

Embryology, anatomy and physiology of the oesophagus

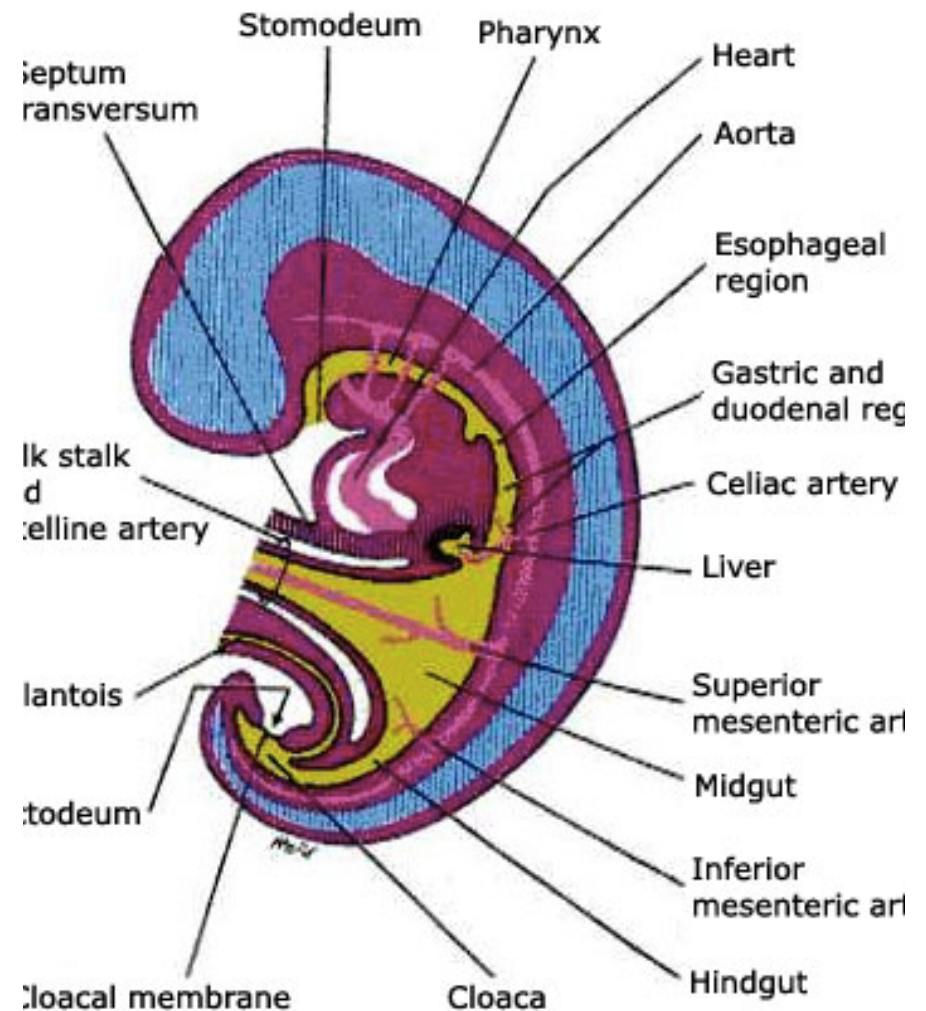
Sarah Forsyth



Embryology

Basics

- **Endoderm** forms scaffolding of GIT
 - ▣ Endoderm forms the lining of the **yolk sac**
- Derivative of **foregut**
- **Wk 4** - Foregut develops a diverticulum on ventral surface
- Rapidly elongates



A few important dates....

- **Wk 6** - circular muscle & myenteric plexus cells
- **Wk 7** - blood vessels enter mucosa
- **Wk 7/8** - luminal epithelium proliferates & almost occludes foregut
- **Wk 10** - vacuoles form, coalesce, form foregut lumen w superficial layer **ciliated epithelium**
- **Wk 16** - **stratified squamous epithelium** replaces ciliated epithelium (continues until birth)
- Residual islands of ciliated epithelium give rise to the **submucosal glands** that are at prox. & distal oesophagus

Muscle embryology

□ **Striated muscle & UOS**

- Derived from mesenchyme of branchial arches 4/5/6
- UOS supply = vagus (BA 5 nerve) & RLN (BA 6 nerve)

□ **Smooth muscle & LOS**

- Derived from mesenchyme of somites surrounding foregut

□ **Middle third**

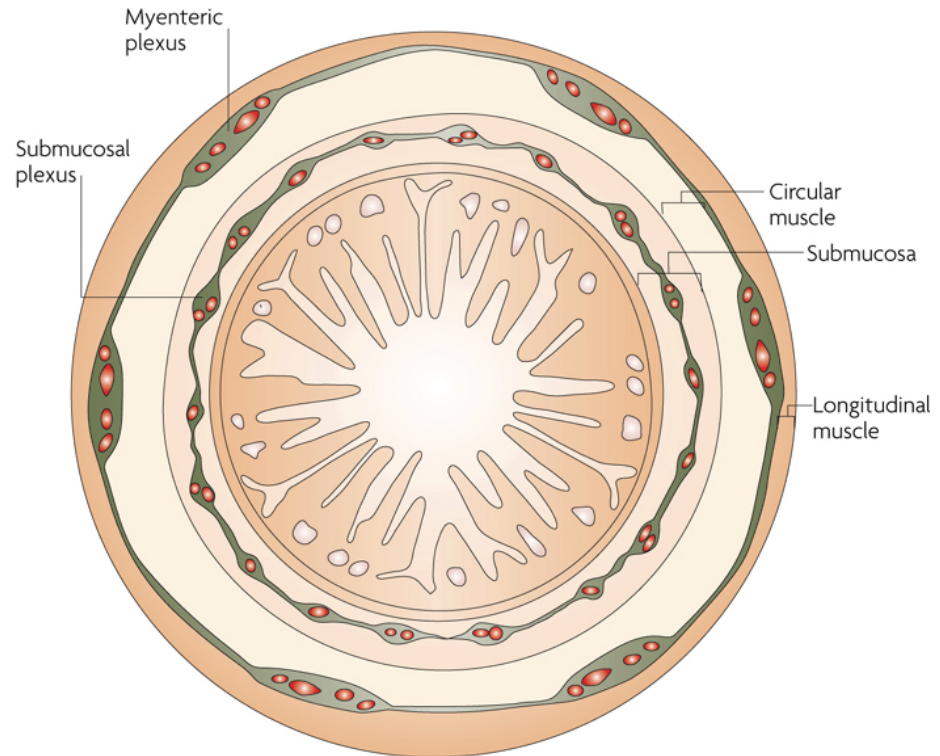
- Mixed striated & smooth muscle – derivative controversial
- Likely that the two distinct muscle types arise from separate pathways

