Anatomy of the GI Tract

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Year 3 Medical Students

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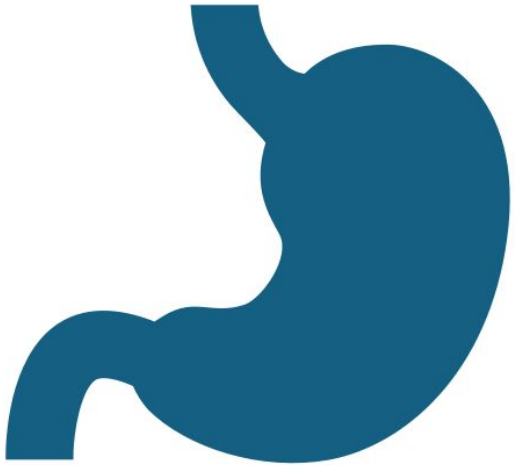
Anatomical Layers



Anterolateral abdominal wall consists of 4 main layers- superficial to deep

- Skin
- Superficial fascia
- Muscles
- Associated fascia
- Parietal peritoneum

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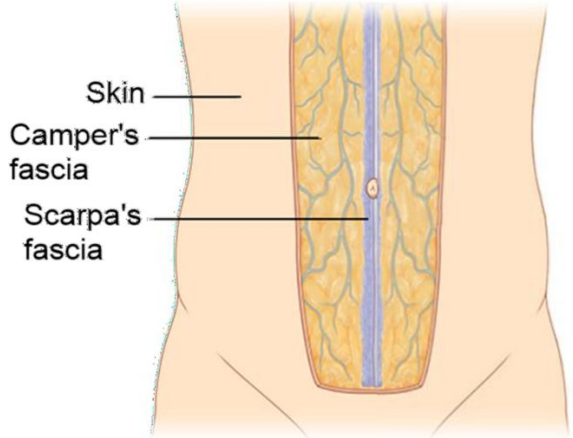
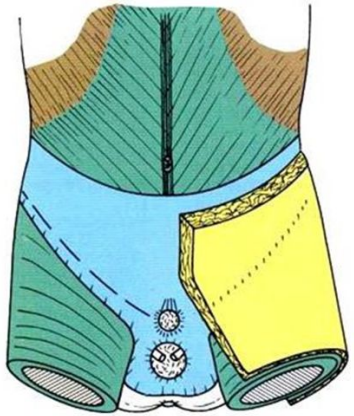
Superficial Fascia





Superficial Fascia

Below the umbilicus, there are 2 layers of superficial fascia

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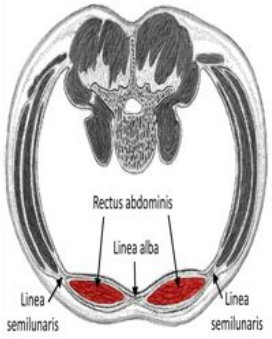
Muscles

Rectus Abdominis

- A multi-bellied muscle with tendinous intersections
- Flexor of trunk and depressor of ribcage
- VERTICAL muscle



Key facts about the rectus abdominis muscle	Table quiz
Origin	Pubic symphysis, pubic crest
Insertion	Xiphoid process, costal cartilages of ribs 5-7
Innervation	Intercostal nerves (T7-T11), subcostal nerve (T12)
Blood supply	Inferior epigastric and superior epigastric arteries; contributions from posterior intercostal, subcostal and deep circumflex arteries
Function	Trunk flexion, compresses abdominal viscera, expiration

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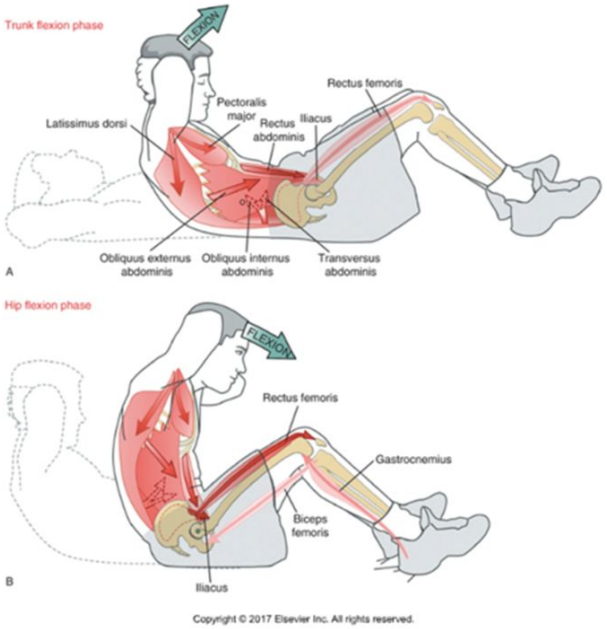
Rectus Abdominis



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SBA 1

The rectus abdominis muscle originates from the cartilage that forms the mid-line at the front of the pelvic bone. What is this body part called?

a) Pubic symphysis

b) Pubic crest

c) Xiphoid process

d) Costal cartilage

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b) Pubic crest BUT ALSO THIS

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a) Pubic symphysis

b) Pubic crest BUT ALSO THIS

c) Xiphoid process

d) Costal cartilage RIB 5-7

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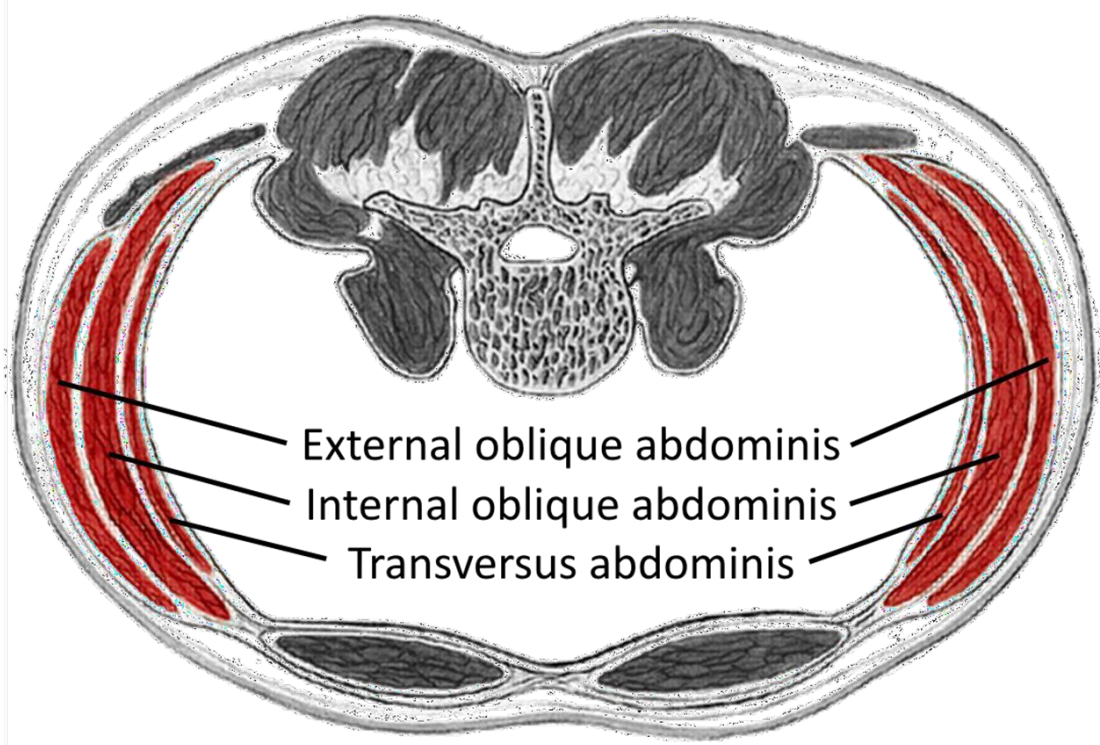
Lateral Abdominal Wall Muscles

Three flat muscles, situated laterally on either side of the abdomen.



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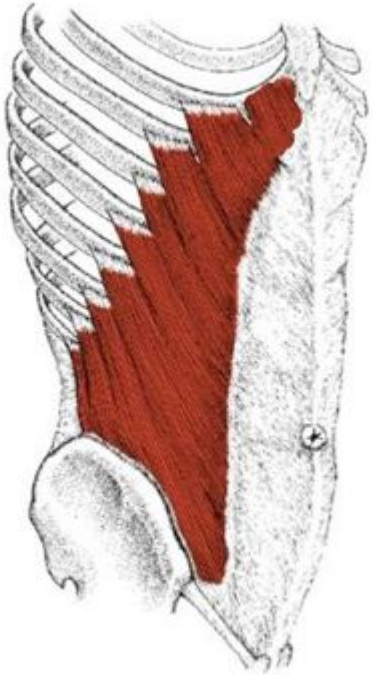
External Oblique Abdominis



- largest and most superficial flat muscle in the abdominal wall.
- Its fibers run inferomedially (forwards and downwards, hands down towards pockets

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External Oblique Abdominis

Key facts about the external abdominal oblique muscle	Table quiz
Origin	External surfaces of ribs 5-12
Insertion	Linea alba, pubic tubercle, anterior half of iliac crest
Action	Bilateral contraction - Trunk flexion, compresses abdominal viscera, expiration Unilateral contraction - Trunk lateral flexion (ipsilateral), trunk rotation (contralateral)
Innervation	Motor: Intercostal nerves (T7- T11), Subcostal nerve (T12) Sensory: Iliohypogastric nerve (L1)
Blood supply	Lower posterior intercostal arteries, subcostal artery, deep circumflex iliac artery

Each muscle will cause trunk to rotate to opposite side whilst flexing the trunk
Eg, R external oblique pulls R side of chest downwards towards L hip

When both external obliques contract together, they cause flexion of the trunk

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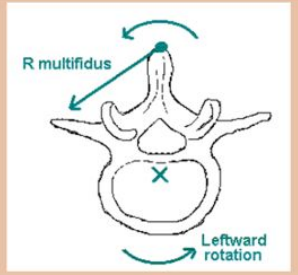
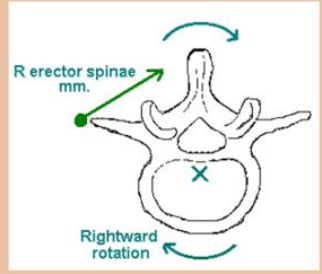
Therefore, this group causes contralateral rotation*.	Therefore, this group causes ipsilateral rotation * of the trunk.
	

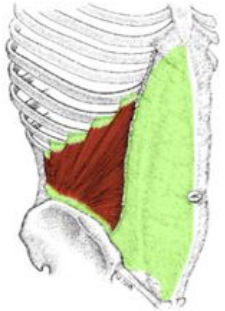
Ipsilateral Vs Contralateral

The terms "ipsilateral and contralateral trunk rotation" refer almost exclusively to muscles' effects on trunk rotation.

