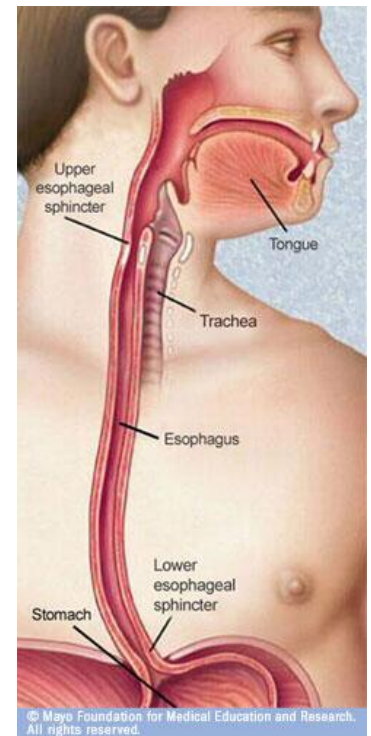


## Physiology of Esophageal Motility and Pathophysiology of Reflux

- The esophagus functions primarily to conduct food from the pharynx to the stomach.
- This process is controlled mainly by the swallowing centre “ in medulla oblongata”
- type of Transport is accomplished by peristalsis movement → propulsive and receiving segments produced by neurally organized contractile behavior of the longitudinal and circular muscle layers
- The esophageal musculature, both striated and smooth, is mainly innervated by branches of vagus nerve.
- Neurons of myenteric plexus directly innervate the smooth muscle cells of esophagus → at level of lower esophageal sphincter it will relax it .



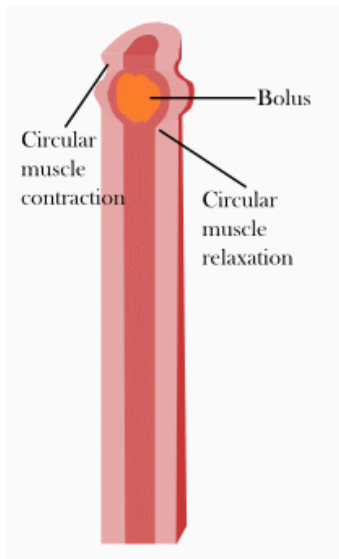
### Physiologically:

The esophagus is divided into three functionally distinct regions:

- A- The upper esophageal sphincter.
- B- The esophageal body.
- C- The lower esophageal sphincter

Anatomically it divided into :

- 1- Cervical
- 2- Thoracic
- 3- abdominal



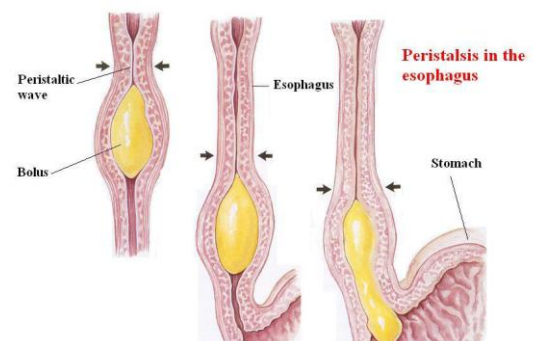
- Esophageal peristalsis :

Type of esophageal smooth muscle movement ..

It is initiated by ( VAGAL reflex ) :

Receptor in esophagus → afferent vagus → “medulla oblongata” → efferent vagus → muscle of esophagus →→ peristalsis waves start

The vagus nerve at the same time , send efferent fibers to the lower esophageal sphincter to open it !!



- There are 2 types of peristalsis :

| Primary peristalsis  | Secondary peristalsis   |
|--|---|
| Is initiated by voluntary act of swallowing<br>“pharyngeal movement”                 | Initiated when the primary peristalsis fails to<br>pass the bolus “ bolus is big!!” |
| coordinated locally by myenteric plexus  |   |
| It travels at 3-5 cm / sec. and traverse the<br>entire esophagus in less than 10 sec | Start above stick bolus   |

- Esophageal sphincters ..

