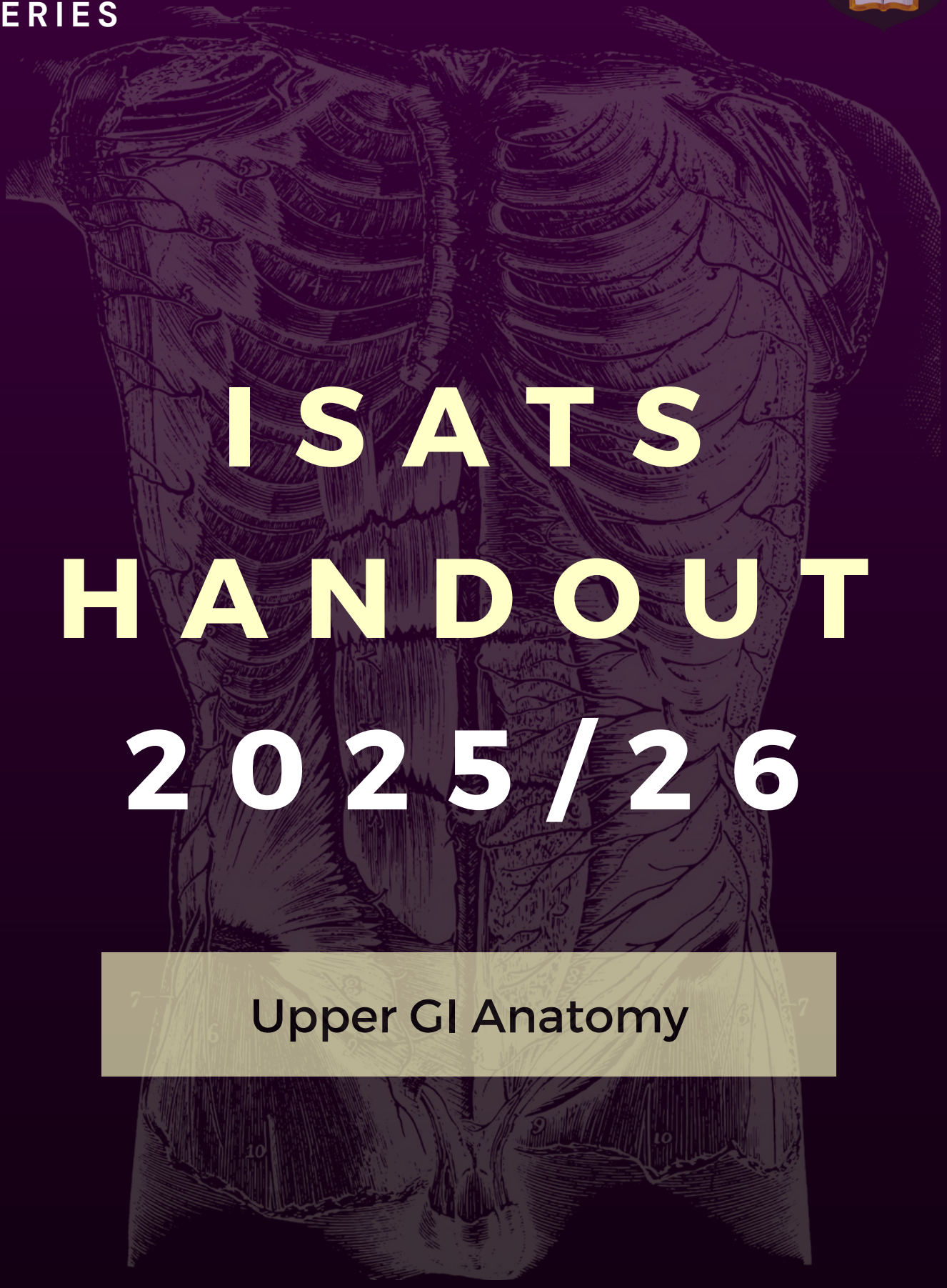
INTERNATIONAL SURGICAL ANATOMY TEACHING SERIES



ISATS HANDOUT 2025/26

Upper GI Anatomy

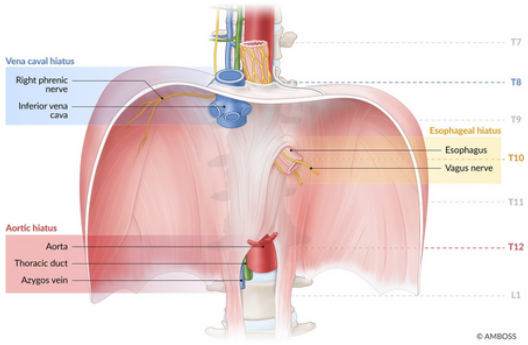
High Yield | Surgical Relevance | Approved for CPD Hours

UPPER GI ANATOMY

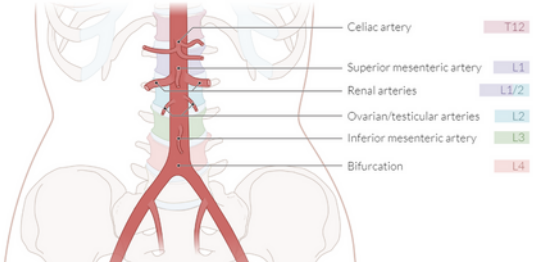
***Objectives**: Describe the diaphragmatic openings and their contents; Label the main branches of the abdominal aorta; Understand the structure and attachments of the Peritoneum, Mesentery and Omentum; and Identify the vascular territories of the GI tract*

Diaphragmatic Openings

Opening	Level	Structures passing	Mnemonic
Caval Opening	T8	Inferior vena cava, phrenic nerve & lymphatics	I Ate(8) IVC passes at T8
Oesophagus Hiatus	T10	Oesophagus, vagus nerve, esophageal branch of L. gastric artery	10 eggs Eso, Gus (Vagus) at T10
