MEDICAL EDUCATION RESOURCE

Small and Large Intestines

? Small and Large Intestine

Introduction

- The **intestine** extends from the **pylorus of the stomach** to the **anus**.
- It is divided into:
    1. **Small intestine** ? involved mainly in digestion and absorption.
    2. **Large intestine** ? concerned with water absorption and faeces formation.

Total length: about **6.5–7 metres** in adults.

- **Small intestine:** ~6 metres
- **Large intestine:** ~1.5 metres

The small intestine is longer and narrower; the large intestine is wider and sacculated due to *taeniae coli*.

Small Intestine

Parts:

1. **Duodenum** – 25 cm

2. **Jejunum** – 2.4 metres
3. **Ileum** – 3.6 metres

Functions:

- Final digestion of food.
- Absorption of nutrients and electrolytes.
- Secretion of intestinal juice and hormones.

Peritoneal Relations:

- **Duodenum:** mostly retroperitoneal.
- **Jejunum and ileum:** intraperitoneal (mobile with mesentery).

Blood supply:

- From **superior mesenteric artery (SMA)** and its branches.
- Venous drainage ? **superior mesenteric vein ? portal vein**.

Lymphatics:

- Drain into **mesenteric lymph nodes**, then to **cisterna chyli**.

Nerve supply:

- **Sympathetic (T9–T11)** ? inhibits peristalsis and causes vasoconstriction.
- **Parasympathetic (vagus)** ? stimulates peristalsis and secretion.

Relevant Features of the Small Intestine

1. Mucosal folds (valves of Kerckring or plicae circulares):

- Permanent circular folds of mucosa and submucosa.
- Increase surface area for absorption.
- Most prominent in **jejunum**, fewer in **ileum**, absent in **duodenum** and distal ileum.

2. Villi:

- Microscopic finger-like projections of mucosa containing **blood capillaries** and **lacteals**.
- Greatly increase absorptive surface area.

3. Microvilli:

- Present on the apical surface of epithelial cells; form the **brush border**.
- Contain digestive enzymes for final carbohydrate and protein breakdown.

4. Peyer's patches:

- Lymphoid aggregates in **ileum** (antimesenteric border).
- Provide immune defense in gut (GALT – gut-associated lymphoid tissue).

5. Brunner's glands:

- Submucosal glands in the **duodenum** secreting alkaline mucus ? neutralises gastric acid.

Large Surface Area – Anatomical Adaptations

The small intestine has the largest absorptive surface in the body due to:

- **Plicae circulares** ? 3× increase.
- **Villi** ? 10× increase.
- **Microvilli** ? 20× increase.
  ? Combined ? approximately **600 times greater surface area** than a simple tube.

Functional advantage:
Maximises nutrient absorption despite compact anatomical length.

Duodenum

General Features:

- Shortest and widest part of the small intestine (~25 cm).
- Begins at **pylorus (L1)** and ends at the **duodenojejunal flexure (L2)**.
- Mostly **retroperitoneal** except the **first 2.5 cm (duodenal cap)**.
- Forms a **C-shaped loop** around the **head of pancreas**.

Parts (by position):

1. **First (Superior) part** – 5 cm
2. **Second (Descending) part** – 7.5 cm
3. **Third (Horizontal) part** – 10 cm
4. **Fourth (Ascending) part** – 2.5 cm

Dissection Notes (for Duodenum)

1. **Locate the pylorus** on the right of the midline at the level of **L1**.
2. Trace the **first part of the duodenum** posteriorly from pylorus.
3. Note its relation to **gall bladder, liver, and common bile duct**.
4. Follow the **C-shaped loop** of duodenum embracing the **head of pancreas**.
5. Identify:
    - **Opening of the common bile duct and pancreatic duct** on the posteromedial wall of second part ? **major duodenal papilla**.
    - **Accessory pancreatic duct** opens at **minor duodenal papilla**, 2 cm above the major one.
6. The **duodenojejunal flexure** lies at the **left of L2**, held by the **suspensory muscle of duodenum (ligament of Treitz)**.

