MIDLANDS SURGICAL ANATOMY TEACHING SERIES

MSATS HANDOUT 2021/22

High Yield | Surgical Relevance | CPD Accredited

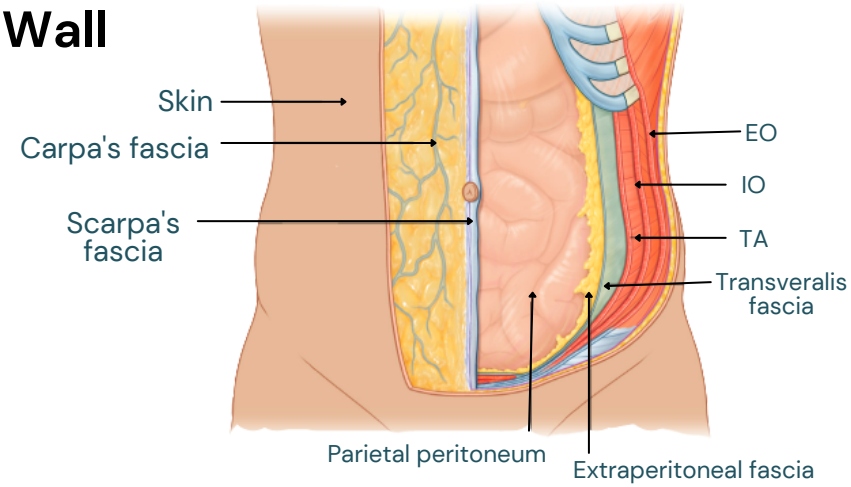
LOWER GI ANATOMY

Objectives: *Recall the muscular layers of the anterolateral abdominal wall. Understand the gross anatomy and structure of the distal small bowel (jejunum and ileum), large bowel, rectum and anal canal. Appreciate and understand the neurovascular supply of the lower gastrointestinal tract. Apply anatomical knowledge to the setting of colorectal surgery.*

Anterolateral Abdominal Wall

Layers:

1. Skin
2. Superficial fascia
   - **Camper's fascia** – fatty layer
   - **Scarpa's fascia** – thin and membranous
3. 3 flat muscles + 3 vertical muscles
4. Transversalis fascia
5. Extraperitoneal fascia
6. Peritoneum (parietal & visceral)



3 Flat Muscles

1. **External oblique:**
   - Direction of muscle fibres: **inferomedial**
2. **Internal oblique:**
   - Direction of muscle fibres: **superomedial**
3. **Transversus abdominis:**
   - Direction of muscle fibres: **transverse**

- **Function:** compresses abdominal contacts & rotation of torso
- **Innervation:** T7–T11 thoracoabdominal nerves + T12 (subcostal nerve)
- Each flat muscle forms an aponeurosis in the midline **= linea alba**

2 Vertical Muscles

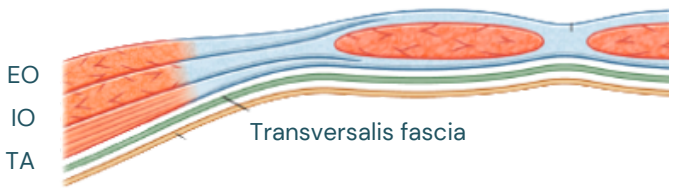
1. **Rectus Abdominis:**
   - Extends from pubic crest to costal margin
   - Contains tendinous intersections
   - Paired muscle split in the midline by linea alba
   - **Innervation**: T7–T11 thoracoabdominal nerves
2. **Pyramidalis:**
   - Small triangular crest (pubic crest to pubic symphysis)
   - **Innervation:** T12 subcostal nerve

- **Function:** compresses and stabilises abdominal viscera

Rectus Sheath

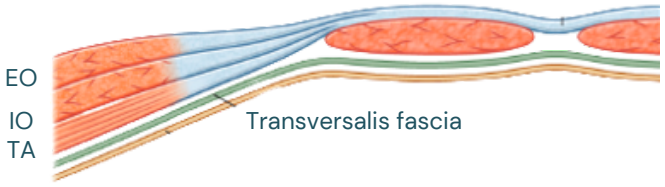
- Rectus sheath: aponeurotic tendinous sheath enclosing vertical muscles.
- **Arcuate line** – approx. half way between umbillicus and pubic crest

Above Arcuate Line



Anterior wall – aponeurosis of EO & 1/2 IO
Posterior wall – aponeurosis of 1/2 IO & TA