□ **GOJ**

- Embryological origin still controversial
- Gastric rotation believed to determine its formation

Plexus formation

- **Myenteric plexus**
 - ▣ Week 4-7
 - ▣ Neural crest cells enter foregut to form MP
- **Submucosal plexus**
 - ▣ Neural crest cells migrate through circular muscle layer to form SMP





Anatomy

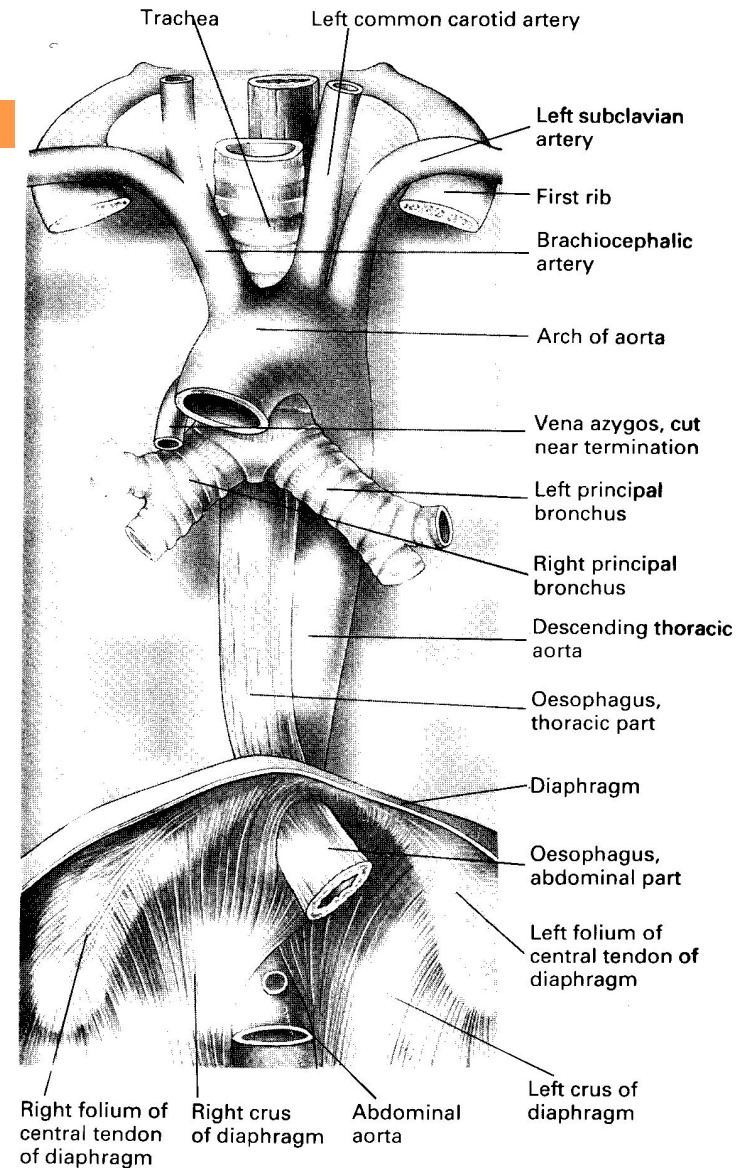
Oesophagus

“A muscular tube, 25cm in length, that extends from the cricoid cartilage (C6) to the cardiac orifice of the stomach (T10)”

- 3 parts; upper, middle, lower thirds
 - ▣ Cervical
 - ▣ Thoracic
 - ▣ Abdominal (GOJ)

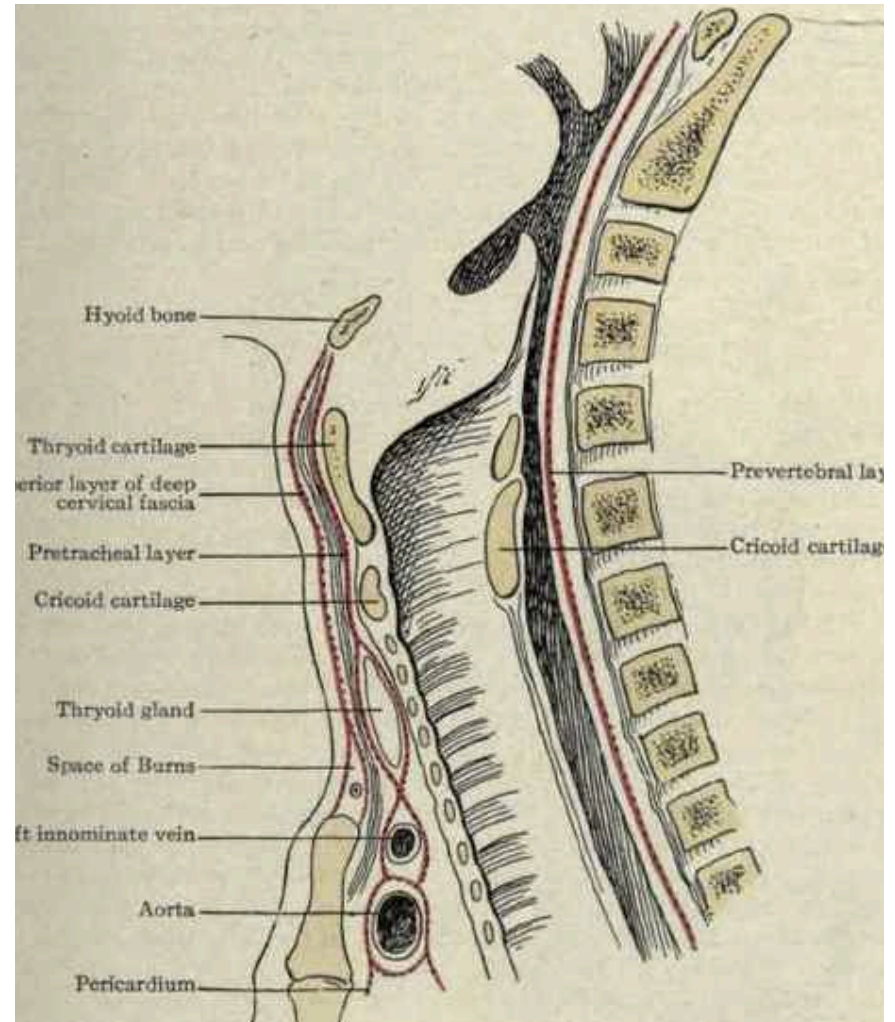
Course

- Starts midline
- Curves LEFT in neck/ sup mediastinum
- Curves RIGHT below trachea bifurcation
- Curves LEFT as passes through diaphragm