Relations of Duodenum (Overview)

PART	ANTERIOR RELATIONS	POSTERIOR RELATIONS
1st (superior)	Gall bladder, liver	Portal vein, gastroduodenal artery, bile duct
2nd (descending)	Transverse colon	Hilum of right kidney
3rd (horizontal)	Root of mesentery, SMA & SMV cross anteriorly	IVC, aorta

PART	ANTERIOR RELATIONS	POSTERIOR RELATIONS
4th (ascending)	Beginning of jejunum	Left psoas, aorta

Blood and Nerve Supply

- **Arterial supply:**
  - **1st and 2nd parts:** *Superior pancreaticoduodenal artery* (branch of gastroduodenal).
  - **3rd and 4th parts:** *Inferior pancreaticoduodenal artery* (branch of SMA).
  - These form an **anastomotic arcade** between coeliac and SMA territories.
- **Venous drainage:**
  - Into **portal vein** via pancreaticoduodenal veins.
- **Lymphatic drainage:**
  - **Pancreaticoduodenal and pyloric nodes ? coeliac nodes.**
- **Nerve supply:**
  - Sympathetic (T9–T10) ? via coeliac and superior mesenteric plexuses.
  - Parasympathetic ? via **vagus nerve**.

Clinical Anatomy

- **Duodenal ulcers** are most common in the **first part (duodenal bulb)** due to acid exposure.
- Posterior ulcers may **erode the gastroduodenal artery**, causing severe bleeding.
- The **ampulla of Vater** (in second part) is a common site for **gallstone impaction**, leading to **obstructive jaundice and pancreatitis**.
- **Congenital duodenal atresia** ? bilious vomiting in neonates (“double bubble” sign on X-ray).
- **Superior mesenteric artery syndrome** ? compression of 3rd part between SMA and aorta.

? Peritoneal Relations of the Duodenum

- The **duodenum** is **mostly retroperitoneal**, except its **first 2.5 cm (duodenal cap)**, which is **intraperitoneal** and movable.
- The **remainder** (descending, horizontal, ascending parts) is **fixed** to the posterior abdominal wall and covered by peritoneum **anteriorly only**.

Detailed relations:

1. **First (Superior) Part:**
    - *Anterior surface*: covered by **peritoneum** and in contact with **liver and gall bladder**.

- *Posterior surface*: bare, related to **portal vein, bile duct, and gastroduodenal artery**.
- *Superior border*: related to the **neck of gall bladder**.
- *Inferior border*: continuous with the **second part**.

2. **Second (Descending) Part:**
   - *Anterior*: covered by **peritoneum** and related to **transverse colon and jejunum**.
   - *Posterior*: bare; related to **right kidney, hilum, renal vessels, and ureter**.
   - *Medial*: receives **bile duct and pancreatic duct** at the **major duodenal papilla**.
3. **Third (Horizontal) Part:**
   - *Anterior*: crossed by **superior mesenteric vessels** and **root of mesentery**.
   - *Posterior*: related to **inferior vena cava, aorta, and right psoas major**.
   - Peritoneum covers **front only**.
4. **Fourth (Ascending) Part:**
   - *Anterior*: covered by peritoneum and related to the **transverse colon** and **stomach** .
   - *Posterior*: related to **aorta, left psoas, and left sympathetic chain**.
   - Ends at the **duodenojejunal flexure** (left of L2), suspended by the **ligament of Treitz**.

? Suspensory Muscle of Duodenum (Ligament of Treitz)

- A fibromuscular band connecting the **duodenojejunal flexure** to the **right crus of the diaphragm**.
- Consists of **skeletal muscle fibres (from right crus)** and **smooth muscle fibres (from duodenum and connective tissue)**.

Attachments:

- **Upper end:** Right crus of diaphragm near the oesophageal opening.
- **Lower end:** Duodenojejunal junction (left of L2).