Below Arcuate Line



Anterior wall – aponeurosis of EO, IO & TA
No posterior wall

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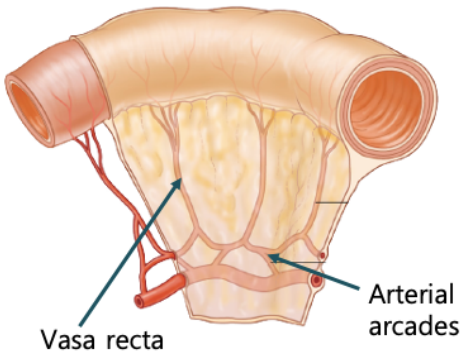
Lower GI Tract

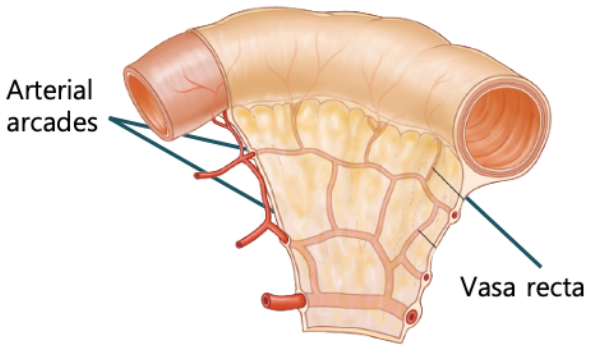
Jejunum

- Proximal 2/5 small bowel (ULQ)
- **Key features**
  a. Thicker intestinal walls
  b. Numerous plicae circulares
  c. Longer vasa recta
  d. Fewer arterial arcades
- **Arterial**: superior mesenteric artery (5 jejunal arteries)
- **Venous**: SMV + splenic vein -> portal vein
- **Innervation**:
  - Sympathetic - celiac and superior mesenteric plexus
  - Parasympathetic - CNX



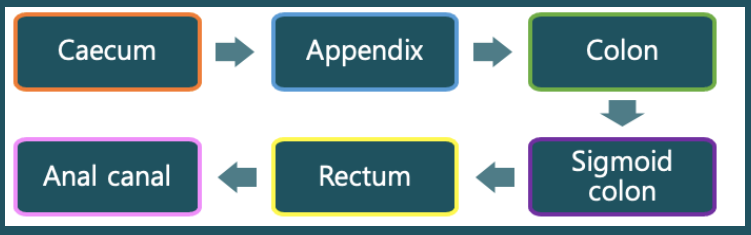
Ileum

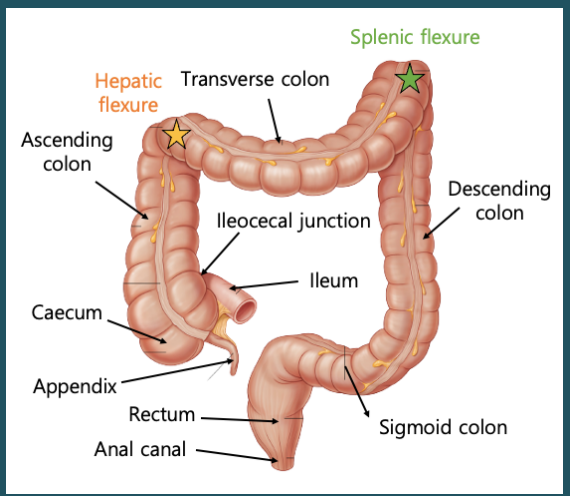
- Distal 3/5 of small bowel (LRQ)
- **Key features**
  a. Thinner intestinal wall
  b. Fewer plicae circulares
  c. Shorter vasa recta
  d. Numerous arterial arcades
- Ends in ileocaecal junction - joins to cecum and ascending colon
- **Arterial**: superior mesenteric artery (ileal and ileocolic artery)
- **Venous**: SMV + splenic vein -> portal vein
- **Innervation:**
  - Sympathetic - celiac and superior mesenteric plexus
  - Parasympathetic - CNX



Large Intestine Overview

- Omental appendices – peritoneal covered accumulations of fat
- Taenia coli – 3 narrow bands along longitudinal muscle walls
- Haustra – sacculations of colon