Aortic Hiatus	T12	Aorta, thoracic duct, azygous vein	AT 12 Aorta and thoracic duct at T12



Abdominal Aorta Branches



Most important branches for the GI tract are:

1. Coeliac trunk
2. Superior mesenteric artery
3. Inferior mesenteric artery

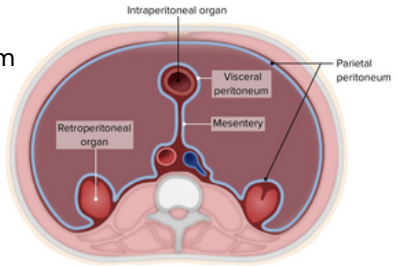
Peritoneum and Mesentery

Peritoneum

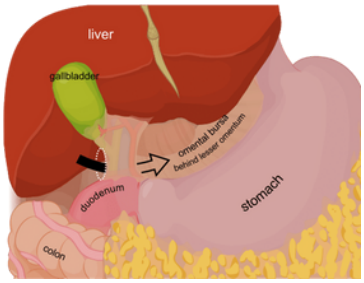
- Serous mesothelial membrane lining the cavity of the abdomen
- Made of 2 layers: The parietal and the visceral
- Between the two layers you have the peritoneal cavity which contains serous fluid

Mesentery

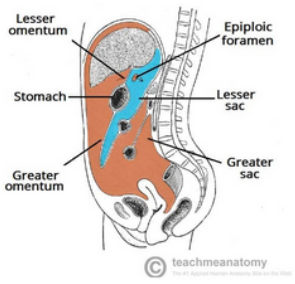
- A double layer of peritoneum
- Attaches intraperitoneal organs to posterior abdominal wall
- Allows passage of neurovascular structures
- Root of mesentery starts at L2