Function:

- **Elevates the duodenojejunal flexure**, helping **movement of chyme** from duodenum to jejunum.
- Maintains the **sharp angle** of the flexure, preventing regurgitation from jejunum to duodenum.

Applied anatomy:

- Acts as a **surgical landmark** separating **upper and lower GI bleeding sources**.
- Its location marks the junction between **retroperitoneal (duodenum)** and **intraperitoneal (jejunum)** bowel.

? Histology of the Duodenum

Layers of the wall:

1. **Mucosa:**
    - Lined by **simple columnar epithelium** with **villi and microvilli**.
    - Villi ? broad and leaf-like.
    - Contains **intestinal glands (crypts of Lieberkühn)**.
    - Lamina propria rich in **lymphoid cells** and **capillaries**.
2. **Submucosa:**
    - Characteristic feature: **Brunner’s glands** (unique to duodenum).
    - Secrete **alkaline mucus** ? neutralises acidic chyme from stomach.
    - Prevents mucosal damage and provides optimal pH for pancreatic enzyme action.
3. **Muscular layer:**
    - Inner **circular** and outer **longitudinal** smooth muscle.
    - Responsible for peristaltic movement.
    - Contains **Auerbach’s (myenteric) plexus** between layers.
4. **Serosa/Adventitia:**
    - **Serosa** covers the first 2.5 cm; rest has **adventitia** (retroperitoneal).

Histological identifiers:

- Villi ? leaf-like.

- Brunner’s glands ? in submucosa.
- No Peyer’s patches (unlike ileum).

?? Clinical Anatomy

1. Duodenal Ulcer:

- Commonest site: **posterior wall of the first part (duodenal cap)**.
- **Complication:** erosion of **gastroduodenal artery** ? severe haemorrhage.
- **Pain** referred to **epigastrium** (T9 dermatome).

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2. Perforated Duodenal Ulcer:

- Causes **peritonitis**; air under diaphragm visible in erect X-ray.
- May lead to adhesions between duodenum and gall bladder ? **cholecystoduodenal fistula**.

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3. Superior Mesenteric Artery (SMA) Syndrome:

- Compression of **3rd part of duodenum** between **SMA and aorta** ? **intestinal obstruction**.
- Seen in emaciated patients with loss of retroperitoneal fat.

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4. Gallstone Ileus:

- Large gallstone erodes into duodenum, passes to ileum, causing **mechanical obstruction** (usually at ileocaecal junction).

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5. Duodenal Atresia:

- Congenital absence or closure of duodenal lumen (failure of recanalisation).
- **Clinical feature:** *Bilious vomiting* soon after birth; *"double bubble"* sign on X-ray (stomach + duodenal bulb distension).

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6. Malrotation of Midgut:

- Improper rotation may alter duodenal position ? **volvulus** or **obstruction**.

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7. Tumours and Cysts:

- **Ampullary carcinoma** near **major duodenal papilla** leads to **obstructive jaundice** and **pale stools**.

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8. Endoscopic Importance:

- **Second part** of duodenum is visualised during **upper GI endoscopy** to identify **ampullary opening** and detect ulcers or stones.

? Key Vascular Note

- The **duodenum** forms the **vascular watershed** between **coeliac** and **superior mesenteric artery** territories, explaining frequent ischaemic ulcers and surgical importance.

? Jejunum and Ileum

General Description

The **jejunum and ileum** form the **mobile, intraperitoneal portion** of the small intestine extending from the **duodenojejunal flexure (L2)** to the **ileocaecal junction** in the right iliac fossa.

- **Total length:** ~6 m
  - **Jejunum:** upper 2/5 (? 2.4 m)
  - **Ileum:** lower 3/5 (? 3.6 m)
- **Suspension:** by a fan-shaped **mesentery** attached to the posterior abdominal wall from the **left side of L2** to the **right sacro-iliac joint**.