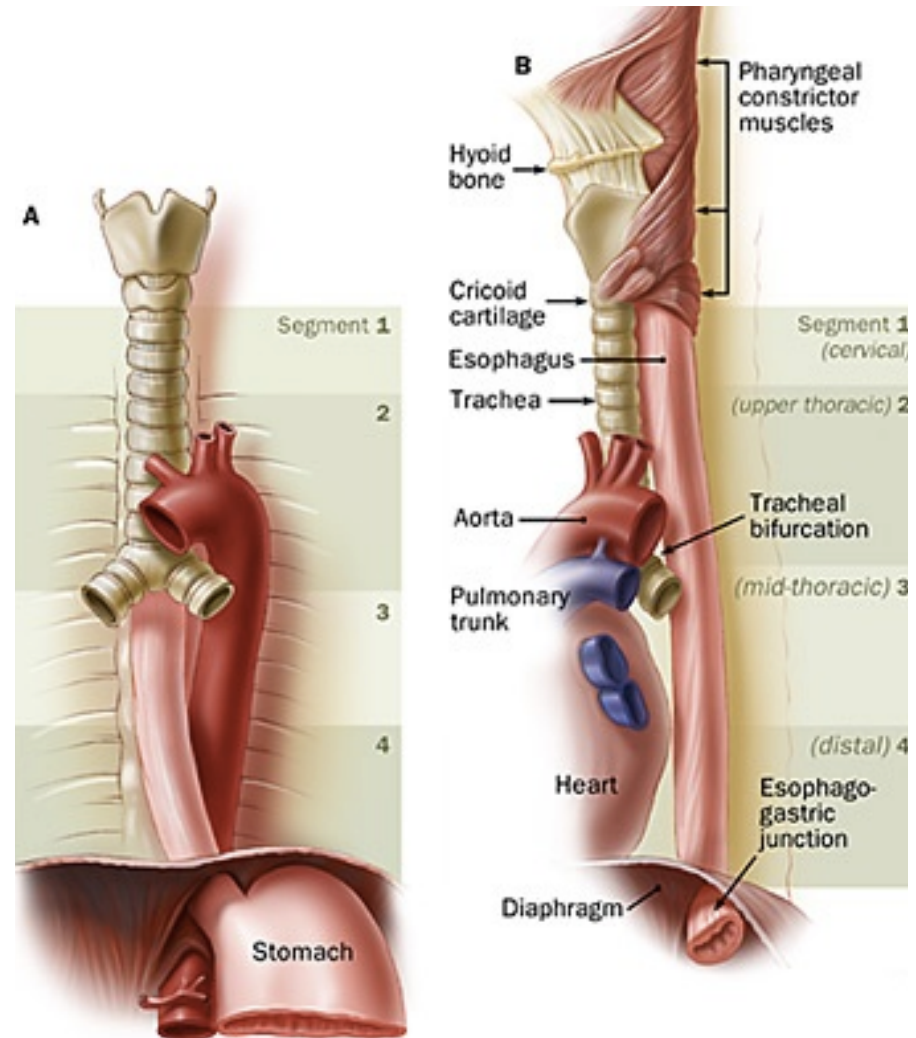
Cervical oesophagus

- Anterior to **prevertebral fascia**
- Posterior to **larynx & trachea**
- L of midline
- Enters thorax in the midline, anterior to **T1**, then passes into superior mediastinum
- Laterally separated from lobes of **thyroid** by deep cervical fascia
- **RLN** in tracheoesophageal groove
- **Thoracic duct** lies to L