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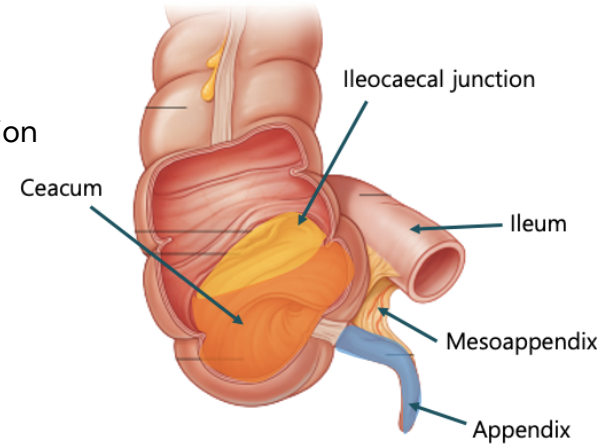
Lower GI Tract

Cecum

- First part of large intestine & inferior to ileocaecal junction
- Position: right iliac fossa



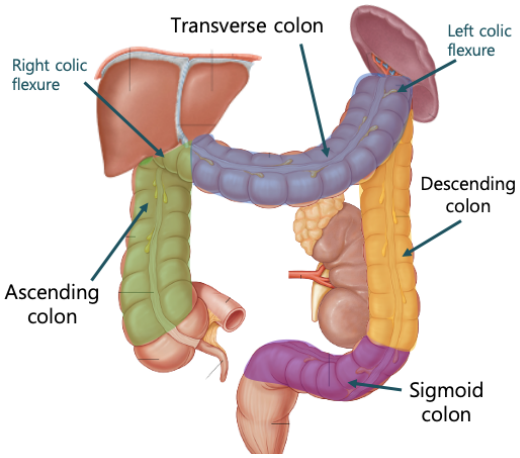
Appendix

- Narrow, hollow, blind-ended tube
- Contains aggregations of lymphoid tissue
- Suspended by mesoappendix

1. **Arterial supply** - anterior and posterior cecal arteries, appendicular artery
2. **Venous drainage** - ileocolic vein --> SMV --> portal vein
3. **Innervation**: superior mesenteric plexus + CNX

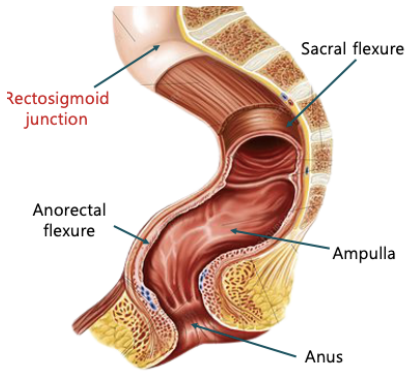
Colon

- **Components**
  - Ascending and descending - **secondarily retroperitoneal**
  - Transverse and sigmoid - **intraperitoneal**
  - Sigmoid colon (S-shaped) - from pelvis inlet to S3 vertebra
- **Neurovascular supply summary**
  - Ascending colon + proximal 2/3 transverse colon (**MIDGUT**) - Superior mesenteric vessels and superior mesenteric plexus
  - Distal colon + sigmoid colon (**HINDGUT**) - Inferior mesenteric vessels and inferior mesenteric plexus



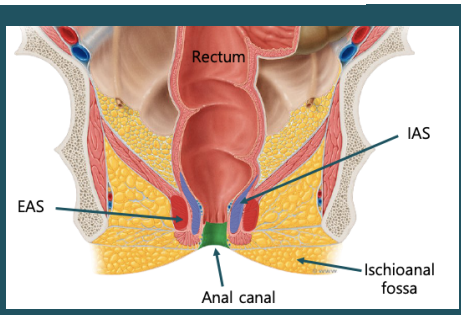
Rectum

- Begins at rectosigmoid junction - S3 vertebra (retroperitoneal structure)
- 2 flexures
  - Sacral flexure - concavity anteriorly
  - Anorectal flexure - convexity posteriorly
- Ampulla (final segment) - relaxes to store faeces.



Anal Canal

- Located in anal triangle - 4cm length
- **Sphincters**
  - Internal anal sphincter - upper 2/3 (**involuntary** control)
  - External anal sphincter - lower 2/3 (**voluntary** control)
- Dentate/pectinate line - divides anal canal into upper and lower parts which differ in structure and neurovascular supply.