Differences Between Jejunum and Ileum

FEATURE	JEJUNUM	ILEUM
Location	Upper left abdomen	Lower right abdomen
Wall	Thick and vascular	Thin and pale
Lumen	Wider	Narrower
Plicae circulares	Large, numerous	Small, sparse; absent distally
Vascularity	Rich, red	Poor, pale

FEATURE	JEJUNUM	ILEUM
Arterial arcades	Few (1–2 tiers)	Numerous (3–4 tiers)
Vasa recta	Long	Short
Fat in mesentery	Less	More (reaching gut wall)
Peyer's patches	Scanty	Abundant along antimesenteric border
Function	Major site of absorption	Terminal absorption of bile salts, vit B??

Peritoneal Relations

- Both are **completely covered by peritoneum** and suspended by the **mesentery of the small intestine**.
- The **root of the mesentery** crosses obliquely over the following:
    - 3rd part of duodenum,
    - aorta,
    - inferior vena cava,
    - right ureter,
    - right psoas major.
- Between its two layers run:
    - **Superior mesenteric vessels**,

- branches to intestine,
- lymphatics and lacteals,
- autonomic nerve plexuses.

Blood Supply

- **Arterial:** *Jejunal and ileal branches* of the **superior mesenteric artery (SMA)**.
  - They form **arterial arcades** in mesentery ? give **vasa recta** to gut wall.
- **Venous:** *Superior mesenteric vein* ? joins *splenic vein* ? **portal vein**.
- **Lymphatics:** Mesenteric nodes ? **superior mesenteric nodes** ? **cisterna chyli**.
- **Nerves:**
  - *Sympathetic (T9–T10)* – inhibit peristalsis and act vasoconstrictor.
  - *Parasympathetic (vagus)* – promote motility and secretion.

> **? Histology of Jejunum and Ileum**

Layers of wall (common to both):

1. **Mucosa:**
   - *Epithelium:* simple columnar with goblet cells.
   - *Villi:* tall, slender (jejunum); short, finger-like (ileum).

- *Crypts of Lieberkühn:* tubular glands between villi.
- *Lamina propria:* rich in capillaries, lacteals, lymphocytes.

2. **Submucosa:**
   - Jejunum: ordinary connective tissue.
   - Ileum: contains **Peyer's patches** — lymphoid follicles forming prominent elevations opposite the mesenteric border.
3. **Muscular coat:**
   - Inner circular and outer longitudinal smooth-muscle layers.
   - **Auerbach's plexus** between them regulates peristalsis.
4. **Serosa:**
   - Entire intestine covered by peritoneum.

Distinctive Features

- Jejunum ? tall villi, fewer goblet cells.
- Ileum ? abundant goblet cells, Peyer's patches, shorter villi.

? Meckel's Diverticulum (Diverticulum Ilei)

- A **congenital remnant** of the **vitellointestinal (omphalomesenteric) duct**.

- Represents **persistence of its proximal part**.

Features:

- True diverticulum (contains all gut layers).
- Located on **antimesenteric border of ileum**, about **60 cm (2 ft)** proximal to **ileocaecal valve**.
- **Length:** usually 2–5 cm (? 2 inches).
- **Rule of 2s:**
    - Occurs in 2 % of population.
    - 2 in long.
    - 2 ft from ileocaecal valve.
    - Common before age 2.
    - May contain 2 types of ectopic mucosa – *gastric* or *pancreatic*.

Complications:

- **Peptic ulceration** (if gastric mucosa present) ? bleeding.
- **Inflammation (Meckel's diverticulitis)** mimics appendicitis.
- **Intussusception or volvulus** if attached by fibrous band to umbilicus.