- **muscles are ipsilateral rotators if the muscles on the right rotate the trunk to the right.**
- **muscles are contralateral rotators if the muscles on the right rotate the trunk to the left.**

Internal Oblique Abdominis

- Fibres run backwards and downwards
- Internal obliques are ipsilateral rotators of trunk when pelvis is anchored
- When both internal and external obliques contract together= power flexion of trunk



Key facts about the internal abdominal oblique — Table quiz

Origin	Anterior two-thirds of iliac crest, iliopectineal arch, thoracolumbar fascia
Insertion	Inferior borders of ribs 10-12, linea alba, pubic crest & pectin pubis (via conjoint tendon)
Action	Bilateral contraction - Trunk flexion, compresses abdominal viscera, expiration Unilateral contraction - Trunk lateral flexion (ipsilateral), trunk rotation (ipsilateral)
Innervation	Intercostal nerves (T7-T11), subcostal nerve (T12), iliohypogastric nerve (L1), ilioinguinal nerve (L1)
Blood supply	Lower posterior intercostal and subcostal arteries, superior and inferior epigastric arteries, superficial and deep circumflex arteries,posterior lumbar arteries

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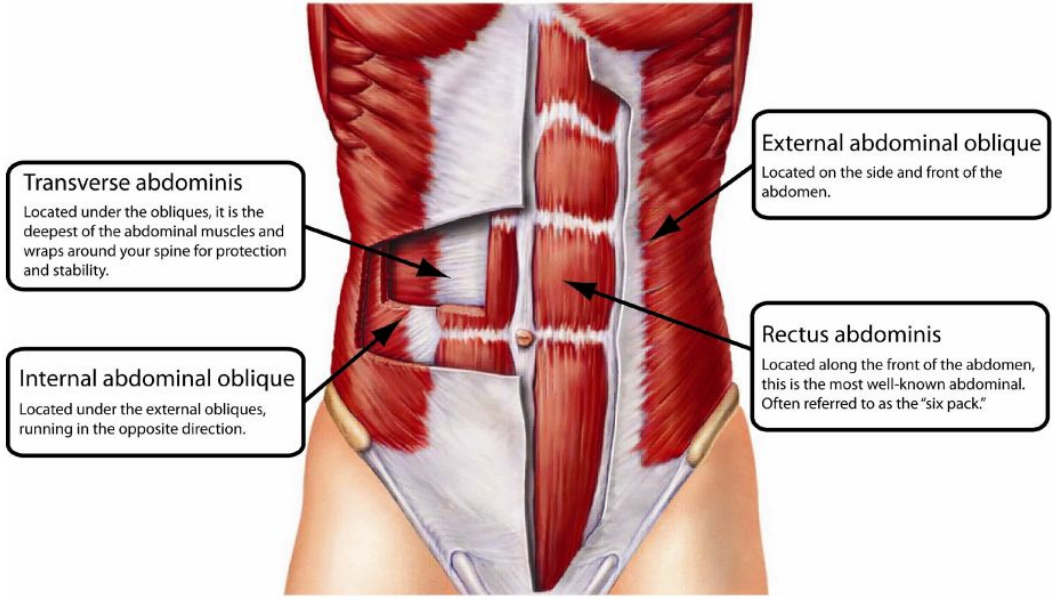
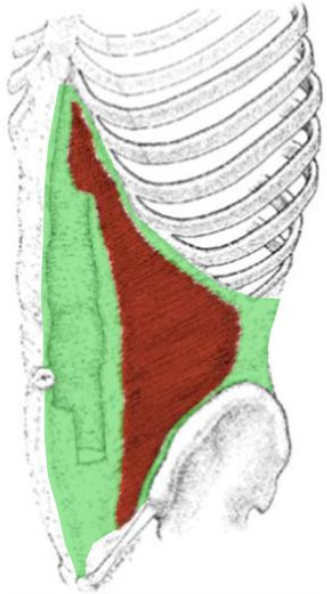
Transversus Abdominis





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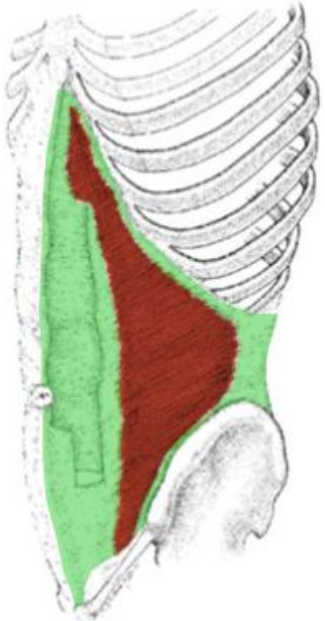
Transversus Abdominis



Key facts about the transversus abdominis muscle	Table quiz
Origin	Internal surfaces of costal cartilages of ribs 7-12, thoracolumbar fascia, anterior two thirds of iliac crest, iliopectineal arch
Insertion	Linea alba, aponeurosis of internal abdominal oblique muscle; pubic crest, pectinal line of pubis
Action	Bilateral contraction - Compresses abdominal viscera, expiration Unilateral contraction - Trunk rotation (ipsilateral)
Innervation	Intercostal nerves (T7-T11), subcostal nerve (T12), iliohypogastric nerve (L1), ilioinguinal nerve (L1)
Blood supply	Lower posterior intercostal and subcostal arteries, superior and inferior epigastric arteries, superficial and deep circumflex arteries,posterior lumbar arteries

Involved in

- Abdominal compression in forced expiration
- Stabilising of back.
- Aid defecation, micturition and parturition.

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SBA 2

Which two muscles, when contracted, cause ipsilateral rotation?

a) External Oblique Abdominis

b) Internal Oblique Abdominis

c) Transversus Abdominis

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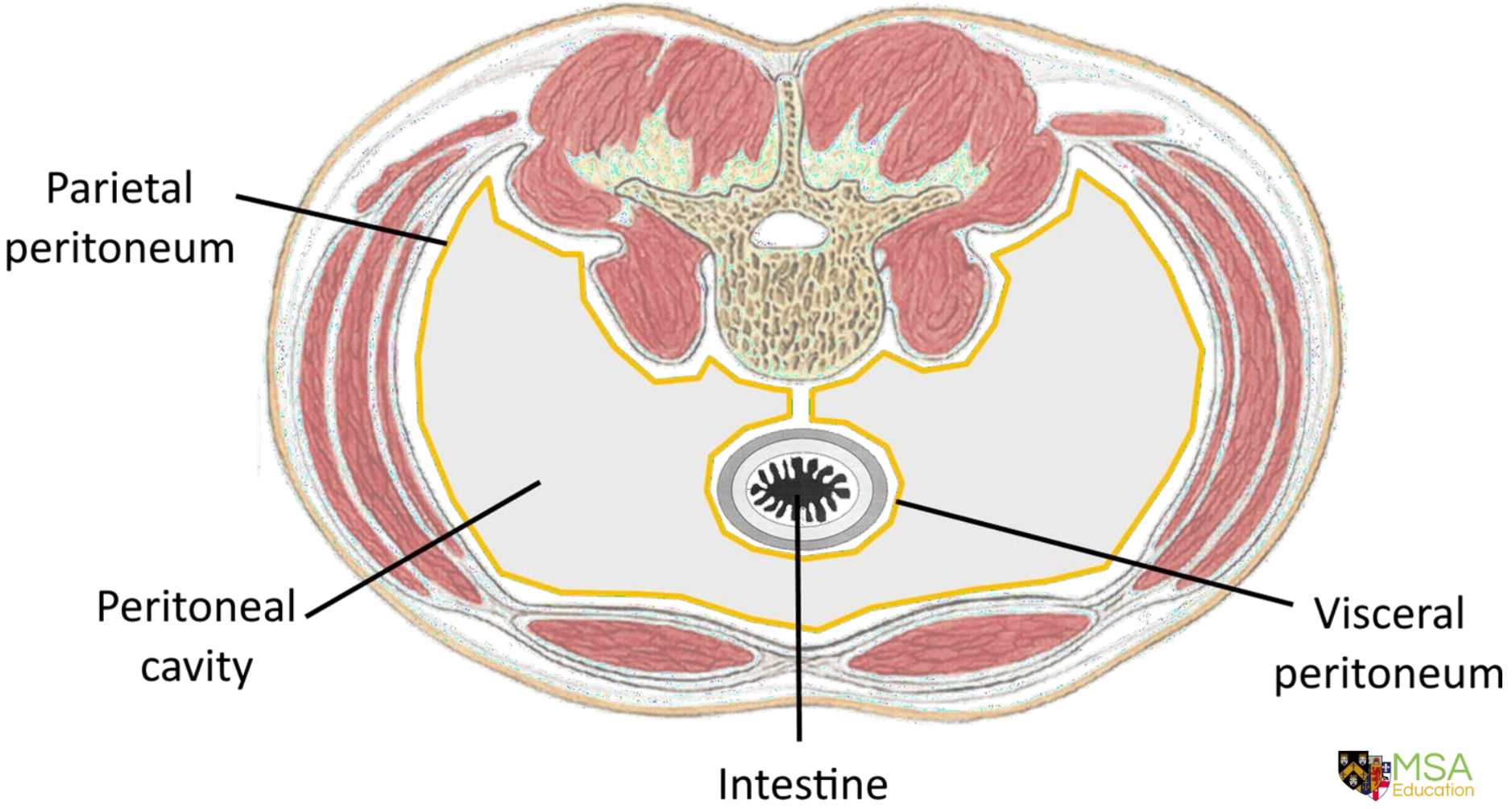
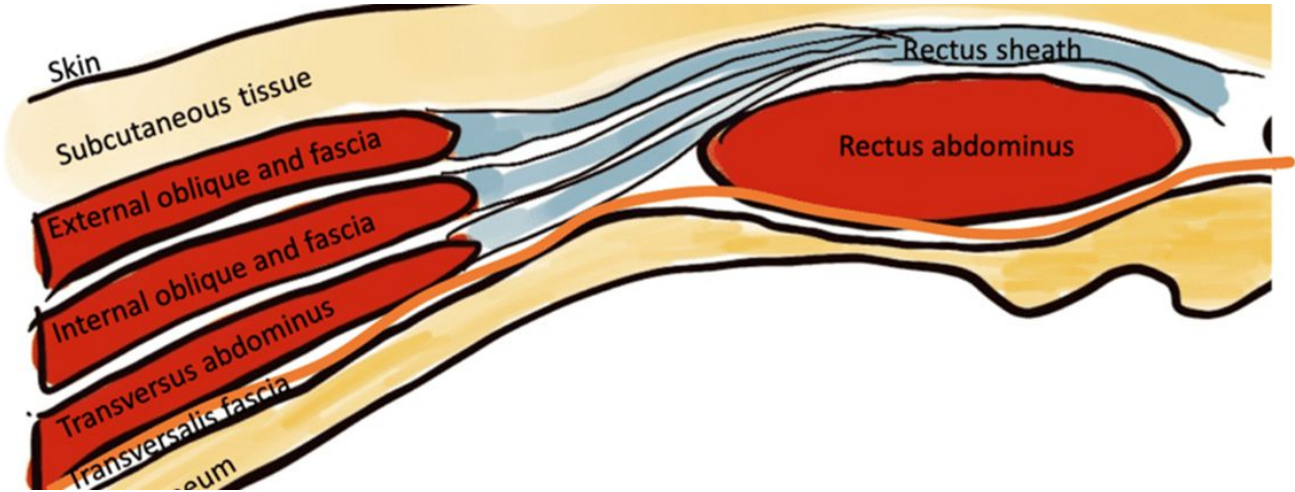

Parietal peritoneum
Peritoneal cavity
Intestine
Visceral peritoneum

Rectus Sheath

- Aponeurosis of 3 lateral muscles encloses Rectus Abdominis and join together in midline to form Linea Alba.

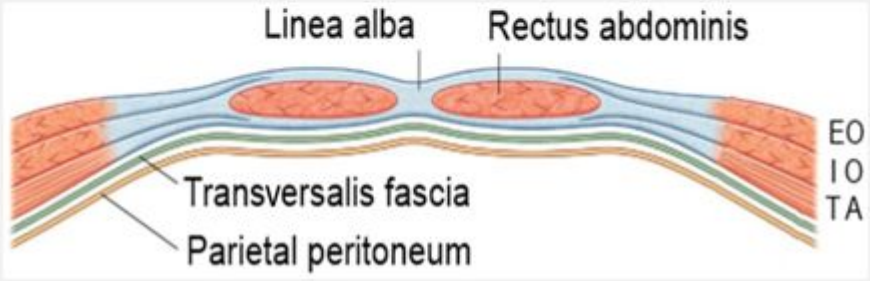
- *below arcuate line



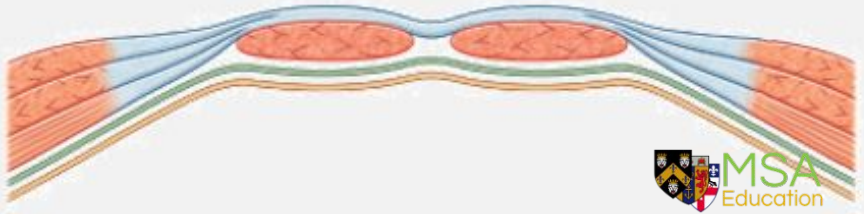
Rectus Sheath Sections

Above arcuate line,

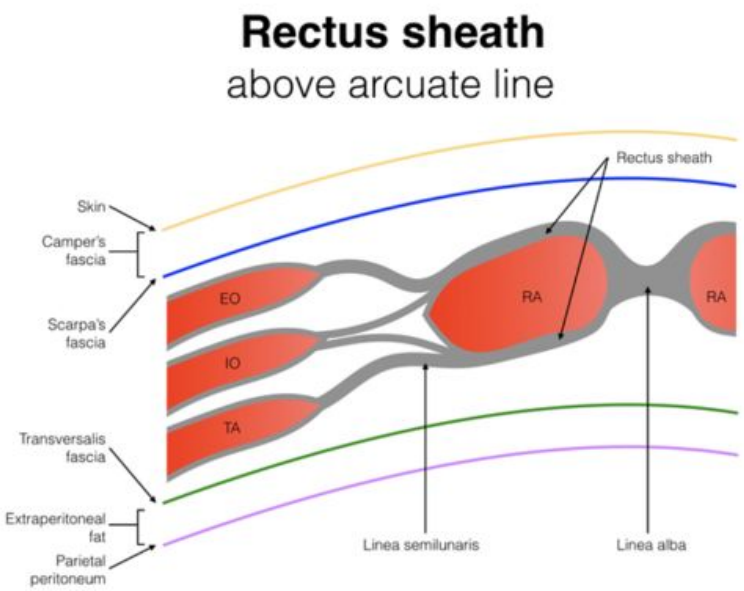
- **Anterior wall** – formed by the aponeuroses of the external oblique, and of half of the internal oblique.
- **Posterior wall** – formed by the aponeuroses of half the internal oblique and of the transversus abdominis.