There are two sphincters :

- 1- Upper esophageal sphincter (UES)
  - 2- Lower esophageal sphincter (LES)
- LES has more physiological features ..

| <u>Upper esophageal sphincter</u>                                  | <u>Lower esophageal sphincter</u>  |
|--|--|
| <u>prevents entry of air into esophagus</u>                        | In absence of esophageal peristalsis, it remains<br>tightly closed to <u>prevent reflux of gastric contents<br/>into esophagus</u> |
| relaxes during swallowing for about <u>1 second</u> .              | it relaxes (for 7-10 sec.)   |
| allowing the bolus to be forced <u>through the relaxed<br/>UES</u> | initiation of esophageal peristalsis, The LES opens<br>mediated by impulses in vagus nerve.  |

- LES : Anatomically this sphincter is not different from the remainder of the esophagus.
- However, physiologically it normally remain tonically constricted, in contrast to the mid and upper portions of the esophagus which normally remain completely relaxed.
- However 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.

## So, Function of LES is :

- The principle function of the LES is to prevent reflux of stomach contents into the esophagus.
- 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.  
That's why we need a tight junction between esophagus and stomach.. !!

### Anatomical sphincter :

*The muscle layer is very thick*

### Physiological sphincter:

*There are physiological features that make this region of sphincter tight !!*

## What factors make this sphincter tightly closed?

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

- 1- Its **HIGH** resting pressure (15-30 mmHg)
- 2- 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.  
This flutter-valve closure of the lower esophagus by the increased intraabdominal pressure prevents the high pressure in the stomach from forcing its contents into the esophagus.
- 3- The Right crura of the diaphragm wrap around the esophagus at the level LES, contraction of the diaphragm helps to increase the pressure in the LES with each inspiration.
- 4- The LES is physiologically not anatomically sphincter

## Control of LES function

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

### Relax sphincter

During swallowing, efferent impulses in the vagus are inhibitory

#### Parasympathetic effect ( via VIP )

Secretin and cholecystikine (CCK) released from the upper intestine

### Contract sphincter

After swallowing " by vagus nerve"

#### Sympathetic effect

The hormone gastrin, released from the stomach by food

*The myenteric plexus is cholinergic located in muscular layer of esophagus  
It is excitatory in other GIT muscular layer  
But in esophagus "LES" it is inhibitory*

## Diseases of LES :

### 1- Achalasia

### 2- Incompetence

#### 1. ACHALASIA :

\* It is a condition due to high resting pressure of the LES.

→ so; it fails to relax during swallowing.

- As a result, food transmission from the esophagus into the stomach is impeded or prevented.

- The Cause of ACHALASIA :

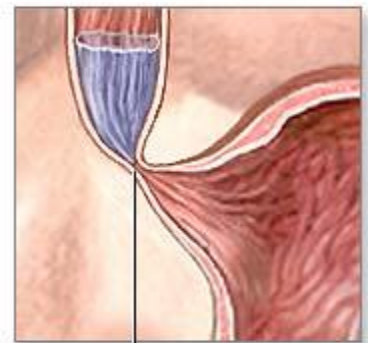
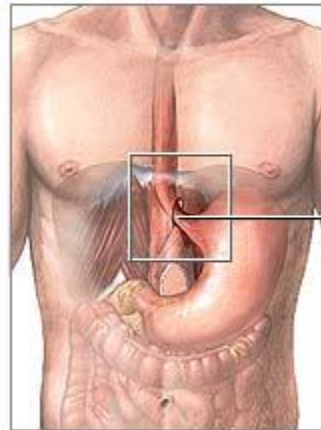
Physiological basis of this condition is either pathology of or absence of the myenteric plexus containing VIP & NO in the lower third of esophagus.

- 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.
- When achalasia becomes sever, the esophagus may not empty the swallowed food into the stomach for many hours.
  - The esophagus becomes enlarged which may be infected and cause ulceration, sever substernal pain or even rupture and death.
  - ➔ The food often reflux into the pharynx and is then aspirated into the lungs.

#### Therapy of Achalasia

1. Mechanically dilating LES.
2. Surgically weakening the LES.
3. Administering drugs that inhibit the tone of the LES.

Lower esophageal sphincter fails to relax



Lower esophageal sphincter

ADAM.

#### 4. INCOMPETENCE .. gastroesophageal reflux disease (GERD).

- The LES is very weak and wide
- Incompetence cause esophageal reflux and result in chronic exposure of esophageal mucosa to acid.
- The esophagus mucosa not protected from high acidity ..
- The stomach contents are highly acidic and contain many proteolytic enzymes enter to esophagus and cause injury !!
- It can lead to reflux esophagitis, heart burn, esophageal ulcer and dysplastic changes that may become cancerous.