Omentum and Sacs

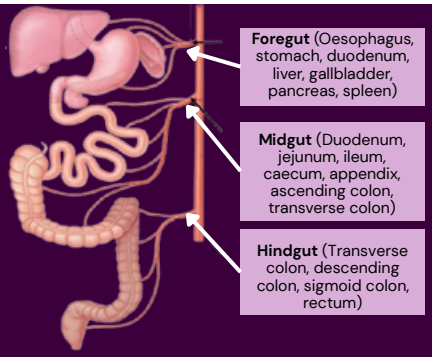


- The lesser omentum is a fold between the lesser curvature of the stomach and the liver.
- The greater omentum is a double-fold between the greater curvature of the stomach and the transverse colon.
- They form the two main sacs of the peritoneum: The lesser and the greater sacs, connected by the **Foramen of Winslow**.



Vascular Territories of the GI Tract

Foregut	Distal oesophagus to proximal duodenum (ampulla of vater)	Coeliac trunk
Midgut	Distal duodenum to proximal 2/3s of transverse colon	Superior mesenteric artery
Hindgut	Distal 1/3 of transverse colon to anorectal junction	Inferior mesenteric artery

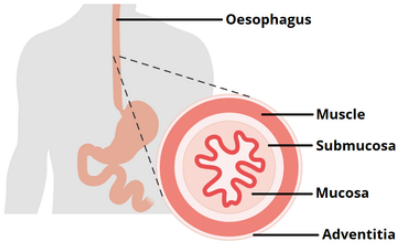


UPPER GI ANATOMY

Objectives:
The oesophagus anatomy: Its course, relations, and neurovascular supply

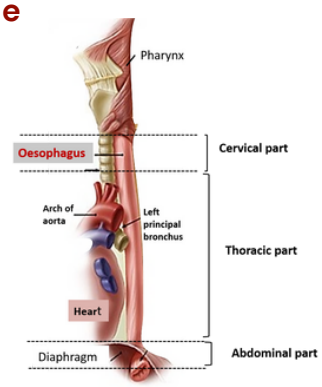
The Oesophagus

Four concentric layers



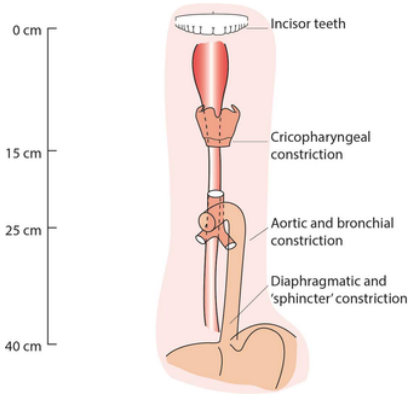
- Outer to inner: Adventitia → muscular layer → submucosa → mucosa
- Muscular layer further divided to
  - Inner circular layer
  - Outer longitudinal layer
- Type of muscle changes along the esophagus
  - the upper third: **skeletal muscle**
  - the middle third: **skeletal and smooth**
  - the lower third: **entirely smooth muscle.**

Course



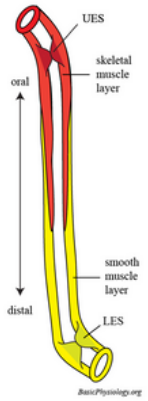
- **3 sections:** Cervical, thoracic, and abdominal oesophagus
- Starts at the **circoid cartilage** at **C6**
- Cervical oesophagus runs posterior to **the trachea**, and thoracic oesophagus runs to the right of the **thoracic aorta**
- Pierces the diaphragm at **T10**

Oesophageal Constrictions



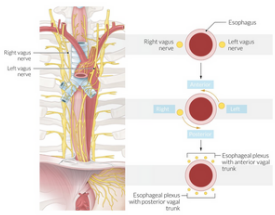
Constriction	Level
Cricopharyngeal constriction	C6
Aortic constriction	T4
Bronchial constriction	T5
Diaphragmatic constriction	T10