? Dissection Notes

1. Expose coils of **jejunum and ileum** by lifting greater omentum and transverse colon.
2. Trace the **root of mesentery** obliquely from the **left of L2** to **right sacro-iliac joint**.
3. Identify **vascular pattern:**
    - Jejunum ? long vasa recta, few arcades.
    - Ileum ? many arcades, short vasa recta.
4. Observe **colour difference:** jejunum pink and thicker; ileum paler and thinner.
5. Locate **Peyer's patches** on antimesenteric border of ileum.
6. Follow ileum to **ileocaecal junction**, identifying the **ileocaecal valve**.

?? Clinical Anatomy

1. Intestinal Obstruction:

- May occur due to **adhesions**, **hernias**, **volvulus**, or **intussusception** (telescoping of one segment into another).
- Presents with colicky pain, distension, vomiting, and constipation.

2. Mesenteric Ischaemia:

- Occlusion of **SMA** or its branches ? gangrene of jejunum/ileum.

- Severe abdominal pain disproportionate to clinical findings.

3. Meckel's Diverticulitis:

- Inflammation of Meckel's diverticulum mimics **appendicitis**, pain in right lower quadrant.

4. Enteric Fever (Typhoid):

- **Peyer's patches** undergo necrosis and ulceration ? intestinal perforation and haemorrhage (usually distal ileum).

5. Malabsorption Syndromes:

- Damage to **villi or microvilli** (celiac disease, tropical sprue) ? diarrhoea, weight loss, anaemia.

6. Intussusception:

- Invagination of ileum into caecum ? "red-currant jelly" stools, common in infants.

7. Crohn's Disease:

- Chronic granulomatous inflammation, mostly involving **terminal ileum**, leading to fibrosis and obstruction.

8. Surgical Landmark:

- The **duodenojejunal flexure** (left of L2) marks transition from fixed to mobile intestine.

- **Ligament of Treitz** helps locate upper GI versus lower GI bleed.

? Summary of Key Points

FEATURE	JEJUNUM	ILEUM
Length ratio	2/5	3/5
Plicae circulares	Large, numerous	Small, sparse
Vascularity	High	Low
Peyer’s patches	Absent/scanty	Prominent
Function	Major absorption	Terminal absorption
Common pathology	Ischaemia	Typhoid ulcers, Meckel’s

? Large Intestine

Introduction

- Extends from the **ileocaecal junction** to the **anus**.
- **Length:** about **1.5 metres**.
- **Function:** absorption of water and electrolytes, formation and temporary storage of faeces, and bacterial synthesis of vitamin K and certain B-complex vitamins.

Parts:

1. Caecum

2. Appendix
3. Ascending colon
4. Transverse colon
5. Descending colon
6. Sigmoid colon
7. Rectum
8. Anal canal

Characteristic Features

These features distinguish the large intestine from the small intestine:

FEATURE	DESCRIPTION
Taeniae coli	Three longitudinal muscle bands: *taenia libera, taenia mesocolica, taenia omentalis*.
Haustra coli	Sacculations of the wall between the taeniae due to shorter outer muscle.
Appendices epiploicae	Fat-filled peritoneal pouches along the colon.
Wider lumen	About 5–6 cm in diameter.
Mucosa	Smooth—no villi, but has straight tubular crypts of Lieberkühn rich in goblet cells.

Peritoneal Relations

- **Caecum and transverse colon** ? intraperitoneal and mobile.
- **Ascending and descending colon** ? secondarily retroperitoneal (fixed).
- **Sigmoid colon** ? intraperitoneal with its own mesocolon.

Blood Supply

- **Arteries:**
  - *Caecum to mid-transverse colon* ? **superior mesenteric artery (SMA)** branches (ileocolic, right colic, middle colic).
  - *Distal transverse to upper rectum* ? **inferior mesenteric artery (IMA)** branches (left colic, sigmoid, superior rectal).
  - These form a continuous **marginal artery of Drummond** along the inner border.
- **Veins:**
  - Correspond to arteries ? drain into **SMV and IMV ? portal vein**.
- **Lymphatics:**
  - Epicolic ? paracolic ? intermediate ? main colic ? SMA/IMA nodes ? cisterna chyli.
- **Nerves:**
  - *Sympathetic* – T10–L2 via superior and inferior mesenteric plexuses ? inhibit peristalsis.