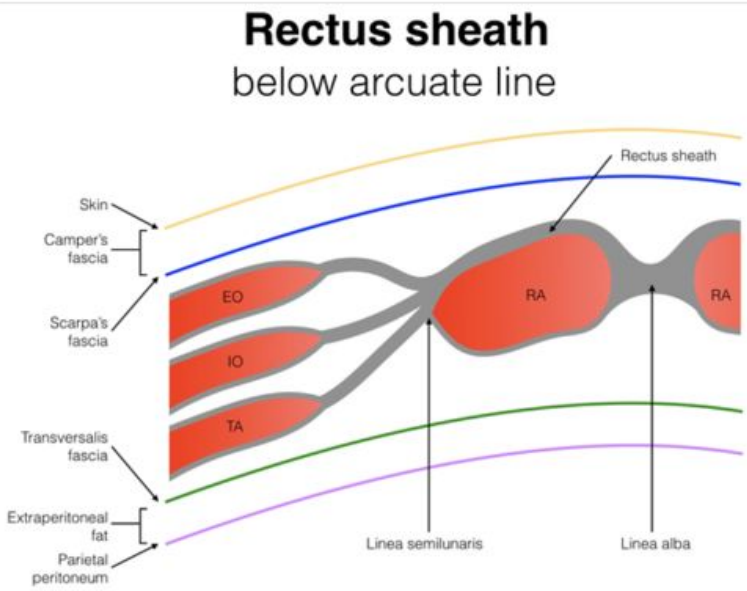


Below arcuate line
all the aponeuroses move to the anterior wall of the **rectus sheath**. At this point, there is no posterior wall to the sheath; the rectus abdominis is in direct contact with the **transversalis fascia**.



Rectus Sheath Sections



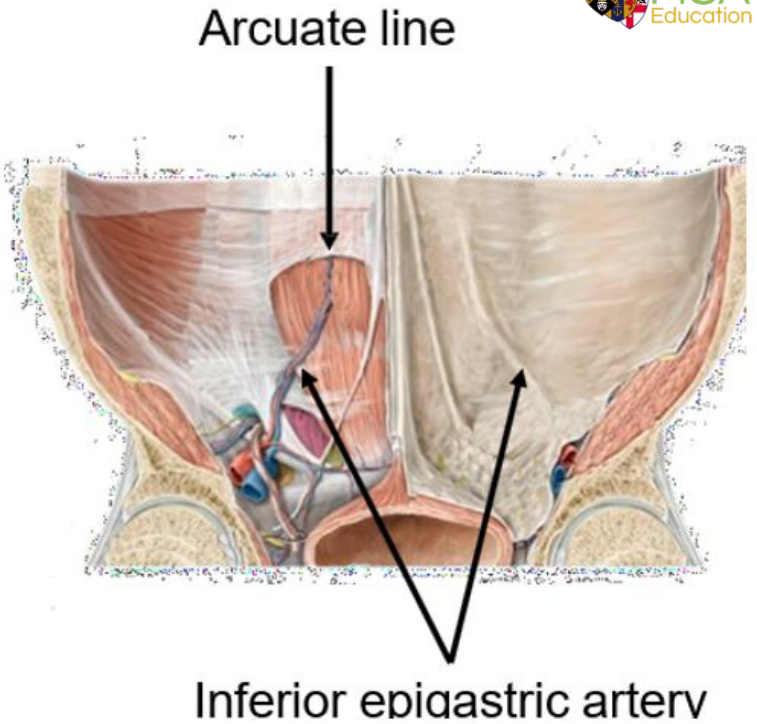


arcuate line = demarcation point where the posterior layer of the rectus sheath ends (midway between the umbilicus and the pubic symphysis)

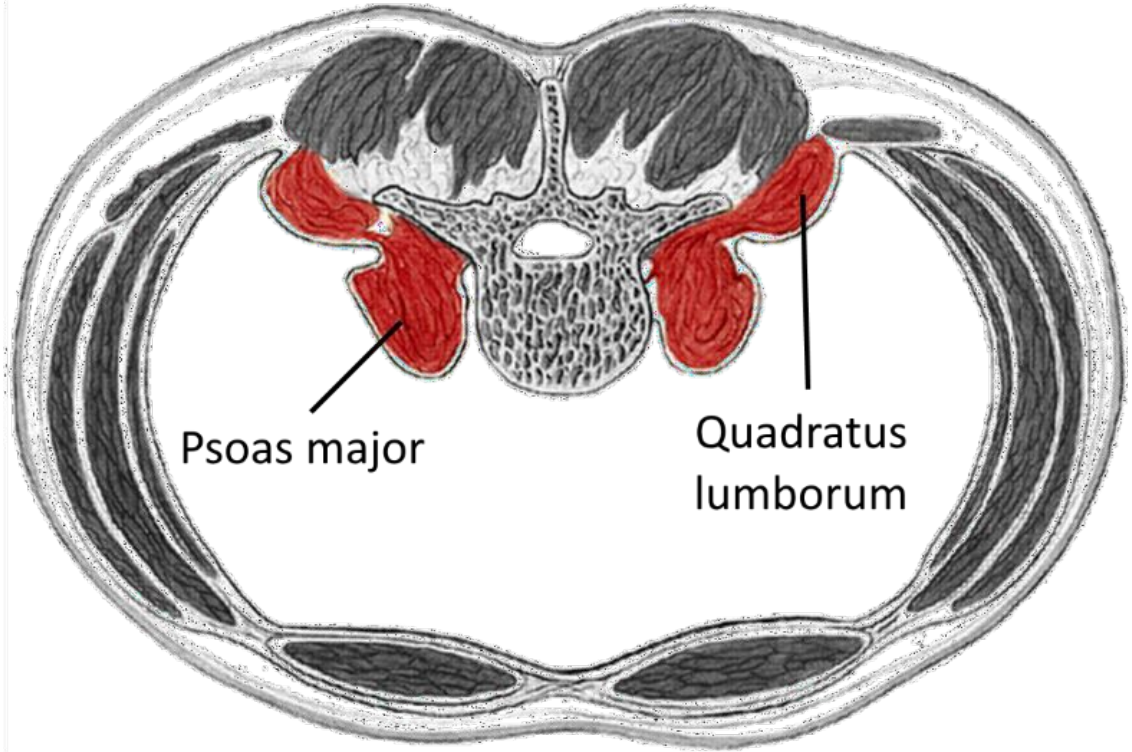
Arcuate Line

- Arcuate line allows blood vessels to gain access to rectus abdominis,

- The vessel only pierces thin transversalis fascia



Posterior Abdominal Wall Muscles



Quadratus Lumborum= most lateral of posterior abdominal wall muscles

- Origin: posterior 1/3 of iliac crest and lumbar transverse processes
- Insertion: 12th rib
- is important in depression of that rib during breathing. This maximizes contraction of diaphragm

Psoas Major= more medial
Origin: lumbar transverse processes and lumbar vertebral bodies of T12 –L5.
Insertion: lesser trochanter of femur
This flexes thigh on trunk

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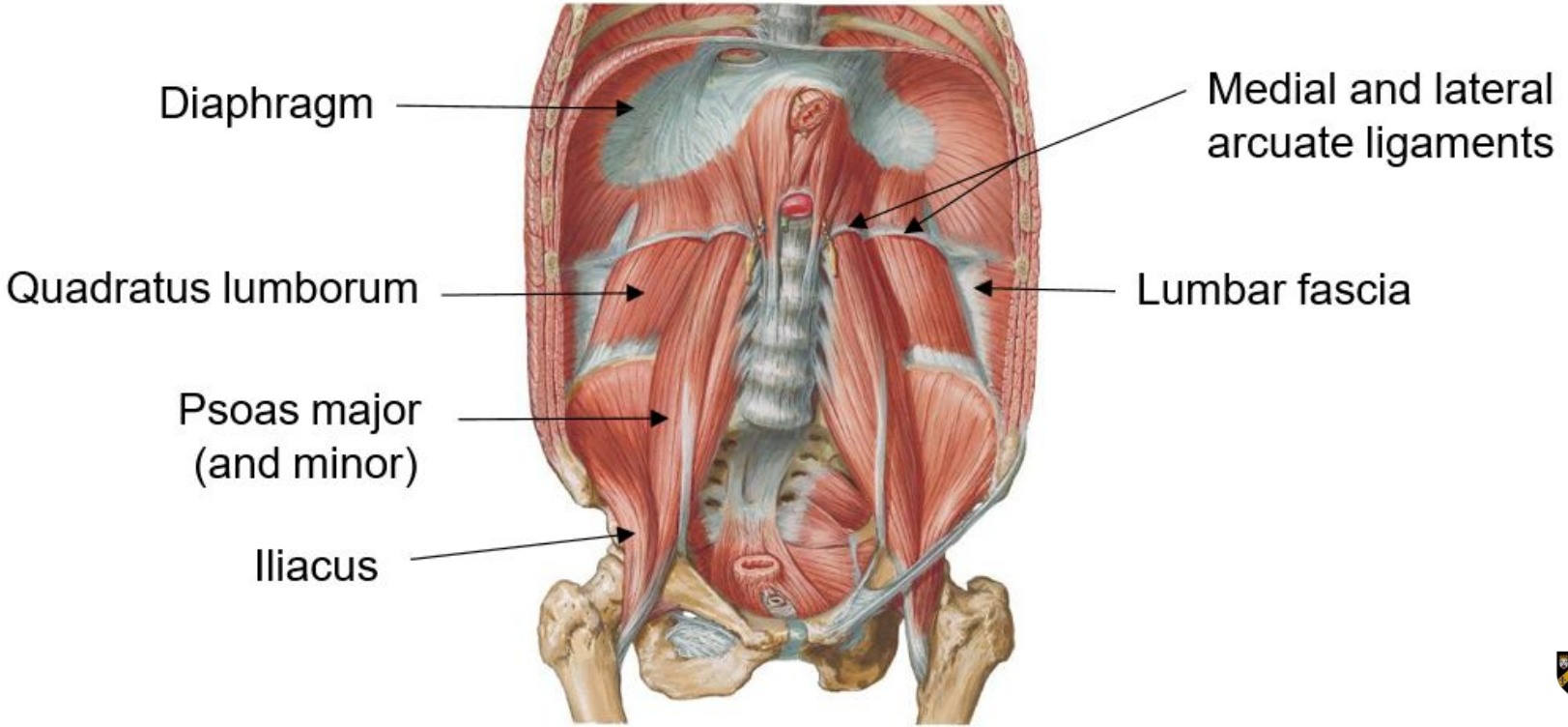
Posterior Abdominal Wall Muscles



SBA 3

The superior and inferior epigastric arteries lie directly beneath which structure?

a) External Oblique Abdominis

b) Internal Oblique Abdominis

c) Rectus Abdominis

d) Transversus Abdominis

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The superior and inferior epigastric arteries lie directly beneath which structure?