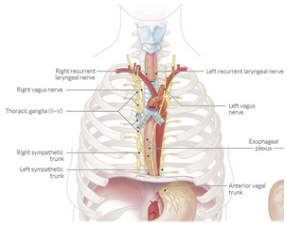
Oesophageal Sphincters



- **Upper Oesophageal Sphincter (UES):** Voluntary; made of striated skeletal muscle (cricopharyngeus)
- **Lower Oesophageal Sphincter (LES):** Involuntary; made of smooth muscle to prevent acid reflux

Nerve Supply

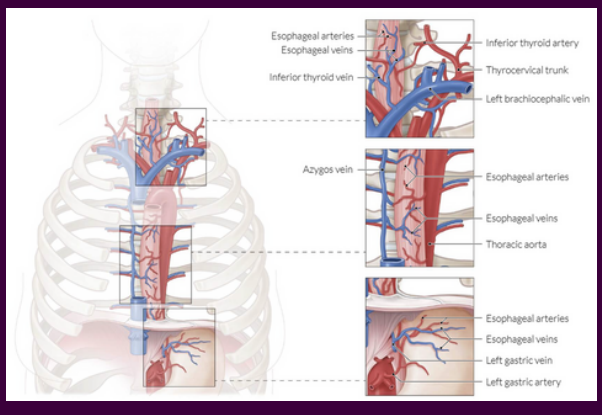




- **Sympathetic innervation** via thoracic ganglia II-V
- **Parasympathetic innervation** via branches of the vagus nerve
  - Right vagus nr. → posterior vagal trunk
  - Left vagus nr. → anterior vagal trunk

Blood Supply per region

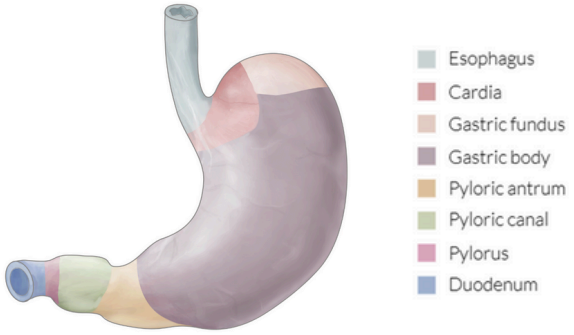
Section	Arteries	Veins	Lymphatics
Cervical	Inferior Thyroid Artery	Inferior Thyroid Vein	Mediastinal Lymph Nodes
Thoracic	Thoracic Aorta	Azygos and Hemiazygos Veins	
Abdominal	Left gastric artery	Left gastric vein	



UPPER GI ANATOMY

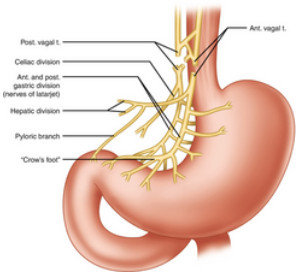
Objectives:
Anatomy of the stomach: course, relations, and neurovascular supply

Anatomy of the Stomach



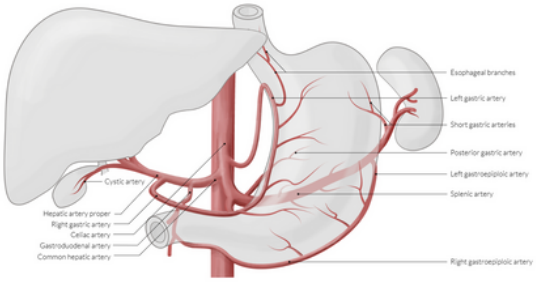
Stomach Nerve Supply

- **Sympathetic innervation** via coeliac ganglia (perception of pain)
- **Parasympathetic innervation** via branches of the vagal nerve (perceptions of nausea and fullness)