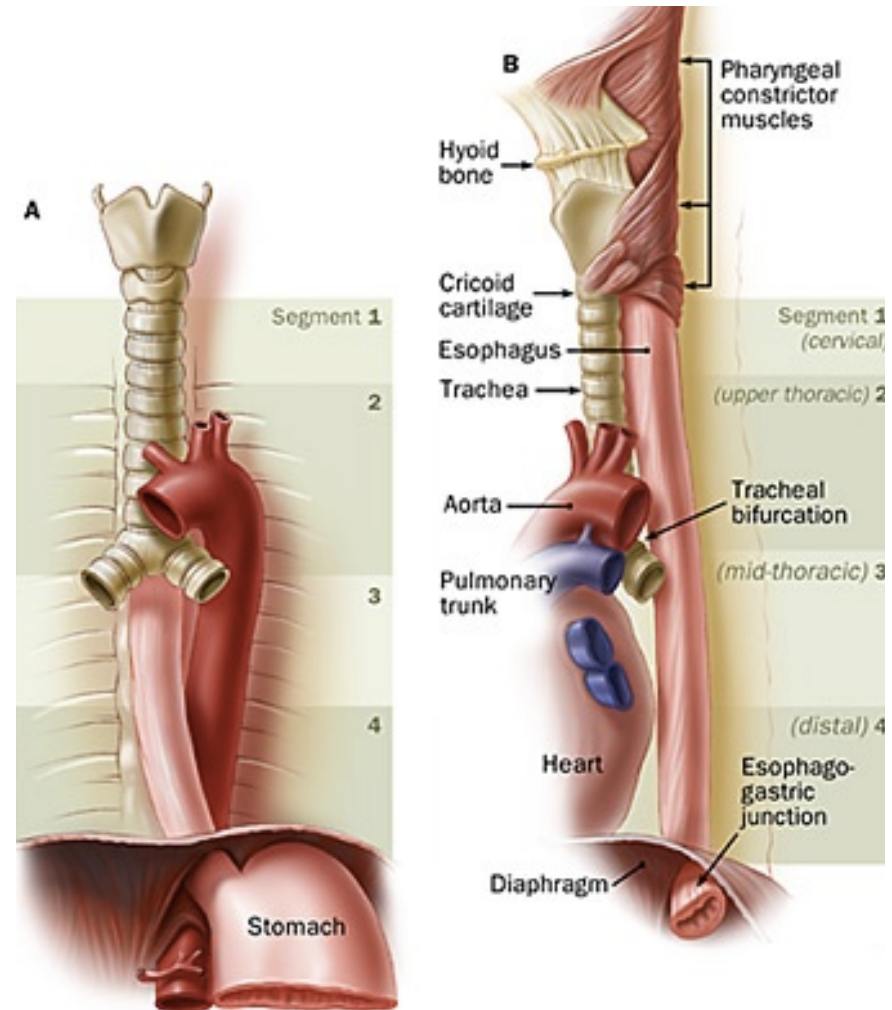
Thoracic oesophagus

- Curves L of midline, then R, then post. to **L bronchus** (indent), in contact w vertebral bodies
- Curves L in front of **descending thoracic aorta**
- Pierces diaphragm to L of midline, opp. body of **T10**
 - ▣ **Surface marking** -> 7th CC, thumbs breadth to L of sternum



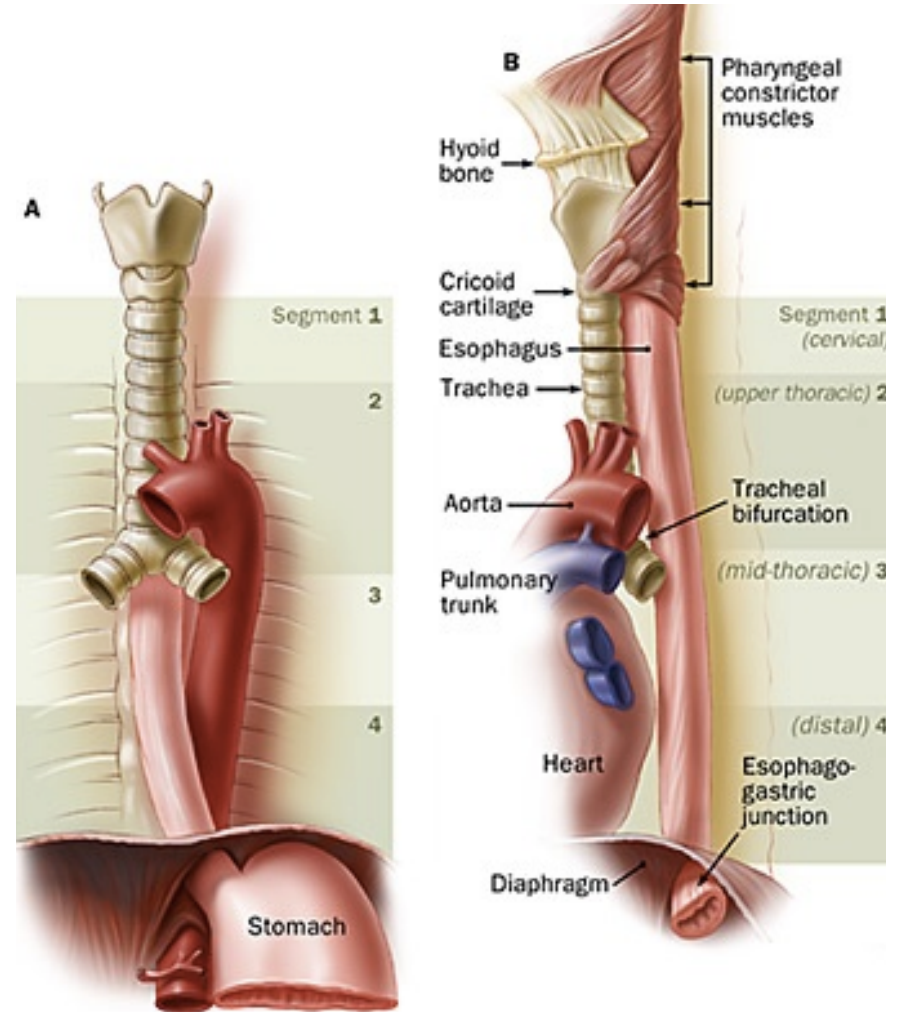
Thoracic oesophagus

- Crossed by **arch of aorta** on L, **azygous** on R
- Below trachea bifurcation, crossed anteriorly by **L main bronchus/R pulmonary artery**
- **Thoracic duct** lies posterior to R then moves to L
- **Pleura** close but not attached