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SBA 4

A 17 year-old, male with a past medical history of hypertension presents to your emergency clinic with severe abdominal pain. Past medical history reveals blunt trauma to the abdomen after engaging in a school fight that afternoon. Physical examination reveals a progressive contusion that you begin to worry about. You quickly call a surgical consult and obtain radiological imaging of the patient's abdomen, which confirms your suspicion. The MOST likely cause of this patient's bleed is damage to the:

a) Short Gastric Artery

b) Splenic Artery

c) Left Gastric Artery

d) Inferior Epigastric Artery

e) Gastroduodenal Artery

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SBA 5

A surgeon performs a surgery on the lateral aspect of a patient's abdominal wall. He comes upon a muscle in which the fibers are running "down and in." What is the muscle or fascia that is most likely immediately deep to this muscle?

a) Scarpa's Fascia

b) External Oblique

c) Internal Oblique

d) Transversalis Fascia

e) Transverse Abdominis

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MSA Education

SBA 6

If a surgeon is performing a left paramedian incision below the arcuate line, what will be the last layer he cuts through before reaching the transversalis fascia?

a) Rectus Abdominis

b) Fascia of the External Oblique

c) Fascia of the Internal Oblique

d) Fascia of Transversus Abdominis

e) External Oblique Muscle

f) Internal Oblique Muscle

g) Transversus Abdominis Muscle

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SBA 6

If a surgeon is performing a left paramedian incision below the arcuate line, what will be the last layer he cuts through before reaching the transversalis fascia?

a) Rectus Abdominis

b) Fascia of the External Oblique

c) Fascia of the Internal Oblique

d) Fascia of Transversus Abdominis

e) External Oblique Muscle

f) Internal Oblique Muscle

g) Transversus Abdominis Muscle

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Organs of the GI System

Oesophagus

- Fibromuscular tube
- Originates at the inferior border of the cricoid cartilage (C6)
- Descends downward into the **superior mediastinum** of the thorax
- Then enters the abdomen via the **oesophageal hiatus** at T10
- It terminates by joining the **cardiac orifice** of the stomach at level of T11.

•**Adventitia –** outer layer of connective tissue.

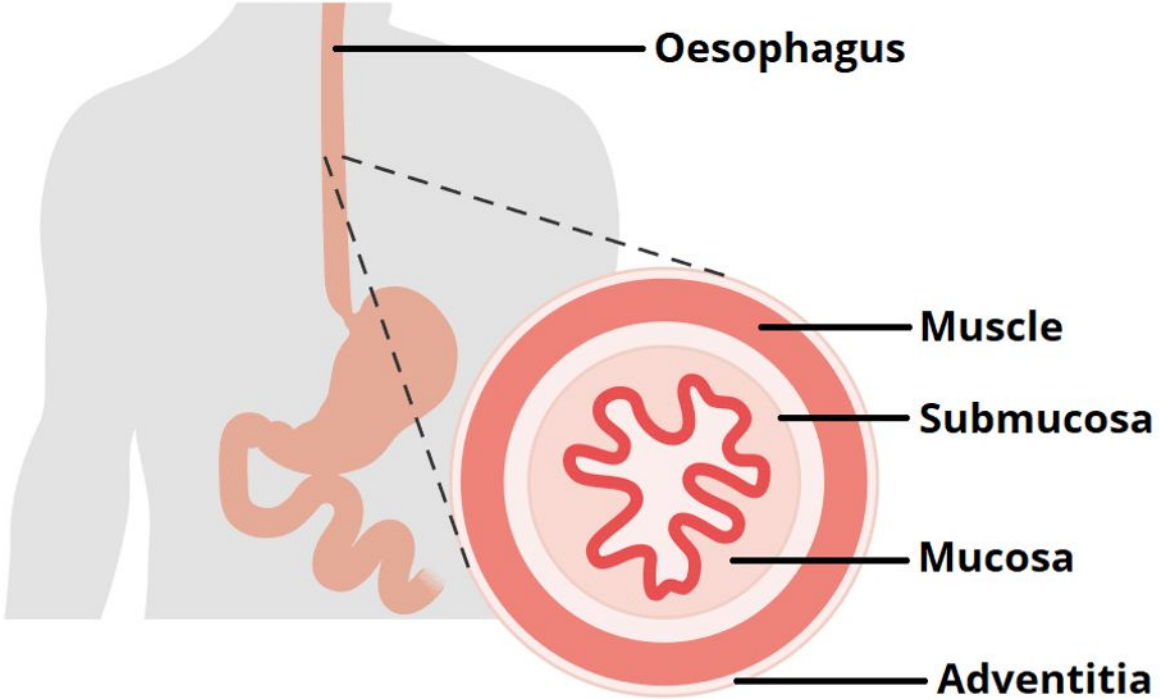
•**Muscle Layer –** external layer of longitudinal muscle and inner layer of circular muscle. The external layer is composed of different muscle types in each third:

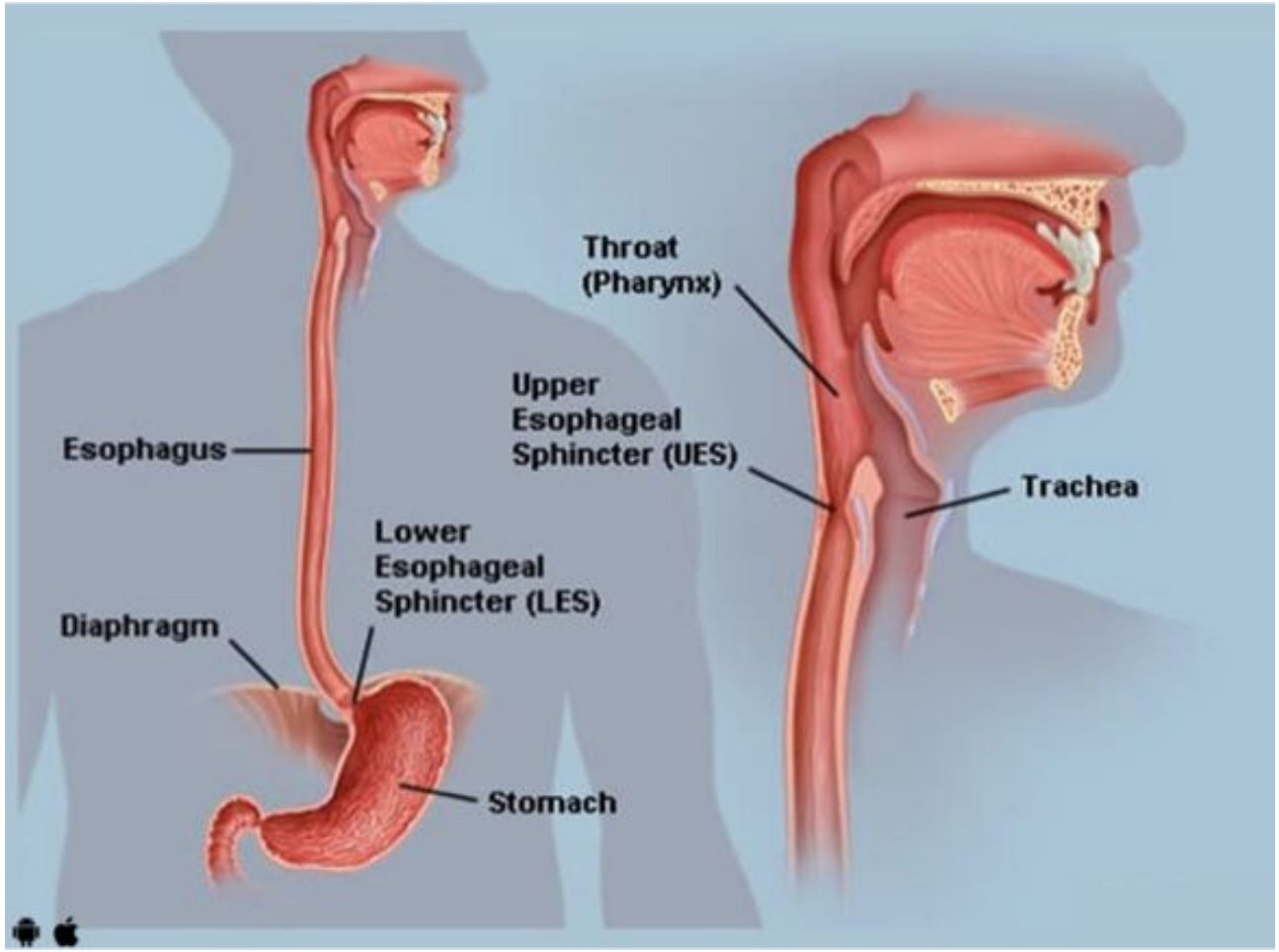
Superior third – voluntary striated muscle

Middle third – voluntary striated and smooth muscle

Inferior third – smooth muscle

•**Mucosa –** non-keratinised stratified squamous epithelium (contiguous with columnar epithelium of the stomach)




Throat
(Pharynx)
Upper
Esophageal
Sphincter (UES)
Trachea
Esophagus
Lower
Esophageal
Sphincter (LES)
Diaphragm
Stomach

Stomach

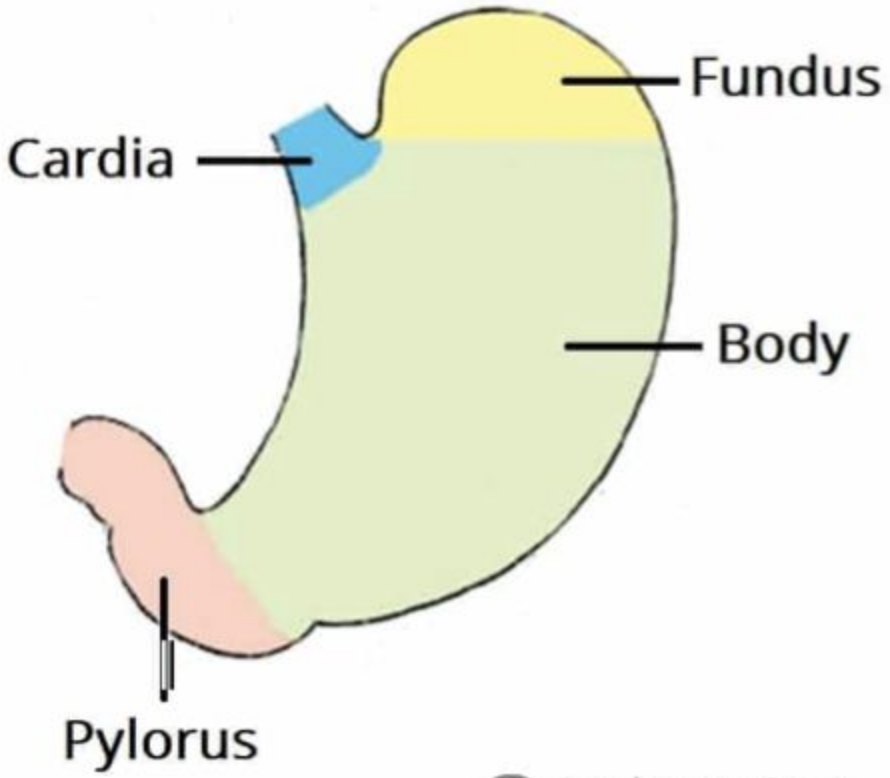
- Intraperitoneal organ
- Located between the oesophagus and the duodenum
- ‘J’ shape
- Lies in the epigastric and umbilical regions