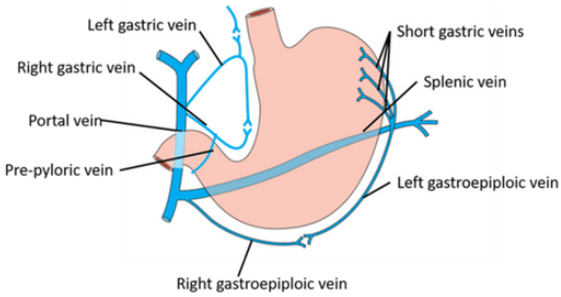


Blood Supply

- **Lesser curvature** - R & L gastric arteries and veins
- **Greater curvature** - R & L gastro-epiploic arteries and veins



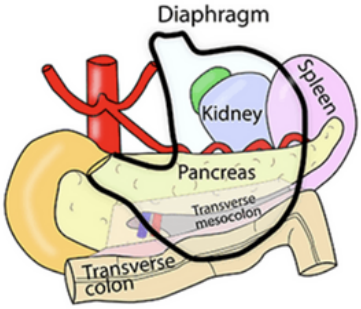
Arterial:
All branches of **the coeliac trunk**

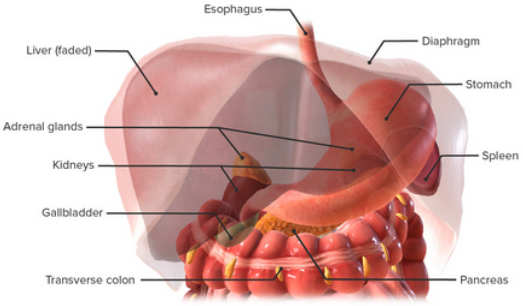


Venous:
All drain to **the portal vein**

Relations

Superiorly	The oesophagus The lesser omentum The left dome of the diaphragm
Anteriorly	The liver The diaphragm Anterior abdominal wall
Inferiorly	Transverse colon Greater omentum
Posteriorly	Lesser sac Pancreas Spleen and Splenic artery Left kidney and renal gland



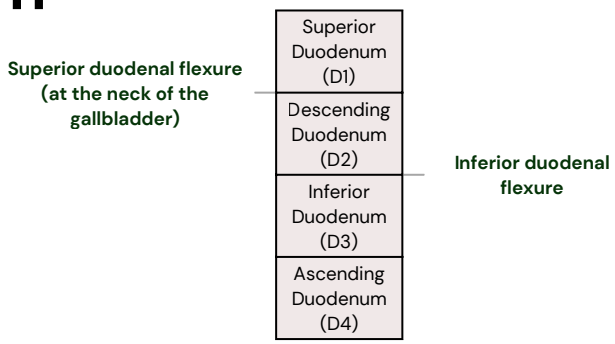


UPPER GI ANATOMY

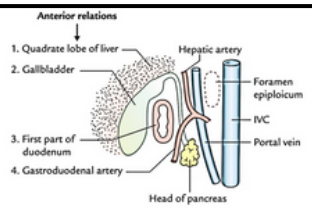
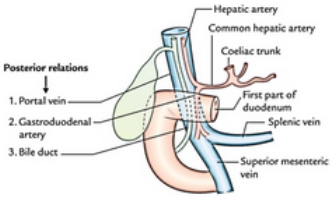
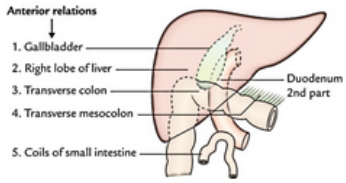
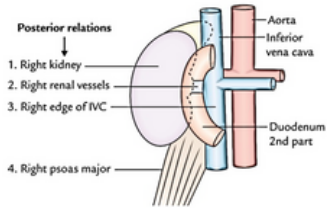
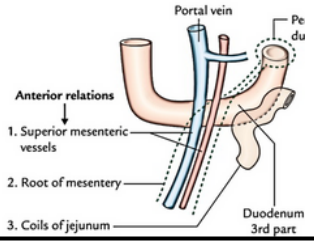
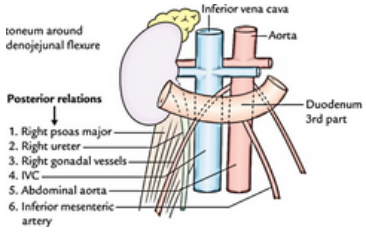
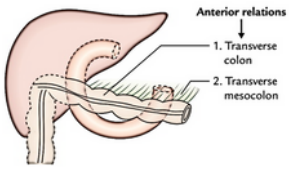
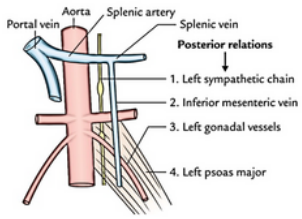
Objectives:
Anatomy of the duodenum: course, relations, and neurovascular supply