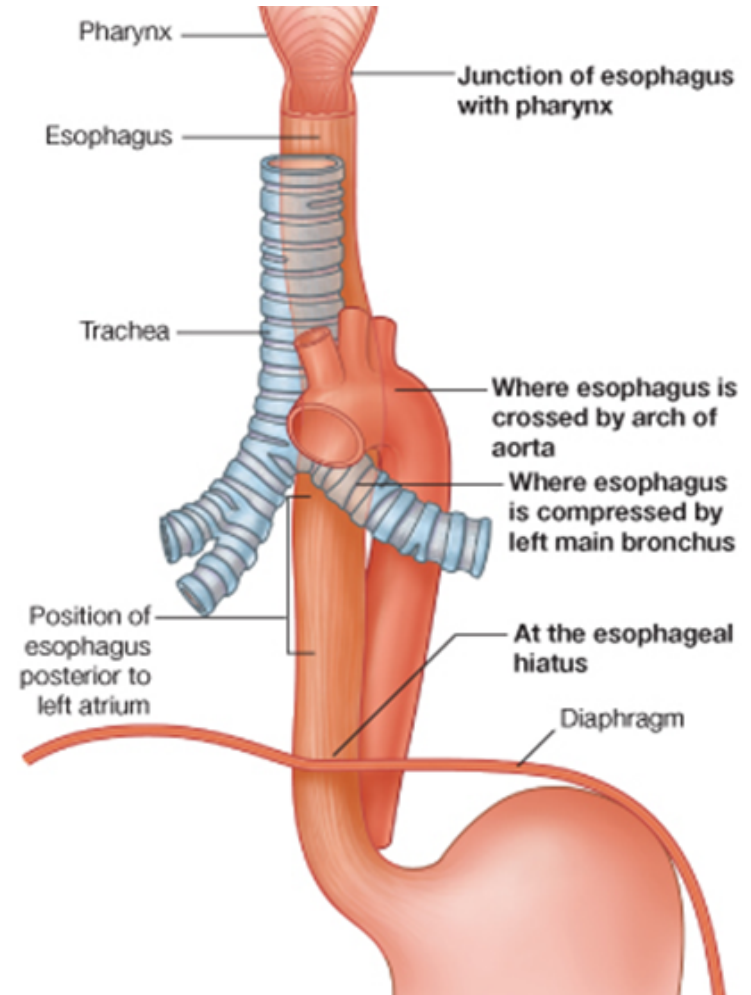
Distal oesophagus

- **R crus** fibres sweep around oesophageal opening (sling like loop)
- Intrabdominal oesophagus 1-2cm
- Above the oesophageal opening in diaphragm:
 - ▣ Firm CT connects posterior surface to aorta -> loosening of this allows sliding HH

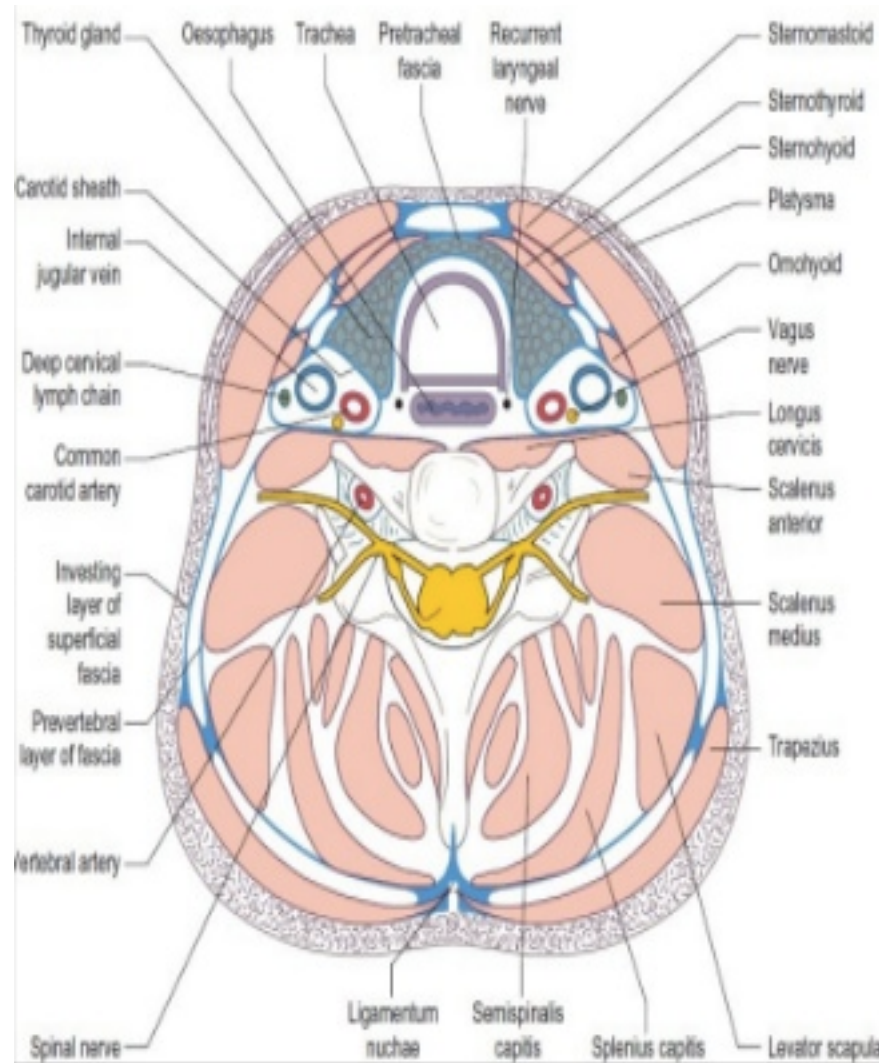


Constrictions

- **Cripharyngeus**
 - 15cm, narrowest part
- **Aortic arch**
 - 22cm
- **Left main bronchus**
 - 27cm
- **Diaphragm**
 - 38



Relations



Blood supply

Arterial

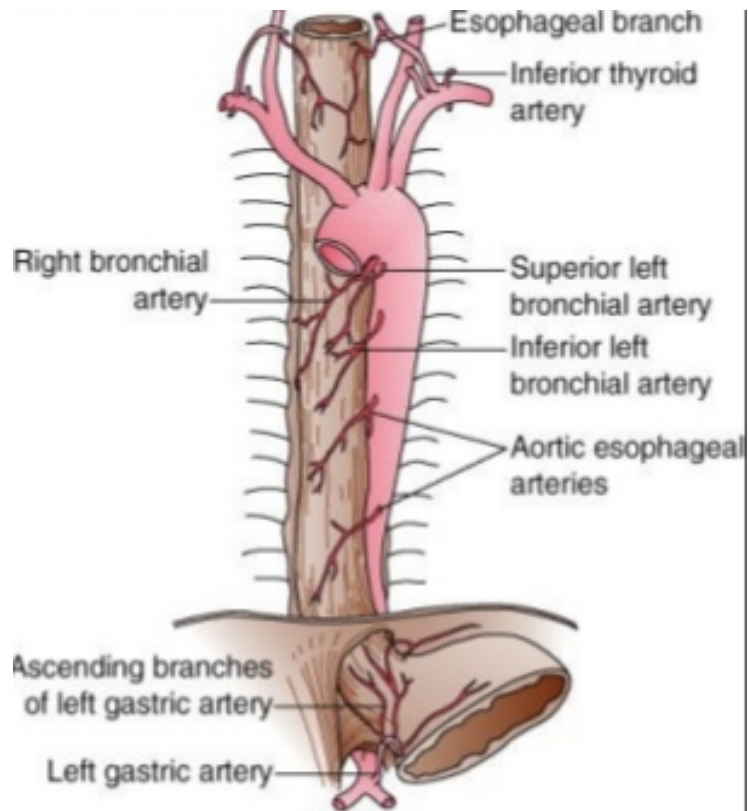
- Upper
 - ▣ **Inferior thyroid artery**
- Middle
 - ▣ **R & L bronchial**
 - ▣ **Oesophageal branches from aorta**
- Lower
 - ▣ **Oesophageal branches of L gastric**