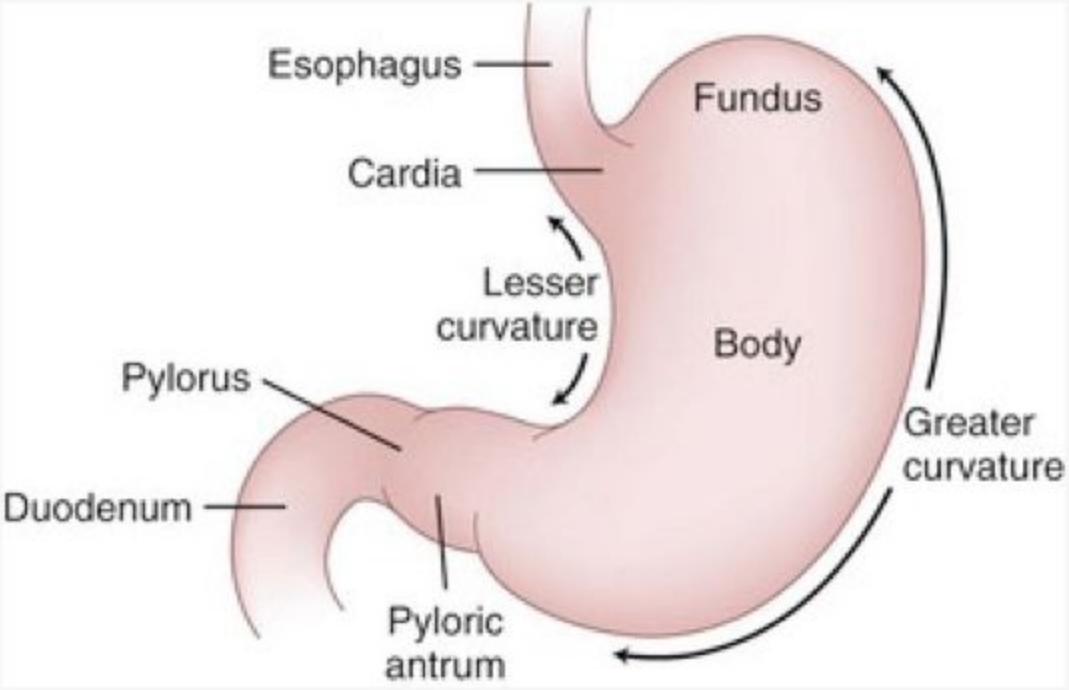
- **Cardia** – surrounds the superior opening of the stomach at the T11 level.
- **Fundus** – the rounded, often gas filled portion superior to and left of the cardia.
- **Body** – the large central portion.
- **Pylorus** – Connects the stomach to the duodenum. Divided into the:

Pyloric antrum

Pyloric canal

Pyloric sphincter - demarcates the transpyloric plane at the level of L1.





- **Greater omentum** – hangs down from the **greater curvature** of the stomach and folds back upon itself where it attaches to the transverse colon.

Contains many **lymph nodes** and may adhere to inflamed areas → key role in GI immunity and minimising the spread of intraperitoneal infections.

- **Lesser omentum**– continuous with peritoneal layers of the stomach and duodenum, this smaller peritoneal fold arises at the lesser **curvature** and ascend to attach to the **liver**.

Main function is to attach the stomach and duodenum to the liver.

SBA

A 45-year-old man develops an abdominal abscess following a complicated appendectomy. Which of the following structures functions to localize the resulting inflammatory process?

A. Lesser Omentum

A. Greater Omentum

A. Visceral Peritoneum

A. Parietal Peritoneum

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SBA

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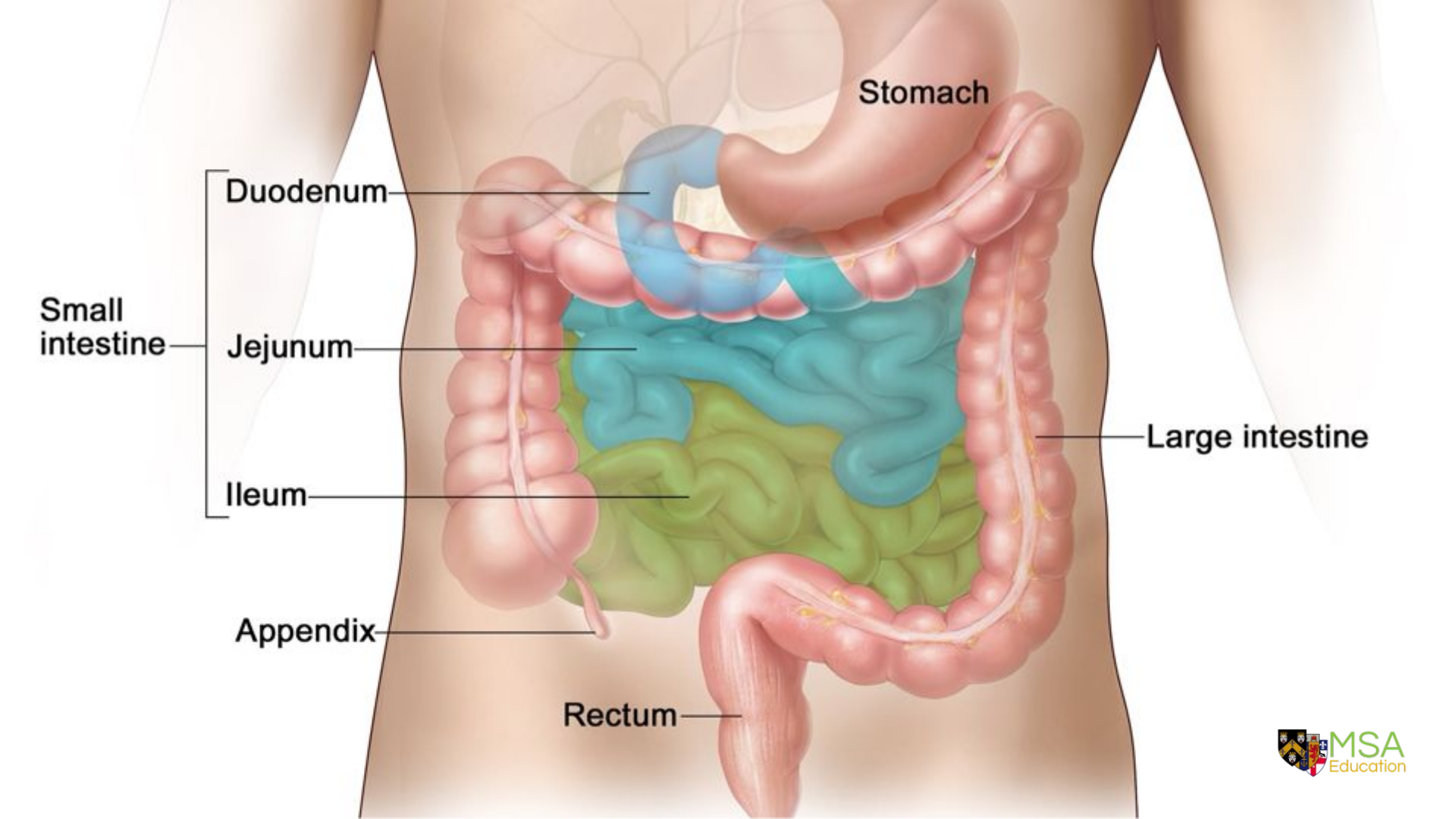
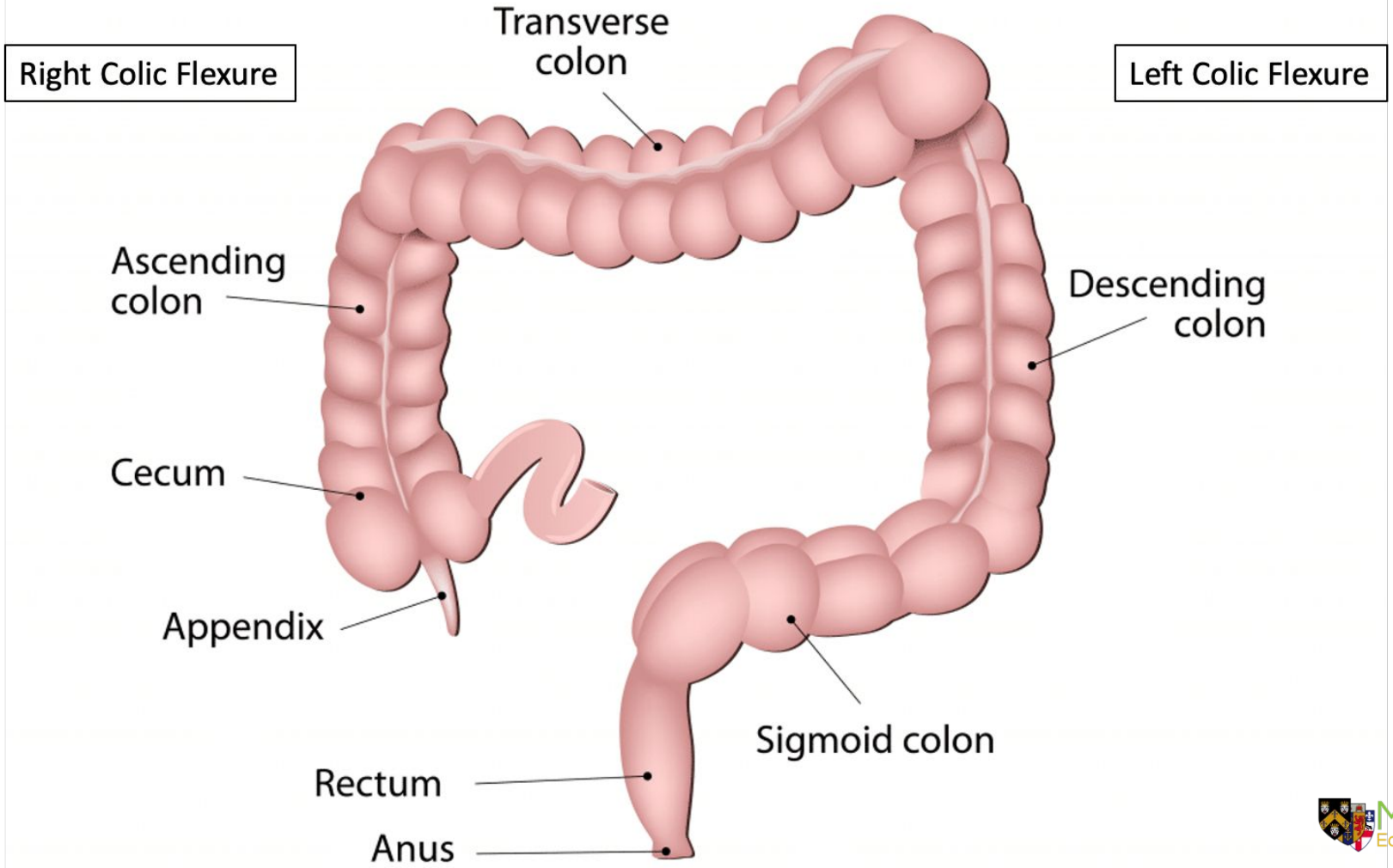
Small Intestines