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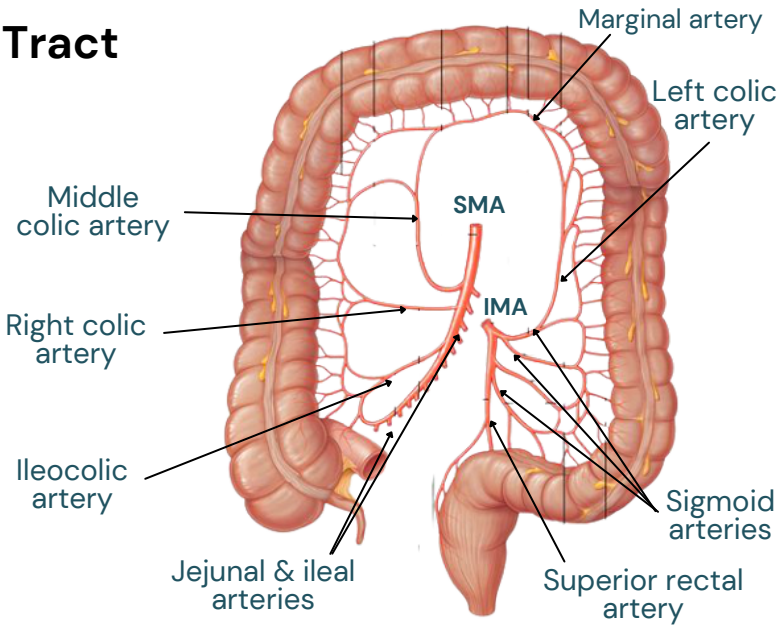
Neurovascular Supply of Lower GI Tract

Arterial Supply

- **SMA Branches:** Jejunal & Ileal arteries, Ileocolic artery, Right colic artery, Middle colic artery & Inferior pancreaticoduodenal
- **IMA branches:** Left colic artery, Sigmoid arteries & Superior rectal artery
- **Rectum/Anal Canal**
  - Above dentate line - superior + middle rectal arteries
  - Below dentate line - inferior + middle rectal arteries

Marginal Artery of Drummond - anastomotic collateral artery between colic arteries.

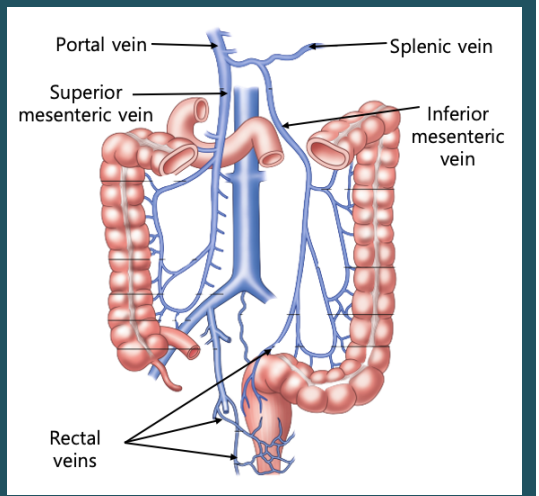


Venous Drainage

- Superior mesenteric vein - drains small bowel, cecum, ascending colon, transverse colon.
- Inferior mesenteric vein - drains rectum, sigmoid colon, descending colon and splenic flexure
- Splenic vein - drains pancreas

IMV --> SMV + Splenic Vein --> Portal Vein --> Liver --> IVC

- **Rectum/Anal Canal**
  - Above dentate line - superior rectal vein --> IMV
  - Below dentate line - inferior rectal vein --> internal pudendal vein --> IVC

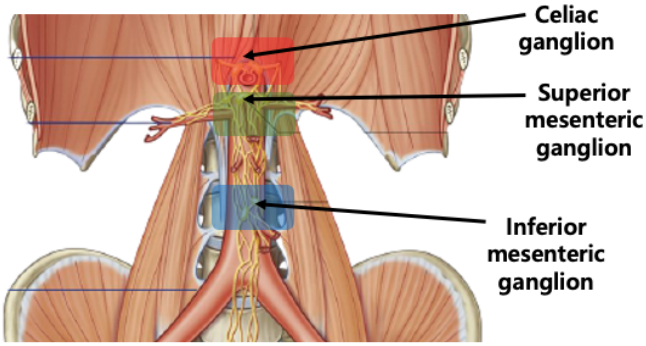


Innervation

Sympathetic

- Abdominal prevertebral plexuses (lumbar/sacral splachnic nerves) - surround abdominal aorta and branches
- Ganglia: celiac, superior mesenteric, inferior mesenteric and inferior hypogastric ganglia.