Anatomy of the Duodenum

- The duodenum is divided to 4 parts
- The foregut ends proximal to **the ampulla of vater**. The midgut starts mid-D2.



Relations

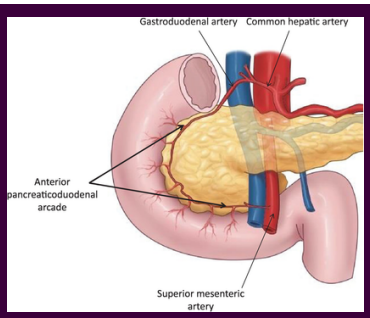
	Anteriorly	Posteriorly	
D1			**Anteriorly**: the liver & GB **Posteriorly**: Bile duct, gastroduodenal artery, portal vein, IVC
D2			**Anteriorly**: the liver & GB **Posteriorly**: R. Kidney, R. ureter
D3			**Anteriorly**: SMA & SMV **Posteriorly**: IVC, Aorta, vertebral column
D4			**Anteriorly**: Transverse colon **Posteriorly**: Aorta

Openings in D2

- Accessory pancreatic duct
  → Minor duodenal papilla
- Bile duct + main pancreatic duct
  → Major duodenal papilla (of Vater)

Blood Supply

Celiac Trunk	• Gastroduodenal artery • 2 Superior pancreatico-duodenal arteries (anterior & posterior)
SMA	• 2 Inferior pancreatico-duodenal arteries (anterior & posterior)



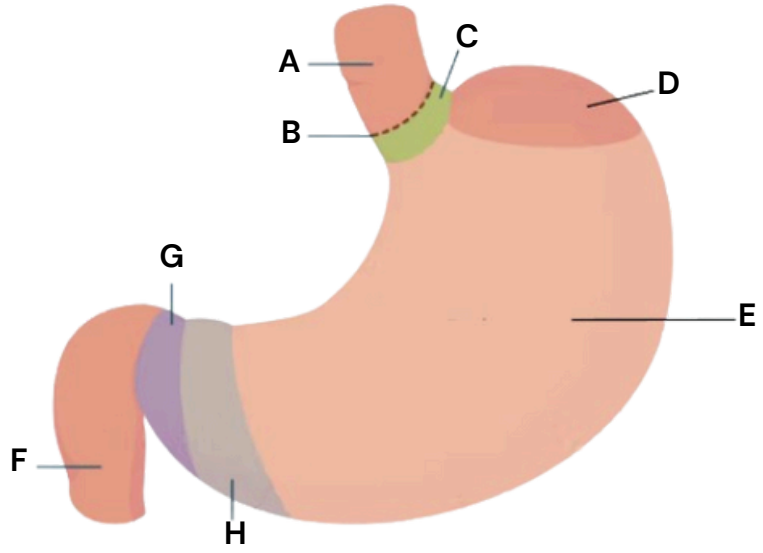
The venous drainage highly varies across people, but follows the same naming as that of the arterial supply.