Venous

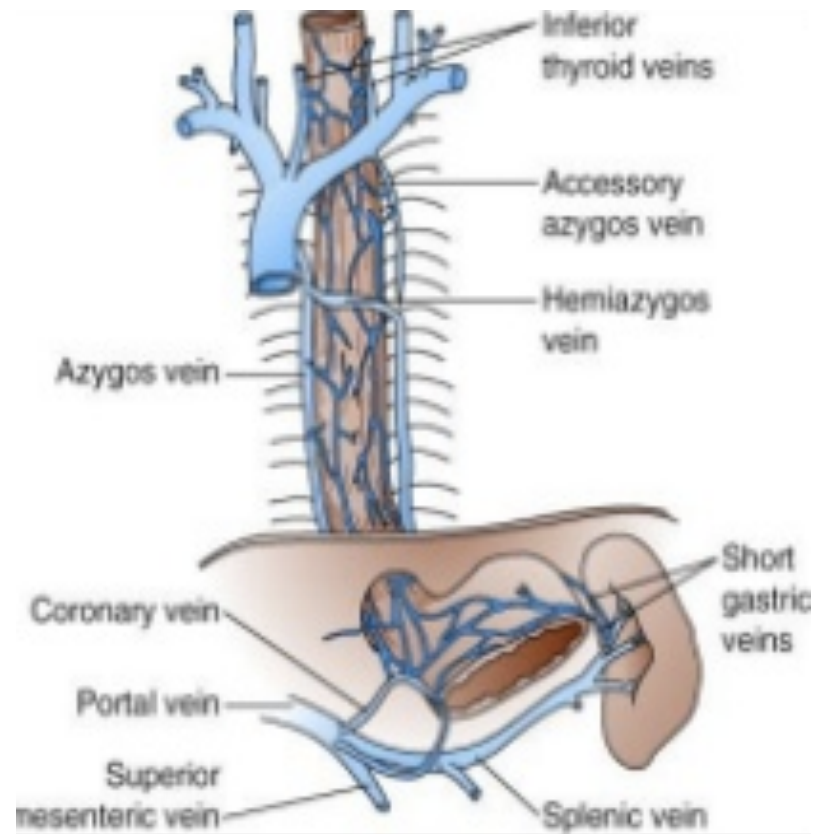
- Upper
 - ▣ **Brachiocephalic**
 - Middle
 - ▣ **Azygous**
 - Lower
 - ▣ **Oesophageal tributaries of L gastric -> portal vein**
- ** Portal-venous anastomosis (oesophageal varices) -> lies above hiatus in diaphragm*