- *Parasympathetic* – vagus (up to mid-transverse colon) and pelvic splanchnic (S2–S4) ? increase motility.

Histology

- **Mucosa:** smooth, numerous straight tubular glands lined by simple columnar epithelium with many goblet cells.
- **Submucosa:** dense connective tissue, blood vessels, nerves.
- **Muscularis externa:** inner circular layer continuous, outer longitudinal condensed into **three taeniae coli**.
- **Serosa:** peritoneal covering with **appendices epiploicae**.

Dissection Steps

1. Open the abdomen; reflect greater omentum upward to expose the coils of small intestine.
2. Trace the **ileum** to its termination at the **ileocaecal junction**.
3. Identify the **caecum**, **appendix**, and **ascending colon** in the right iliac fossa.
4. Note the **taeniae coli** converging at the base of the appendix.
5. Follow the colon upward (ascending), across (transverse), and downward (descending).
6. Observe **haustra** and **appendices epiploicae**.
7. Demonstrate peritoneal folds: **mesocolon** and **paracolic gutters** on either side.

Clinical Anatomy

1. Diverticulosis
– Outpouchings of mucosa through weak points in muscular wall (commonly sigmoid colon).
– May cause bleeding or diverticulitis.

2. Volvulus
– Twisting of mobile segments (sigmoid or caecum) ? intestinal obstruction and gangrene.

3. Intestinal Obstruction
– May occur due to hernia, adhesions, tumours, or volvulus; characterised by pain, distension, vomiting.

4. Colonic Carcinoma
– Common in sigmoid and rectosigmoid regions; spreads via lymphatics to mesenteric nodes and liver (via portal circulation).

5. Hirschsprung's Disease (Congenital Megacolon)
– Absence of ganglion cells in Auerbach's and Meissner's plexuses (usually rectosigmoid) ? failure of peristalsis and dilatation proximally.

6. Appendices Epiploicae Torsion
– Inflammation or infarction of these fat tags can mimic appendicitis.

7. Intestinal Ischaemia
– Sudden occlusion of SMA or IMA ? segmental gangrene of colon; splenic flexure (Griffith's point) most vulnerable.

? Caecum

Anatomy

- First part of the large intestine, situated in the **right iliac fossa** below the level of the ileocaecal junction.

- **Shape:** blind pouch with large capacity (6 × 7 cm).
- **Peritoneal relation:** completely covered; free and mobile.
- **Position:**
    - **Adults:** mainly in right iliac fossa.
    - **Children:** may be higher (subhepatic).

Openings:

1. **Ileocaecal orifice** – communicates with ileum; guarded by the **ileocaecal valve**.
2. **Appendicular orifice** – located below and behind the ileocaecal opening; base marked by convergence of the **three taeniae coli**.

Interior of Caecum

- **Ileocaecal valve:** two semilunar folds projecting into lumen; prevent regurgitation of contents into ileum.
- **Ileo-caecal orifice:** slit-like, bounded by superior and inferior lips.
- **Frenula:** small mucosal folds at each end of the orifice.

Blood Supply

- **Artery:** *Ileocolic artery* (branch of SMA) ? anterior and posterior caecal branches.
- **Vein:** correspond ? drain into *SMV ? portal vein*.

- **Lymphatics:** to *ileocolic and superior mesenteric nodes*.
- **Nerve supply:** sympathetic (T10–T12) and parasympathetic (vagus).

Dissection Steps

1. Identify the **caecum** in the right iliac fossa.
2. Note its **three taeniae coli** meeting at the **base of the appendix**.
3. Observe peritoneal folds: **mesoappendix** and **retrocaecal recess** (site where appendix may lie).
4. Open the caecum anteriorly to display **ileocaecal valve** and **appendicular orifice**.
5. Demonstrate the **frenula** of the valve and the **caecal pouch** below it.