UPPER GI ANATOMY

Test yourself

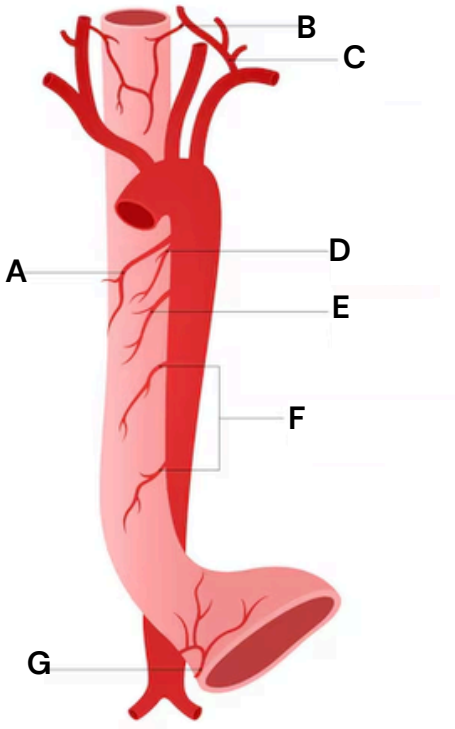
1) Label the parts of the stomach

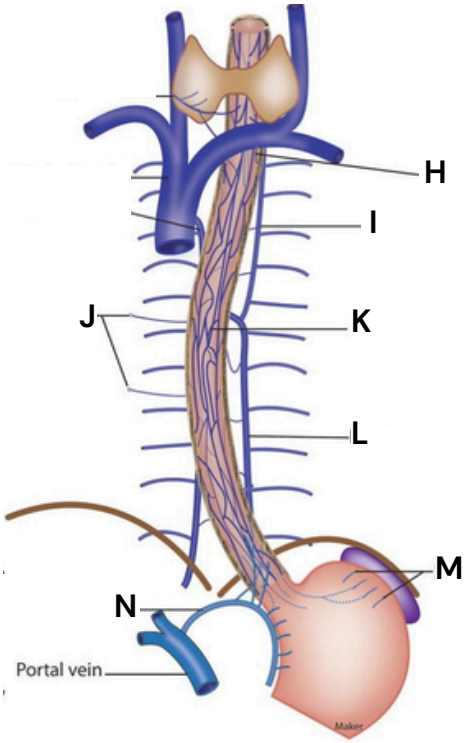
A)
B)
C)
D)
E)
F)
G)
H)



2) Label the arterial supply and venous drainage of the oesophagus:

A)
B)
C)
D)
E)
F)
G)
H)
I)
J)
K)
L)
M)
N)





UPPER GI ANATOMY

Test yourself

MCQ 1
A patient presents with a major upper GI bleed. He was taken to theatres and found to have a posterior duodenal ulcer that has eroded into a major artery. Which artery is most commonly affected?

A. Right gastric artery
B. Left gastric artery
C. Gastroduodenal artery
D. Right gastroepiploic artery
E. Superior mesenteric artery

MCQ 2
A patient with progressive dysphagia and "bird-beak" narrowing of the distal third of the oesophagus on barium swallow. What type of muscle primarily constitutes the esophagus at its lower third?

A. Skeletal muscle
B. Smooth muscle
C. Cardiac muscle
D. Mixed skeletal and smooth muscle
E. No muscle layer

MCQ 3
During a transhiatal esophagectomy, the surgeon encounters a nerve that runs along the anterior surface of the esophagus and must preserve it to avoid postoperative delayed gastric emptying. Which nerve is this?

A. Right recurrent laryngeal nerve
B. Left recurrent laryngeal nerve
C. Left vagus nerve
D. Right vagus nerve
E. Greater splanchnic nerve

MCQ 4
A patient has a carcinoma in the distal oesophagus. To which lymph nodes will the tumour most commonly spread FIRST?