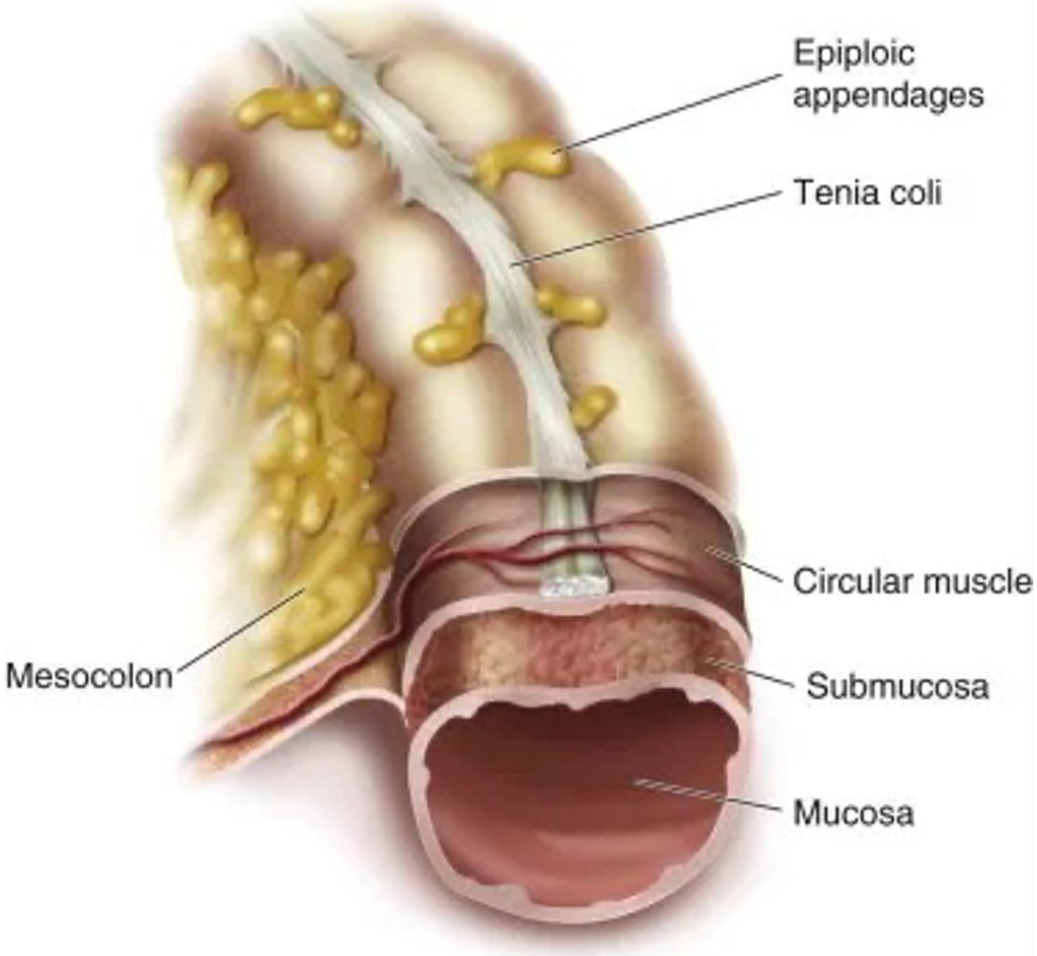
- 3 parts: Duodenum, Jejunum and Ileum
- Pylorus of the stomach à ileocaecal junction


Stomach
Duodenum
Small intestine
Jejunum
Ileum
Large intestine
Appendix
Rectum

Colon (Large Intestines)

- Distal part of the GI Tract
- Divided into **four parts** – ascending, transverse, descending and sigmoid


Right Colic Flexure
Transverse colon
Left Colic Flexure
Ascending colon
Descending colon
Cecum
Appendix
Sigmoid colon
Rectum
Anus



- **Omental Appendices:** small pouches of peritoneum, filled with fat
- **Teniae Coli:** Three strips of muscle running longitudinally along the surface of the large bowel
- **Haustras:** sacculations of the wall of the colon between the teniae

SBA

A surgical intern is performing a left hemicolectomy. How can she differentiate large bowel from small bowel?

A. Tenia coli are present on small bowel

A. Large bowel is located centrally in the abdominal cavity

A. Large bowel is marked by small pouches of peritoneum filled with fat

A. Small bowel has a much wider diameter

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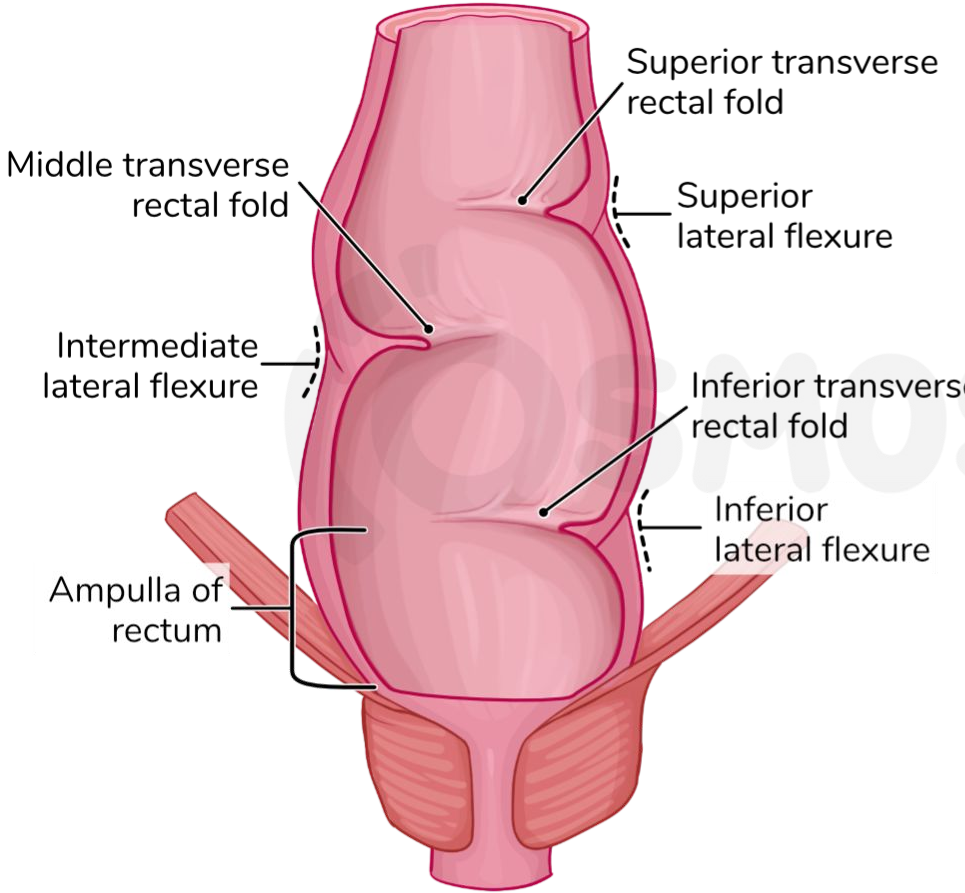
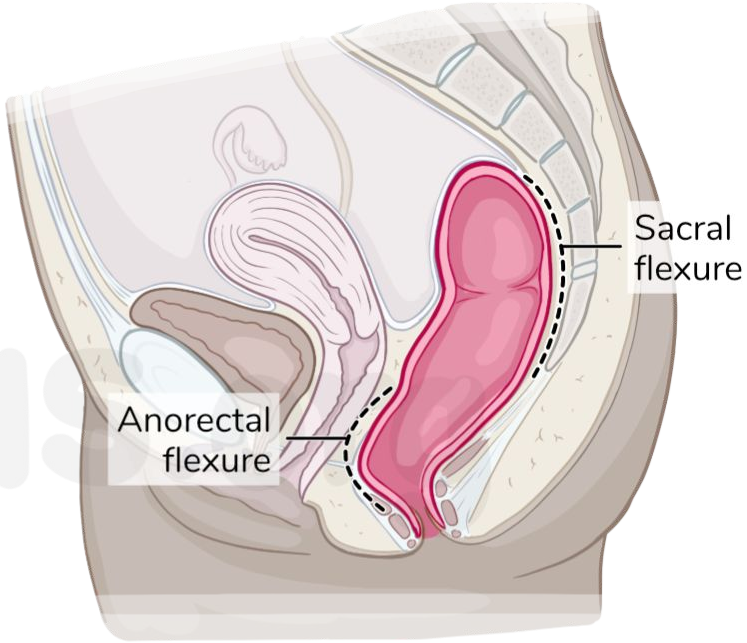
Rectum

- Most distal part of the large intestine
- It is continuous proximally with the sigmoid colon (beginning at the level of S3), and terminates into the anal canal
- Macroscopically distinct from the colon, with an absence of taenia coli, haustra, and omental appendices.

A.

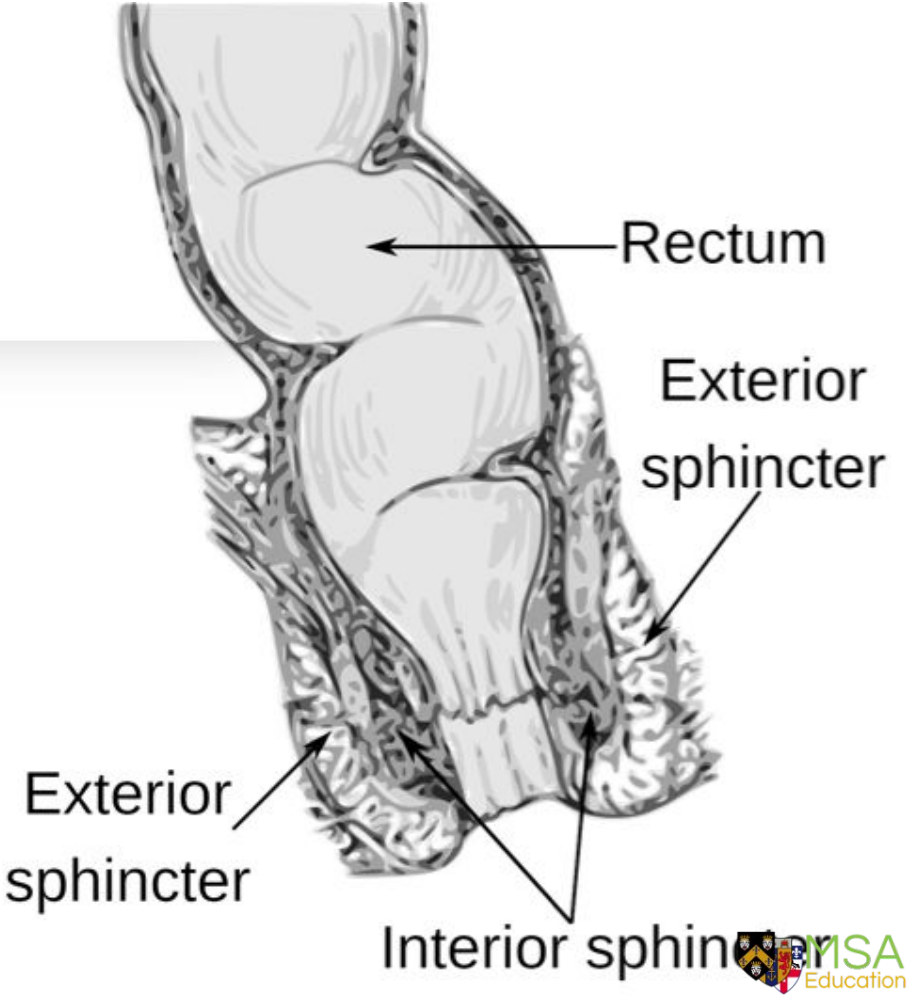

Superior transverse rectal fold
Middle transverse rectal fold
Superior lateral flexure
Intermediate lateral flexure
Inferior transverse rectal fold
Inferior lateral flexure
Ampulla of rectum

B.


Sacral flexure
Anorectal flexure

Anal Canal

- Except during defecation, the anal canal is collapsed by the internal and external anal sphincters to prevent the passage of faecal material.
- **Internal anal sphincter** – surrounds the upper 2/3 of the anal canal. Formed from a thickening of the involuntary circular smooth muscle in the bowel wall.
- **External anal sphincter** – voluntary muscle that surrounds the lower 2/3 of the anal canal. It blends superiorly with the puborectalis muscle of the pelvic floor.



SBA

Which of the following is most consistent with the double-layered fold of peritoneum which connects the lesser curvature of the stomach and 1st part of duodenum to the liver?

A. Is known as the greater omentum and contains the gastrocolic ligament

A. Is known as the greater omentum and contains the hepatoduodenal ligament

A. Is known as the lesser omentum and contains the gastrocolic ligament

A. Is known as the lesser omentum and contains the hepatoduodenal ligament

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SBA

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At which organ is the left colic flexure located at?

A. Liver

A. Pancreas

A. Spleen

A. Stomach

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SBA

At which organ is the left colic flexure located at?

A. Liver

A. Pancreas

A. Spleen

A. Stomach

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SBA

A 54-year-old man underwent endoscopy for suspected gastritis. The endoscopy reached the oesophageal-gastric junction and entered the stomach.

Which of the regions of the stomach is closest to this junction?

A. Fundus

A. Cardia

A. Pyloric Antrum

A. Pyloric Sphincter

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Neurovasculature of the GI tract

OESOPHAGUS – ARTERIAL AND VENOUS SUPPLY

Thoracic:

- Receives arterial supply from branches of the thoracic aorta and inferior thyroid artery.