Blood supply

Arterial



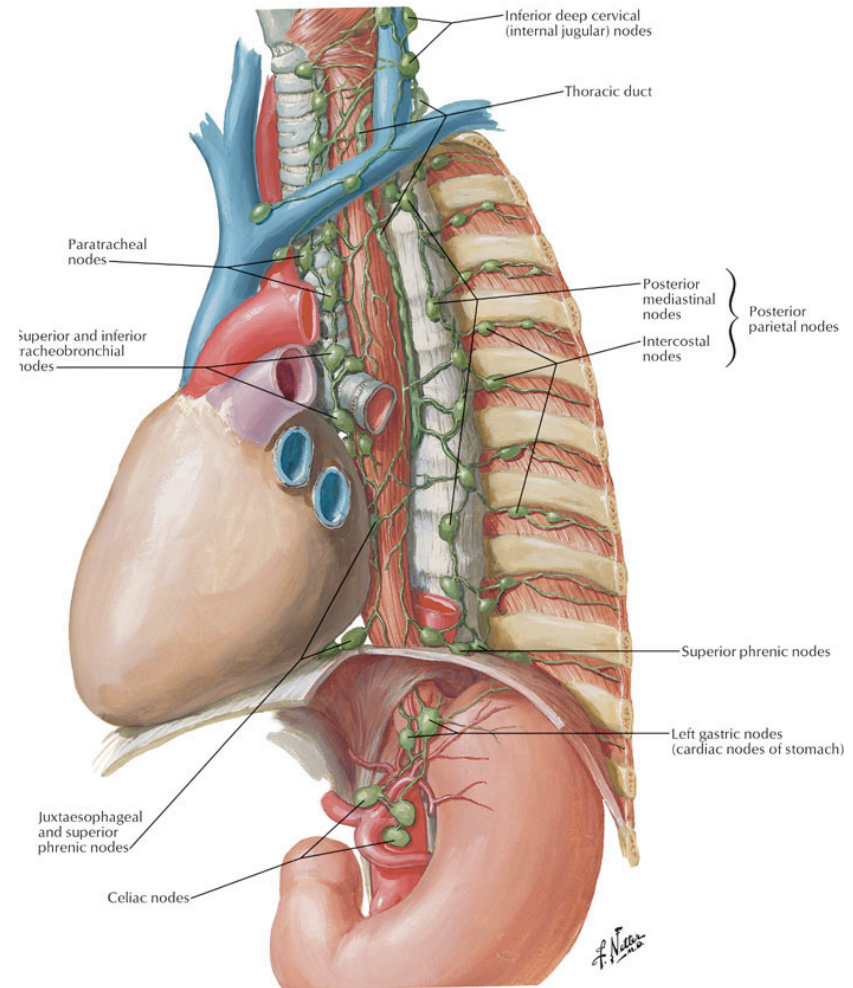
Venous



Lymph drainage

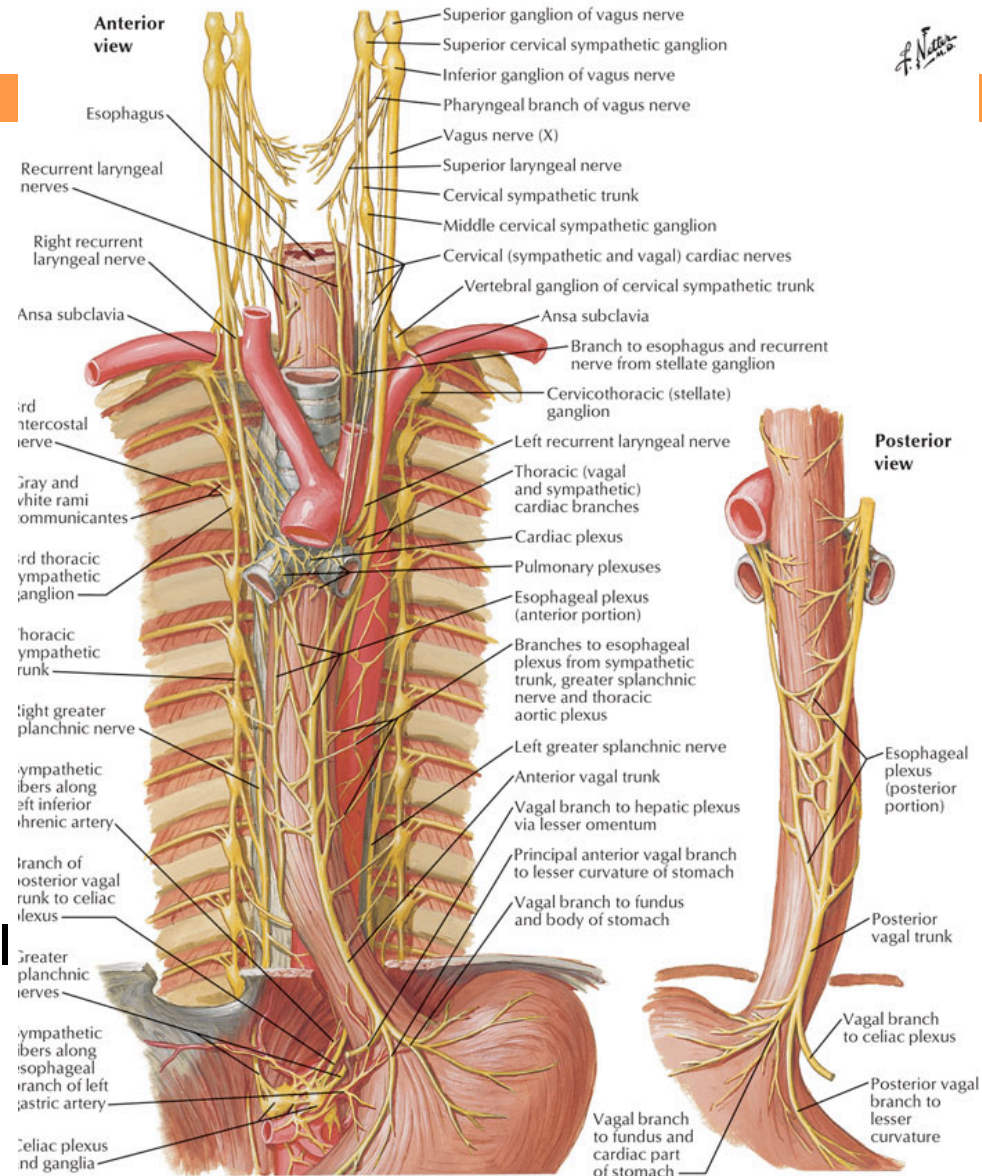
- Follow the arteries
- Deep cervical nodes (near origin of ITA)
- Tracheobronchial group
- Preaortic/coeliac group

**** Lymphatic channels within oesophageal walls allowing lymph to pass long distances to different groups of nodes**



Nerve supply

- Upper
 - ▣ Skeletal muscle – RLN
- Lower
 - ▣ Smooth muscle
 - ▣ SNS: Sympathetic trunk & greater/lesser splanchnics
 - ▣ PNS: **vagus**
 - Form anterior & posterior oesophageal plexuses -> converge to form ant/post vagal trunks
 - Ant trunk – L vagus
 - Post trunk – R vagus