A. Paratracheal nodes
B. Deep cervical nodes
C. Celiac nodes
D. Left gastric nodes
E. Posterior mediastinal nodes

MCQ 5
A patient was admitted with symptoms of bowel obstruction. Scans revealed that the obstruction was caused by compression of the bowel between the SMA and the aorta. The compressed bowel is most likely the:

A. Duodenum
B. Ileum
C. Ascending colon
D. Descending colon
E. Transverse colon

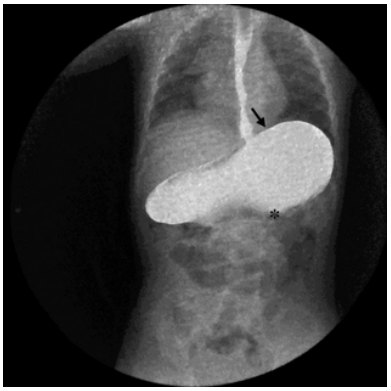
MCQ 6
A surgeon is mobilizing the small intestine during surgery and needs to identify the duodenojejunal junction. Which ligament attaches here and helps suspend this part of the bowel?

A. Hepatoduodenal ligament
B. Ligament of Treitz
C. Gastrosplenic ligament
D. Falciform ligament
E. Phrenicocolic ligament

UPPER GI ANATOMY

Test yourself

OSCE Station - Case Based Discussion



A 72-year-old woman presents with sudden-onset severe upper abdominal pain and repeated non-productive retching. She appears distressed and unable to vomit despite persistent retching. She has a known large para-oesophageal (type II) hiatus hernia.

On Examination

- *HR 118 bpm, BP 94/60 mmHg, RR 28/min, SpO_2 95%*
- *Abdomen: epigastric tenderness with minimal rigidity and no guarding.*
- *Bowel sounds reduced*
- *NG tube insertion attempted but unsuccessful*

Investigations

- *Chest X-ray: massively distended stomach in the thorax with a double air–fluid level on erect chest x-ray. A retrocardiac air-fluid level above the diaphragm on lateral chest film.*
- *An upper GI contrast study shows a paucity of distal bowel gas and a reversal of the greater gastric curvature.*

Q1. What would be the initial management of this patient?

Q2. What are your top differential diagnoses?

Q3. Which investigations will help confirm a diagnosis?

Q4. What is the underlying anatomical problem?

Q5. What triad of clinical presentations will help the clinician reach a diagnosis?

Q6. What is the definitive management?

Answers

Labelling:
Diagram 1:
A) Esophagus B) Gastrooesophageal junction C) Cardia D) Fundus E) Body F) Duodenum G) Pylorus H) Antrum
Diagram 2:
A) Right bronchial artery B) Esophageal branch C) Inferior thyroid artery D) Superior left bronchial artery E) Inferior left bronchial artery F) Esophageal branches from aorta G) Left gastric artery H) Esophageal veins I) Accessory hemiazygous J) Bronchial veins K) Submucosal venous plexus L) Hemiazygous M) Short gastric veins N) Left gastric vein

MCQs:
1) C, **2)** B, **3)** C, **4)** D, **5)** A, **6)** B.

OSCE CBD:
Q1) A–E resuscitation: IV fluids, analgesia, anti-emetics, broad-spectrum IV antibiotics (risk of perforation), attempt NG decompression (often unsuccessful), keep NPO, urgent surgical review
Q2) Top differential: gastric volvulus. Others: small bowel obstruction, strangulated para-oesophageal hernia, perforated peptic ulcer
Q3) CT Scan of chest and abdomen is gold standard
Q4) Loss of normal stomach fixation due to lax or disrupted ligaments. Often occurs in para-oesophageal hernia. Two types: organoaxial and mesenteroaxial.
Q5) Borchardt's Triad: Severe epigastric/chest pain, retching without vomiting, inability to pass a nasogastric tube
Q6) Surgery: gastropexy +/- gastrectomy if necrotic +/- hiatal hernia repair