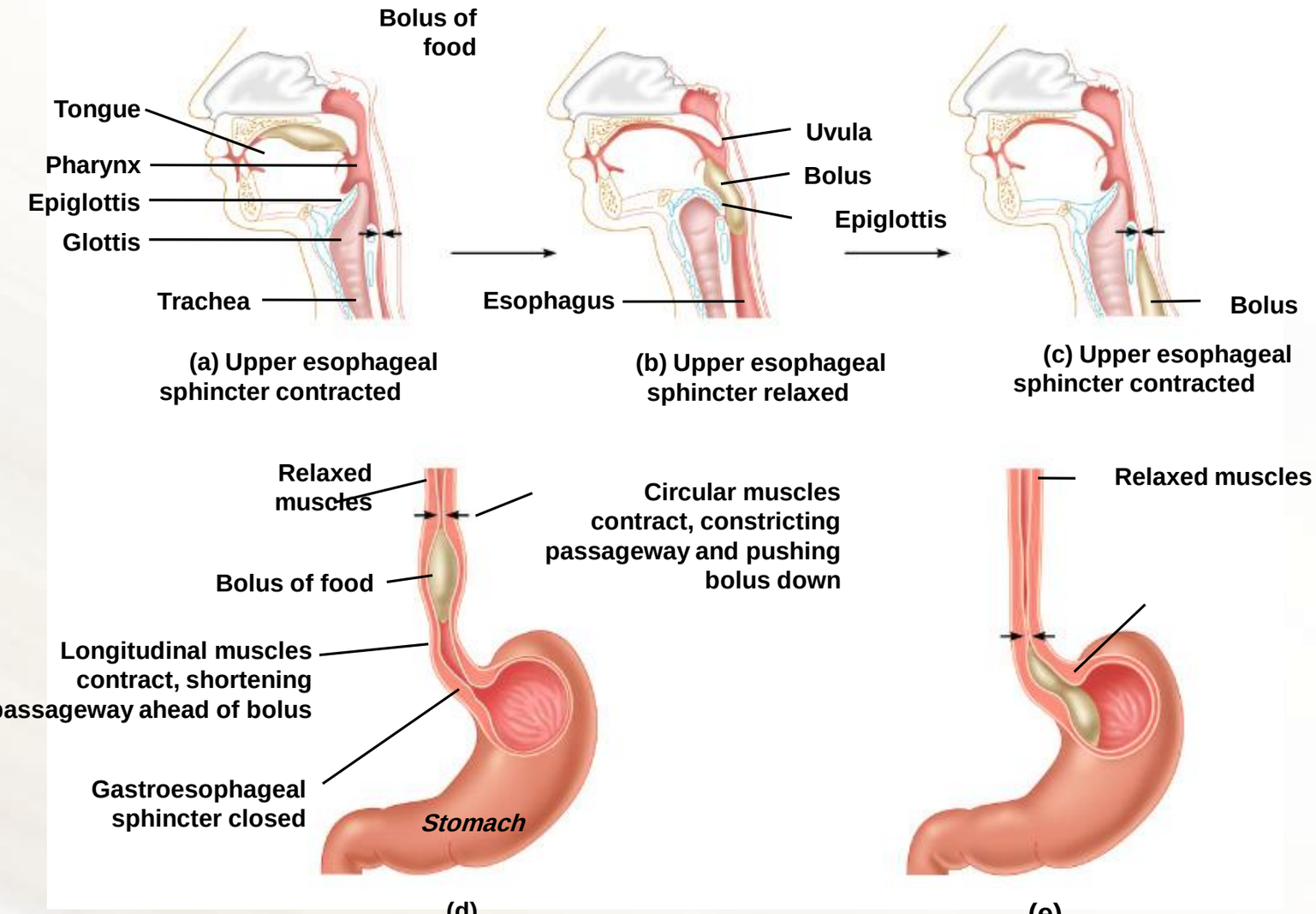
*** Incompetence cause esophageal reflux and result in chronic exposure of esophageal mucosa to acid.**

*** The esophageal mucosa, except in the lower eighth of esophagus, is not capable of resisting for long the digestive actions of gastric secretions.**

*** It can lead to reflux esophagitis, heart burn, esophageal ulcer and dysplastic changes that may become cancerous.**



Deglutition (Swallowing)



summary

http://youtu.be/pNcV6yAfq-g

1- Swallowing is initiated **voluntarily**, but thereafter is almost entirely under **reflex control .**

2- Pharyngeal stage is the most critical stage and should not exceed 2 seconds since the respiration is arrested.

3- the pharyngeal stage of swallowing is a **reflex act** initiated by the voluntary movement of food into the back of the mouth which stimulates involuntary pharyngeal sensory receptors to elicit the swallowing reflex.

4- **Upper third** of esophagus is contracted by **IX and X nerves**, while **lower two third** is contracted by the **Vagus through myentric plexus.**

5- **Achalasia** is a condition in which LES fails to open due to high resting pressure.

6- A primary peristaltic wave is coordinated by the **swallowing reflex .**

7- secondary peristaltic wave (if food is not cleared) is initiated by **ENS** in response to distention.

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GOOD LUCK