Clinical Anatomy

1. Caecal Volvulus:
– Twisting of a mobile caecum on its mesentery ? intestinal obstruction; presents with distension and pain in right lower abdomen.

2. Caecal Typhlitis:
– Inflammation of the caecum, often secondary to appendicitis or ulceration; common in immunocompromised patients.

3. Subhepatic Caecum (in children):
– Due to delayed descent; appendicitis pain then localises in **right upper quadrant**, mimicking gall-bladder disease.

4. Ileocaecal Tuberculosis:
– Most common site of intestinal tuberculosis; causes ulceration, fibrosis, and strictures ? obstruction.

5. Cancer of Caecum:
– May present with anaemia and right-sided mass; spreads to liver via portal circulation.

6. Pericaecal Recesses:
– Four possible: *superior ileocaecal, inferior ileocaecal, retrocaecal,* and *paracaecal*; potential sites for **internal hernia** or **pus collection**.

? Surgical Importance

- **Base of appendix** lies at **McBurney's point** — one-third the distance from anterior superior iliac spine to umbilicus.
- The **taeniae coli converge** here, a key landmark in surgery.

? Vermiform Appendix

Introduction

- The **vermiform appendix** is a narrow, worm-like diverticulum arising from the **posteromedial wall of the caecum**, about **2 cm below the ileocaecal valve**.
- **Length:** 2–20 cm (average 9 cm).
- **Diameter:** about 5 mm.
- **Position:** variable; its base is constant (where **three taeniae coli converge**).
- **Function:** a **lymphoid organ**, part of gut-associated lymphoid tissue (GALT).

Positions of the Appendix

Common positions of the **tip** (base remains constant):

POSITION	DESCRIPTION	FREQUENCY
Retrocaecal	Behind caecum (commonest)	~65%
Pelvic	Hanging into pelvis	~30%
Subcaecal	Below caecum	~2%
Pre-ileal	In front of ileum	~1%
Post-ileal	Behind ileum	~1%

Clinical correlation: Pain of appendicitis may vary with position — pelvic appendicitis may cause suprapubic pain and urinary irritation.

Peritoneal Relations

- **Appendix** is completely **covered by peritoneum** and connected to the mesentery of the terminal ileum by a small triangular fold — the **mesoappendix**.
- The **appendicular artery** runs within the mesoappendix.

Blood Supply

- **Artery:** *Appendicular artery* (branch of the *posterior caecal artery* from *ileocolic artery* of SMA).
- **Vein:** *Appendicular vein* ? *ileocolic vein* ? *SMV*.
- **Lymphatics:** to *ileocolic and superior mesenteric nodes*.

- **Nerves:**
  - *Sympathetic (T10–T12)* ? pain.
  - *Parasympathetic (vagus)* ? peristalsis.

Relations

- **Anteriorly:** coils of small intestine, sometimes caecum.
- **Posteriorly:** psoas major, external iliac vessels (in pelvic position).
- **Base:** located at **McBurney's point** — one-third the distance from the **anterior superior iliac spine (ASIS)** to the **umbilicus**.

Interior

- **Lumen** opens into the caecum by the **appendicular orifice**, guarded by a small mucosal fold — the **valve of Gerlach** (inconstant).
- Lumen often obliterated in elderly due to fibrosis.

> ### ? Histology of Appendix

1. Mucosa:

- Lined by **simple columnar epithelium** with goblet cells.
- Contains **crypts of Lieberkühn**, but **no villi**.

- **Lymphoid follicles** occupy lamina propria and submucosa — characteristic feature.

2. Submucosa:

- Contains **large lymphoid nodules**, which may merge and almost replace the wall.

3. Muscular coat:

- Inner circular and outer longitudinal layers; outer layer continuous with caecal taeniae.
- Between them lies **Auerbach's plexus**.