F. Netter M.D.

Structure

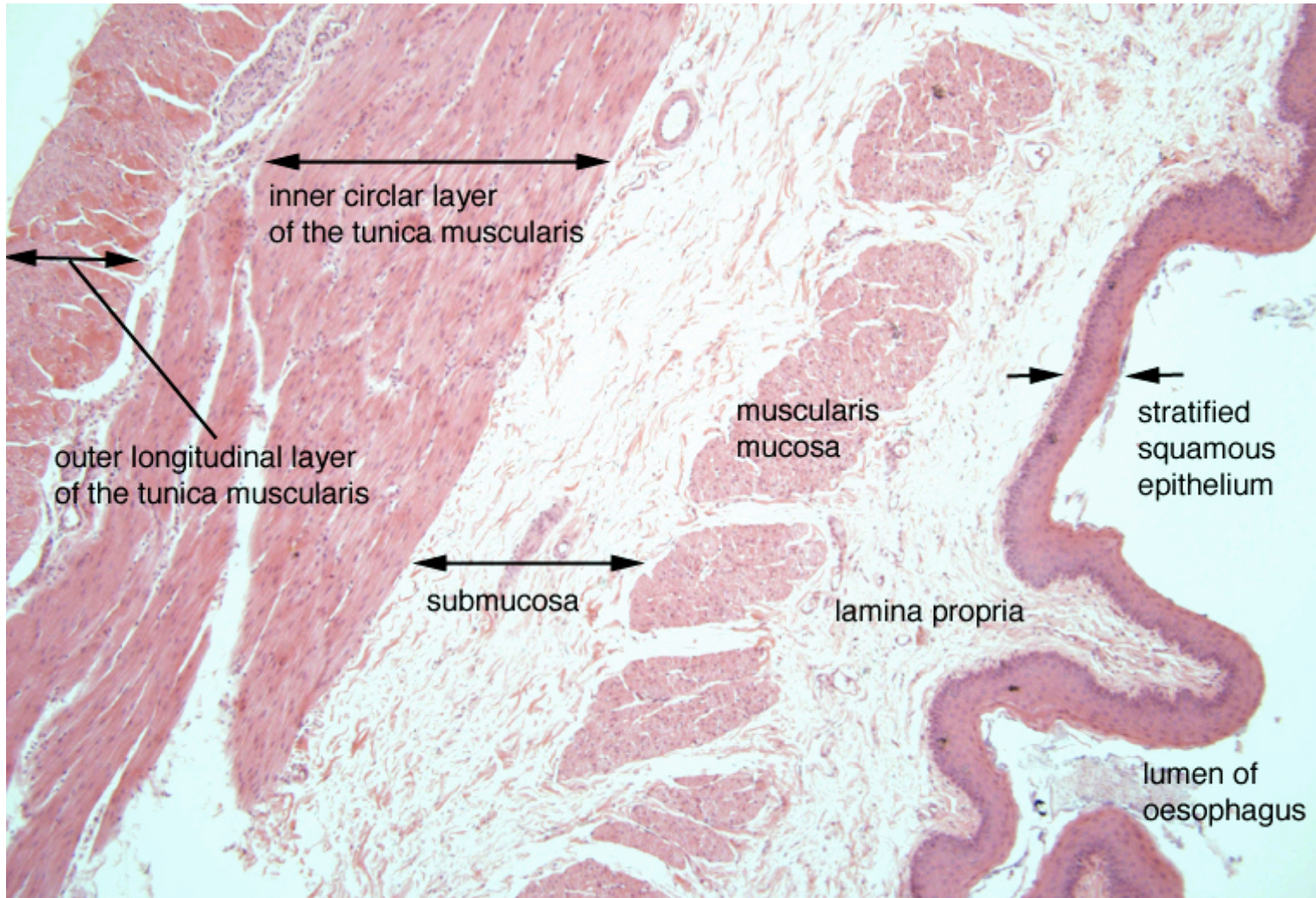
Muscle

- Upper
 - ▣ **Skeletal**
 - Rapid contraction to propel food bolus
- Middle
 - ▣ **Mixed**
- Lower
 - ▣ **Smooth**

Histology

- **Stratified squamous, non keratinising epithelium**
- Sub mucosa – mucous glands, elastic/fibrous tissue, strongest layer
- Thick muscularis mucosa
 - ▣ Inner circular (continuation of cricopharyngeus)
 - ▣ Outer longitudinal

Histology



Lower Oesophageal Sphincter (LOS)

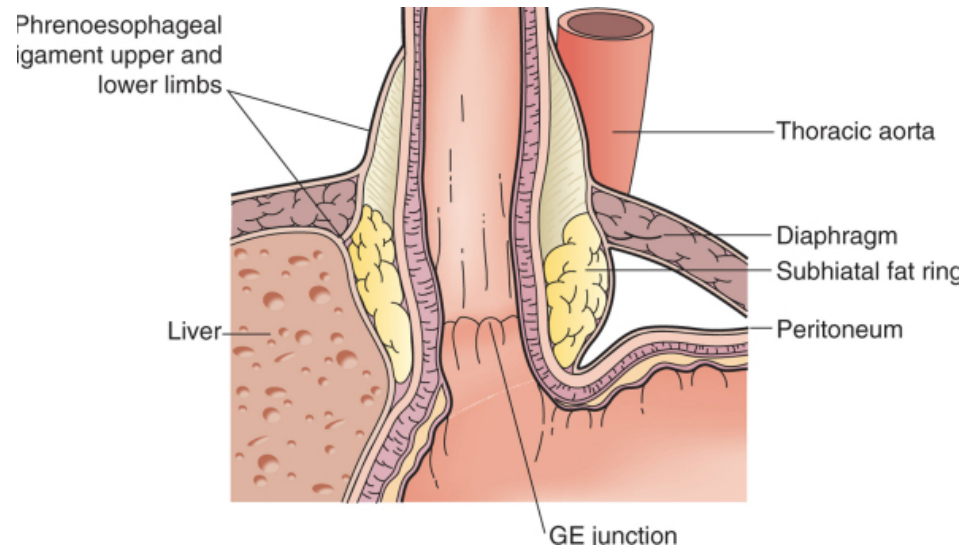
- Created by a series of structures & physiological events – internal/external components
 - ▣ Clasp & sling fibres
 - ▣ Maintained contraction tone (3-4cm segment circ. Muscle)
 - ▣ Crura
 - ▣ Intra abdominal pressure

LOS

- High pressure zone created by thickened region of circular muscle layer (10-15mmHg above intra-gastric pressure)
- 3-4cm in length
- Vagus:
 - ▣ Motor innervation to LOS
 - ▣ Contains afferent neurons that can increase or decrease LO tone by stimulation of inhibitory or excitatory motor neurones in the myenteric plexus
 - ▣ Excitatory: cholinergic -> muscarinic receptors
 - ▣ Inhibitory: cholinergic -> nicotinic receptors (many inhibitory motor neurones at LOS)

Phreno-oesophageal ligament

- Attaches GOJ to diaphragm i.e. oesophagus anteriorly to peritoneum and **endo-abdominal fascia**
- A condensation of endoabdominal fascia from the undersurface of the diaphragm
- 2 layers
 - ▣ Endothoracic fascia
 - ▣ Transversalis fascia





Physiology

Swallowing

- Involuntary, reflex control
 - ▣ Swallowing centre in **medulla**
- Sensory afferents (via vagus & glossopharyngeal) to medulla
- Motor efferents to striated muscle in upper oesophagus
- Three phases:
 1. Oral
 2. Pharyngeal
 3. Oesophageal

Swallowing

- Oesophageal phase

- ▣ Controlled by:

- Swallowing reflex

- Enteric nervous system

- ▣ Involuntary relaxation of UOS, food passes, closes rapidly

- ▣ Primary peristaltic wave – swallowing reflex initiates

- ▣ Secondary peristaltic wave - initiated by continued distension of oesophagus (ENS)

Oesophageal motility

- UOS
 - ▣ Mediated by swallowing reflex, then closes to prevent reflux
- Primary peristaltic wave
 - ▣ Mediated by swallowing reflex, coordinated sequential contractions, high pressure behind bolus
- LOS
 - ▣ Opening mediated by Vagus
 - Release VIP -> relaxation of smooth muscle of LOS
 - ▣ Receptive relaxation of stomach