Pre-ganglionic neurone (sympathetic chain) → Paravertebral ganglia → Celiac, Superior mesenteric, inferior mesenteric, inferior hypogastric ganglia → Post-ganglionic neurone → Abdominal viscera (inhibit gut motility)



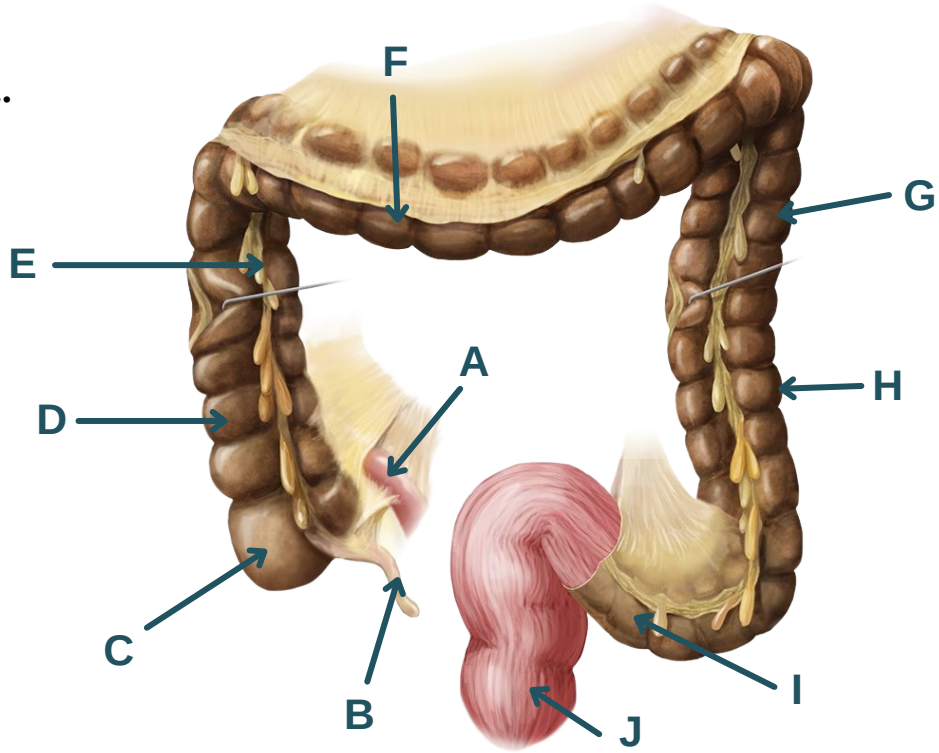
Parasympathetic

- Vagus nerve (CNX) - foregut and midgut
- Pelvis splachnic nerves (S2-S4) supply hindgut via inferior hypogastric plexus.

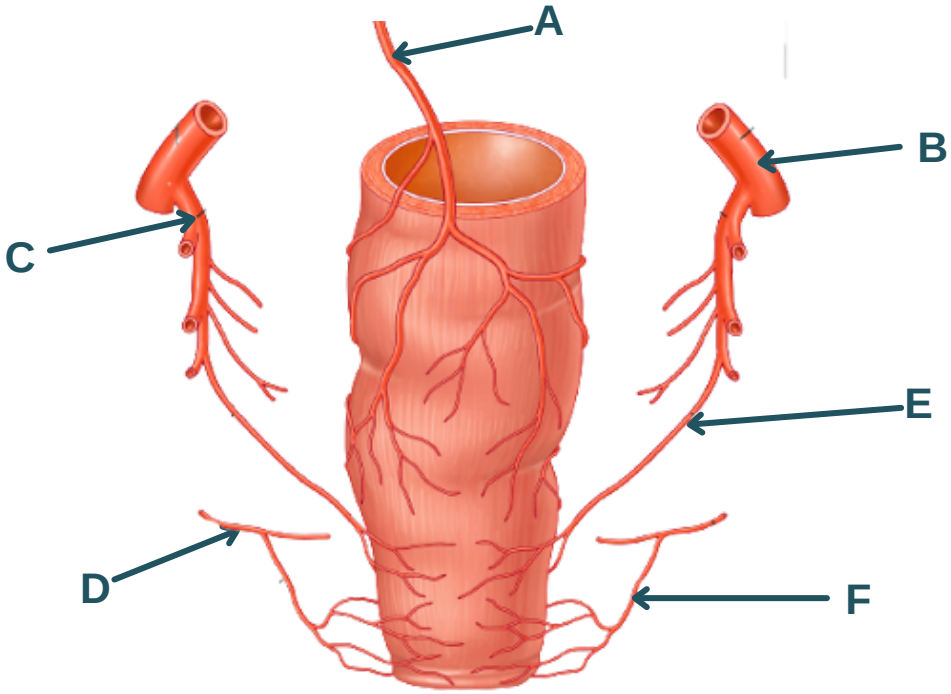
LOWER GI ANATOMY

Test yourself...