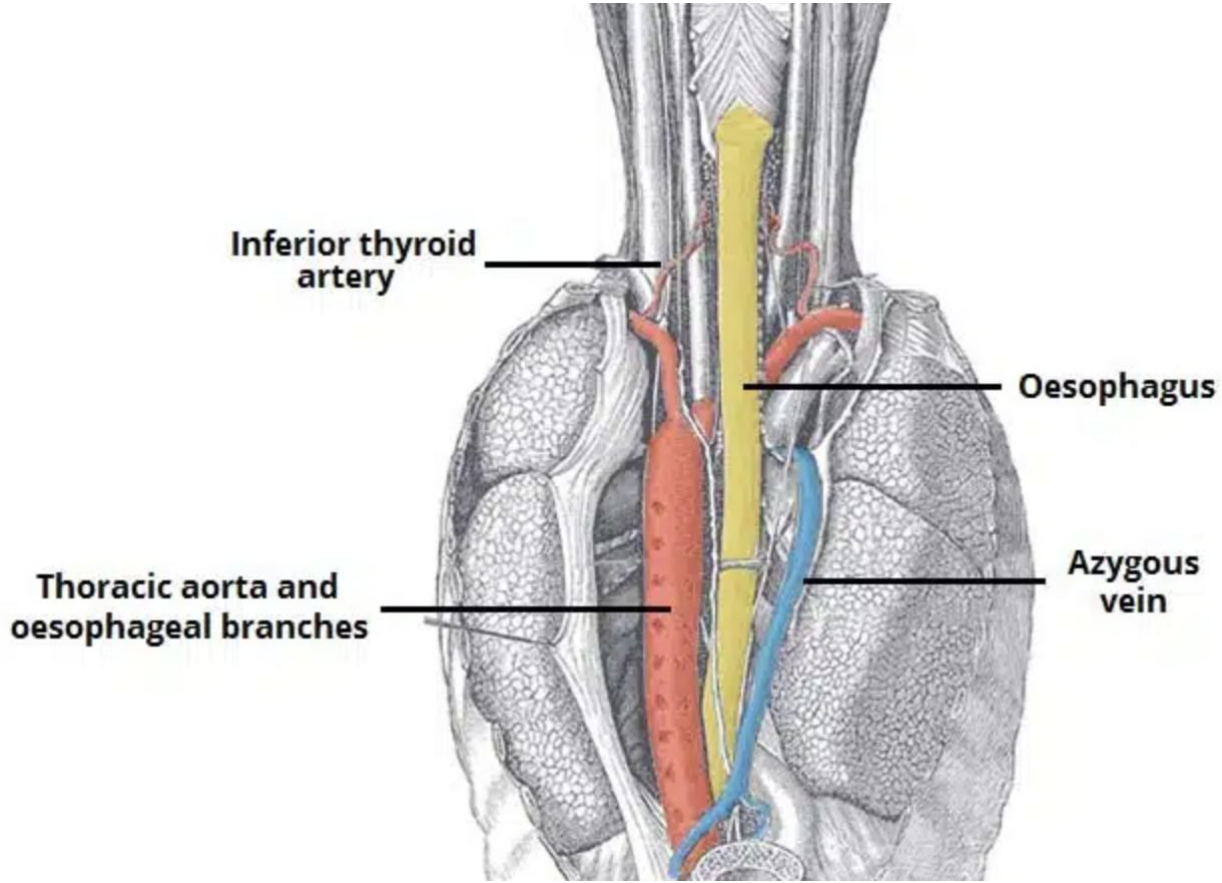
- Branches of the azygos veins and the inferior thyroid vein.

Abdominal

- Supplied by the left gastric artery and the left inferior phrenic artery.

- Portal circulation via left gastric vein

- Systemic circulation via azygos vein

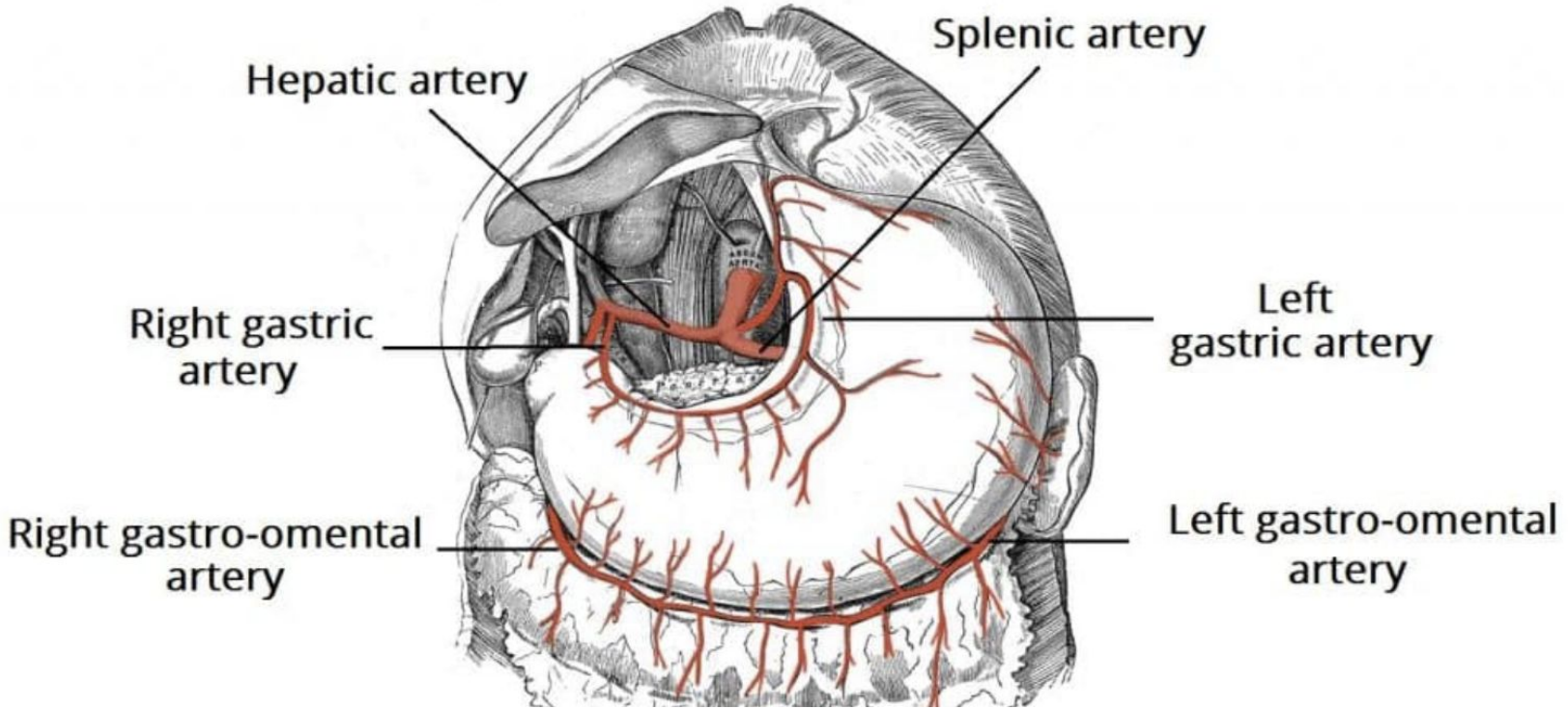

Inferior thyroid artery
Oesophagus
Azygous vein
Thoracic aorta and oesophageal branches

OESOPHAGUS INNERVATION

- Innervated by the oesophageal plexus:
- Combination of parasympathetic vagal trunks and sympathetic fibres from the cervical and thoracic sympathetic trunks.

THE STOMACH – ARTERIAL AND VENOUS SUPPLY

- Arterial supply – celiac trunk and branches.
- Right gastric – branch of the proper hepatic artery
- Left gastric – arises from the celiac trunk
- Right gastro-omental – terminal branch of the gastroduodenal artery
- Left gastro-omental – branch of the splenic artery
- Venous supply – parallel to arteries
- Right and Left gastric veins drain into the hepatic portal vein.
- Short gastric vein, left and right gastro-omental veins drain into the superior mesenteric vein.


Hepatic artery
Splenic artery
Right gastric artery
Left gastric artery
Right gastro-omental artery
Left gastro-omental artery

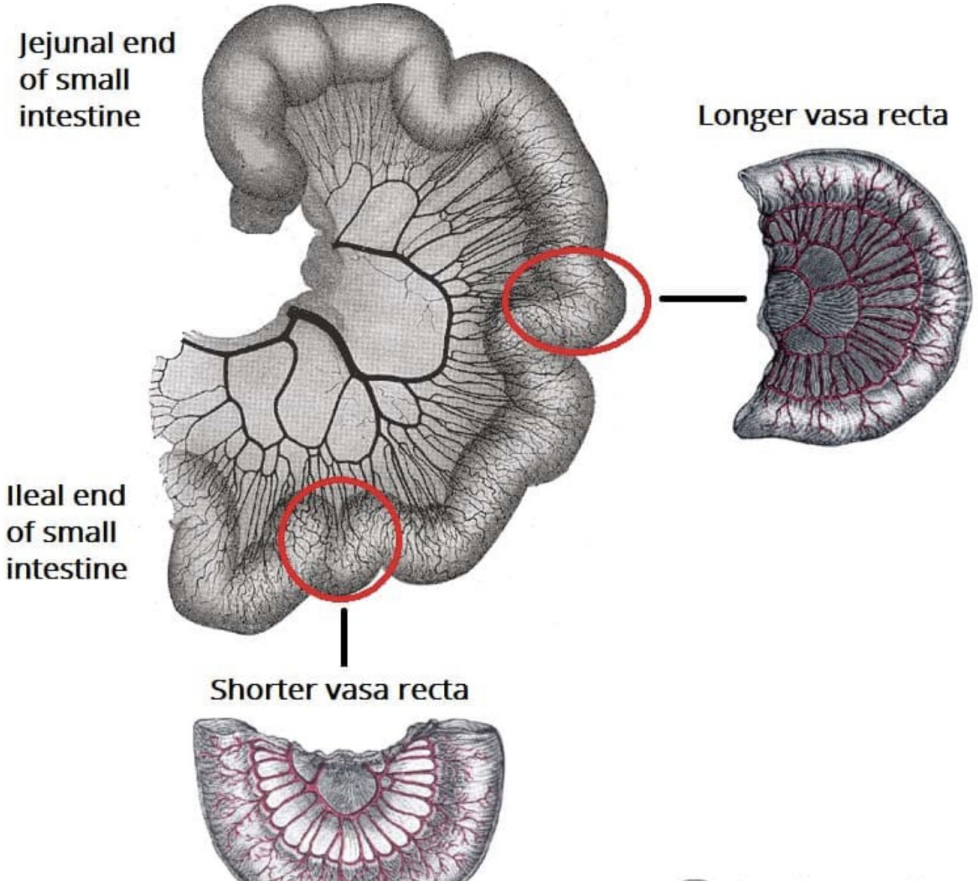
THE STOMACH - INNERVATION

- **Parasympathetic nerve supply** – anterior and posterior vagal trunks, from the vagus nerve.
- **Sympathetic nerve supply** – T6-T9 spinal cord segments and passes to the coeliac plexus via the greater splanchnic nerve.

THE SMALL INTESTINE – ARTERIAL AND VENOUS SUPPLY

- **Duodenum**
- Arterial supply comes from 2 sources
- Proximal to the major duodenal papilla – supplied by gastroduodenal artery
- Distal to the major duodenal papilla – supplied by the inferior pancreaticoduodenal artery
- Veins follow the arteries and drain into hepatic portal vein

- **Jejunum and Ileum**
- Superior mesenteric artery
- Vein – superior mesenteric vein which joins with the splenic vein.


Jejunal end of small intestine
Longer vasa recta
Ileal end of small intestine
Shorter vasa recta

THE CECUM – ARTERIAL AND VENOUS SUPPLY

- Arterial supply:
- Branches of the superior mesenteric vessels – ileocolic artery.
- Venous drainage:
- Provided by the ileocolic vein which drains into the superior mesenteric vein.

THE CECUM – INNERVATION

- Sympathetic and parasympathetic branches of the ANS.
- This is done through the ileocolic branch of the superior mesenteric plexus.

Which artery is at risk of lesion following ulceration of the duodenum?

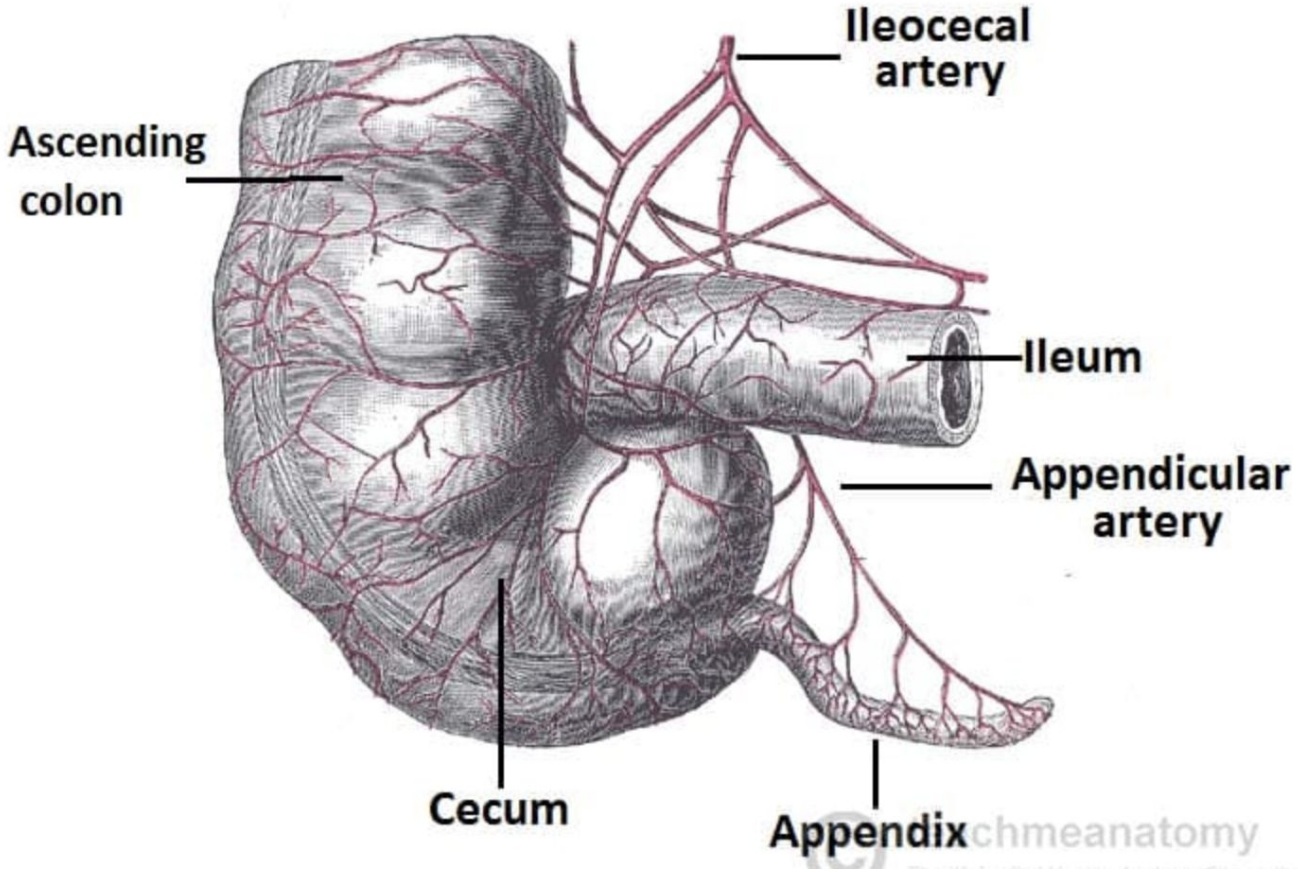
A) Left gastric artery
B) Short gastric arteries
C) Left gastroepiploic artery
D) Gastroduodenal artery
E) Posterior gastric artery

Which artery is at risk of lesion following ulceration of the duodenum?

A) Left gastric artery
B) Short gastric arteries
C) Left gastroepiploic artery
D) Gastroduodenal artery
E) Posterior gastric artery

THE APPENDIX – ARTERIAL AND VENOUS SUPPLY

- Arterial supply:
- Appendicular artery which comes from the ileocolic artery (branch of the superior mesenteric artery).
- Venous drainage:
- Appendicular vein.


Ileocecal artery
Ascending colon
Ileum
Appendicular artery
Cecum
Appendix

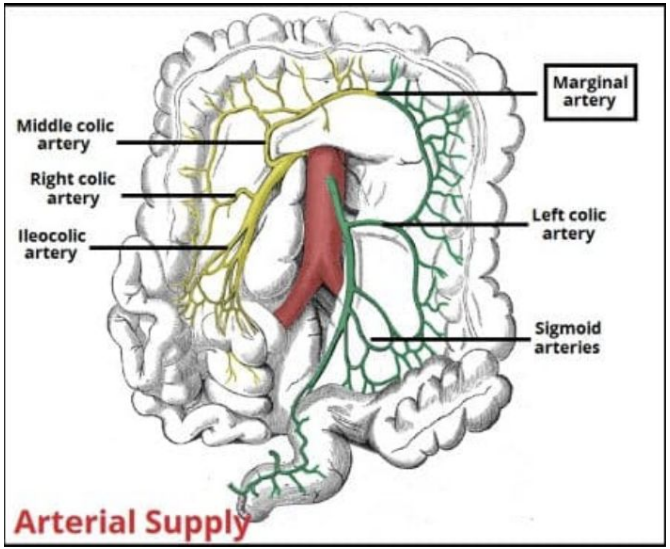
THE COLON – ARTERIAL AND VENOUS SUPPLY

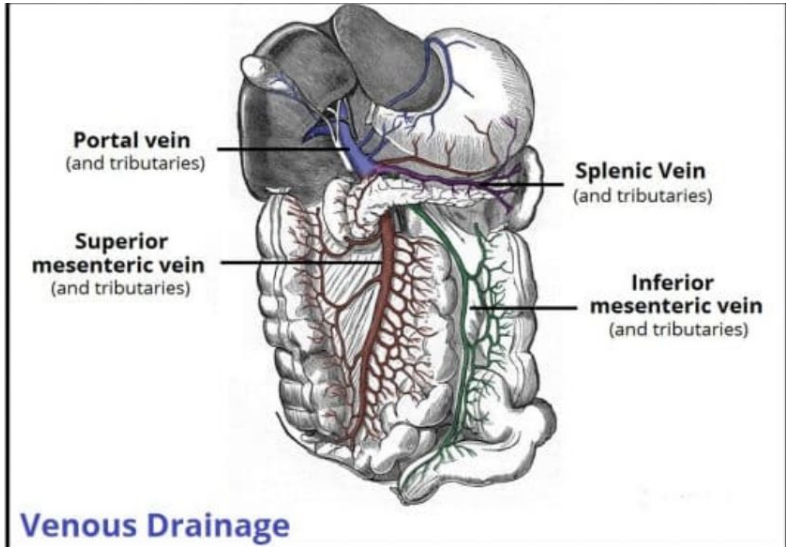
- The neurovascular supply is closely linked to the embryological origin.
- Ascending colon and proximal 2/3rds of the transverse colon – derived from the midgut.
- Distal 1/3rd of the transverse colon, descending colon and sigmoid colon – derived from the hindgut.

THE COLON – ARTERIAL AND VENOUS SUPPLY

- **Arterial supply**
- Ascending colon (midgut) – ileocolic and right colic arteries.
- Transverse colon (hindgut) – right, middle and left colic (branches of superior and inferior mesenteric arteries.).
- Descending colon – left colic (inferior mesenteric artery)
- Sigmoid colon – sigmoid arteries (inferior mesenteric artery)

- **Venous Drainage**
- Ascending colon – ileocolic and right colic veins
- Transverse colon – middle colic vein.
- Descending colon – left colic vein
- Sigmoid colon – sigmoid veins


Marginal artery
Middle colic artery
Right colic artery
Ileocolic artery
Left colic artery
Sigmoid arteries
Arterial Supply


Portal vein
(and tributaries)
Splenic Vein
(and tributaries)
Superior mesenteric vein
(and tributaries)
Inferior mesenteric vein
(and tributaries)
Venous Drainage

THE COLON – INNERVATION

- **Midgut derived:**
- Sympathetic, parasympathetic and sensory supply via nerves from the superior mesenteric plexus

- **Hindgut derived:**
- Sympathetic, parasympathetic and sensory supply via nerves from the inferior mesenteric plexus.

What is the blood supply to the hindgut?

A) Superior Mesenteric Artery
B) Inferior Mesenteric Artery
C) Coeliac Plexus
D) Abdominal Aorta
E) Splenic Artery

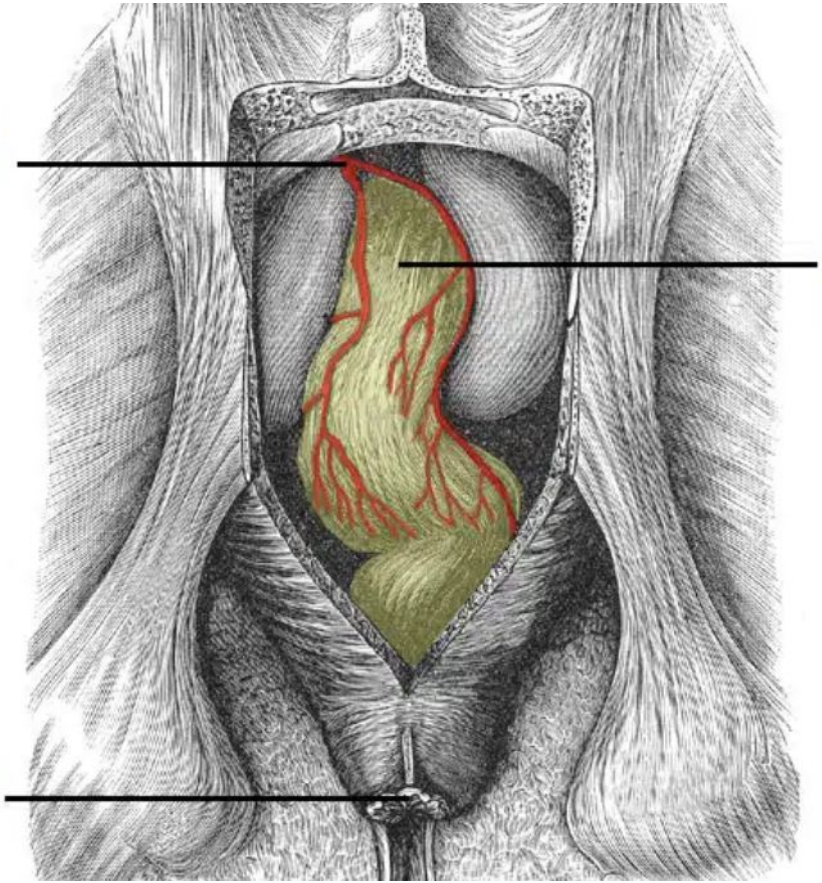
What is the blood supply to the hindgut?

A) Superior Mesenteric Artery
B) Inferior Mesenteric Artery
C) Coeliac Plexus
D) Abdominal Aorta
E) Splenic Artery

THE RECTUM

- **Arterial supply – 3 main arteries.**
- Superior rectal artery
- Middle rectal artery
- Inferior rectal artery

- **Venous drainage – 3 veins**
- Superior rectal vein
- Middle rectal vein
- Inferior rectal vein
- Empties into the portal venous system.


Superior rectal artery
Rectum
External anal sphincter

THE RECTUM – INNERVATION

- Receives sensory and autonomic innervation.
- Sympathetic Nervous Supply – lumbar splanchnic nerves, superior and inferior hypogastric plexuses.
- Parasympathetic supply is from S2-S4 via pelvic splanchnic nerves and inferior hypogastric plexuses.

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