1) Label the structures...



2) Label the structures providing arterial supply to the rectum and anal canal (hint: remember the difference in neurovascular supply above and below the dentate line!**):**



LOWER GI ANATOMY

Test yourself...

MCQ 1

At which anatomical location does the superior mesenteric vein drain into the hepatic portal vein?

A. Anterior the celiac trunk
B. Anterior to the pancreas neck
C. Posterior to the pancreas neck
D. Inferior to the spleen
E. Posterior to pancreas body

MCQ 2

An 69-year-old lady is undergoing a right hemicolectomy through a transverse incision. The procedure is difficult and the incision is extended medially by dividing the rectus sheath. This results in brisk arterial haemorrhage. Which of the following does the damaged vessel originate?

A. External iliac artery
B. Abdominal aorta
C. Superior rectal artery
D. Internal iliac artery
E. Inferior vesical artery

MCQ 3

Which of the following statements on the jejunum and ileum are NOT true:

A. The jejunum has longer vasa recta
B. The ileum has more numerous arterial arcades.
C. The ileum has a thinner intestinal wall
D. The ileum has shorter vasa recta
E. The jejunum has numerous plicae circulares

MCQ 4

A 56-year-old female undergoes a sigmoid colectomy for colon cancer. Which structure is at the highest risk of injury during this surgery?

A. IVC
B. Internal iliac artery
C. External iliac artery
D. Left ureter
E. External iliac vein

MCQ 5

At which vertebral level does the rectum begin?

A. S1
B. S2
C. S3
D. S4
E. L5

MCQ 6

A 49-year-old lady undergoes a Hartmanns procedure with ligation of the neurovascular structures close to the colon. Which vessel will be responsible for supplying the rectal stump directly?

A. External iliac artery
B. Superior rectal artery
C. Middle colic artery
D. Superior mesenteric artery
E. Inferior mesenteric artery

LOWER GI ANATOMY

Test yourself...

OSCE Station - Case Based Discussion

A 10-week year old male neonate presents to the paediatric emergency department with bilious vomiting and abdominal wall discolouration. The parents were also very concerned as it has been 2 days since their child last passed stool. The on-call general surgical registrar performs an examination of the patient who reports a highly distended abdomen and signs of peritonitis. The registrar believes the patients is beginning to show signs of haemodynamic instability.

Q1. What is this patients likely diagnosis?

Q2. What specific signs indicates potential ischaemia to the bowel?

Q3. What investigations would you do to confirm this diagnosis? What are the characteristic features found on imaging?

Q4. Is this patient's presentation considered a surgical emergency and why?

Q5. How would you surgically manage this patient?

Q6. What are the potential complications of surgical management?

Answers

1.A = terminal ileum, B = vermiform appendix, C = cecum, D = ascending colon, E = omental appendices, F = transverse colon, G = haustra, H = descending colon, I = sigmoid colon, J = rectum.

2.A = superior rectal artery (from IMA), B = left common iliac artery, C = right internal iliac artery, D = right internal pudendal artery, E = left middle rectal artery, F = left inferior rectal artery

MCQs = 1. C, 2. A, 3. D, 4. D, 5. C, 6. B

OSCE Questions:

1.Midgut volvulus due to intestinal malrotation. Volvulus is defined as twisting of an organ >180-degrees about the axis of the mesentery. Midgut volvulus can arise due to twisting or torsion of the midgut and its accompanying mesenteric vessels around the narrow mesenteric pedicle. This typically occurs at the region of the duodenojejunal junction and can cause bowel obstruction and gut ischaemia

2.Signs of bowel ischaemia - peritonitis and haemodynamic instability

3.Gold standard investigation: upper GI radiograph with contrast. This shows a dilated stomach, beak-like duodenum & corkscrew duodenum.

4. Yes! This is a surgical emergency due to the acute obstruction of superior mesenteric vessels resulting in bowel ischaemia.

5.Ladd's procedure - prompt surgical intervention. A Ladd's procedure involves de-rotating the bowel, dividing Ladd's bands (adhesions) which extend from the cecum to duodenum and performing an appendectomy.

6. Small bowel obstruction, bowel resection, recurrent volvulus, chronic constipation.