4. Serosa:

- Complete peritoneal covering forming mesoappendix.

Histological hallmark: dense lymphoid tissue ? immune function (produces IgA, protects gut flora balance).

?? Clinical Anatomy of Appendix

1. Appendicitis

- Acute inflammation due to lumen obstruction by fecolith, seeds, or lymphoid hyperplasia.
- Sequence of pain:
  - *Initially periumbilical* (visceral, T10 dermatome).
  - Later *localised to right iliac fossa* (parietal peritoneum involvement).
- *Tenderness point:* McBurney's point.

- *Signs:* guarding, rebound tenderness, fever, leukocytosis.

2. Retrocaecal Appendicitis

- Pain less localised; may cause **psoas sign** (pain on hip extension).

3. Pelvic Appendicitis

- Causes **tenesmus, diarrhoea, and urinary frequency** due to irritation of bladder or rectum.

4. Ruptured Appendix

- Causes **generalised peritonitis** and **septic shock**; life-threatening emergency.

5. Chronic Appendicitis

- Recurrent mild attacks due to fibrosis or partial obstruction.

6. Referred Pain Explanation

- Appendix receives visceral afferents via **T10 segment** ? pain referred to **umbilical region**.

7. Appendicectomy

- Surgical removal; incision at **McBurney's point**.
- Identify base where **taeniae coli converge**.
- Mesoappendix ligated, artery secured to prevent bleeding.

? Ascending Colon

Anatomy

- Extends from **caecum to right colic (hepatic) flexure**.
- **Length:** ~15 cm.
- Lies on **right side of posterior abdominal wall**, between **caecum below** and **inferior surface of right lobe of liver above**.

Peritoneal relation:

- Covered by peritoneum **anteriorly and laterally**, fixed **posteriorly (retroperitoneal)**.

Relations:

- **Anterior:** coils of small intestine.
- **Posterior:** right iliacus, quadratus lumborum, transversus abdominis, and right kidney (via fascia).
- **Medial:** small intestine loops.
- **Lateral:** paracolic gutter (for fluid spread).

Blood Supply

- **Arteries:** Right colic and ileocolic arteries (branches of SMA).
- **Veins:** Correspond ? *SMV*.

- **Lymphatics:** Paracolic ? right colic ? superior mesenteric nodes.
- **Nerves:** Sympathetic (T11–L1) and vagus.

Clinical Anatomy

- **Ascending colon cancer** ? causes occult bleeding and anaemia.
- **Paracolic gutter** ? route for spread of peritoneal pus or fluid to subphrenic space.
- **Crohn's disease** may extend to involve ascending colon from terminal ileum.

? Right Colic Flexure (Hepatic Flexure)

- Junction between **ascending** and **transverse colon**.
- Lies under the **inferior surface of right lobe of liver**, in contact with **gall bladder**.
- More **acute and higher** than the splenic flexure.
- Attached to diaphragm by **hepaticocolic ligament** (peritoneal fold).
- **Clinical note:** site where colon may kink ? obstruction; frequent site of spread of gall-bladder inflammation.

? Transverse Colon

Anatomy

- Longest and most mobile part of large intestine (~45 cm).
- Extends from **right colic flexure** to **left colic (splenic) flexure**.
- Occupies **umbilical and upper hypogastric regions**.

Peritoneal relations:

- Completely covered; suspended by **transverse mesocolon**, which attaches to anterior border of pancreas.
- **Greater omentum** hangs from its anterior border.

Relations:

- **Superiorly:** liver, gall bladder, stomach.
- **Inferiorly:** coils of small intestine.
- **Posteriorly:** duodenum, pancreas.

Blood Supply

- **Arteries:**
  - *Proximal 2/3:* Middle colic artery (from SMA).
  - *Distal 1/3:* Left colic artery (from IMA).
  - *Marginal artery* connects them.
- **Veins:** SMV and IMV ? portal vein.

- **Lymphatics:** middle colic ? superior mesenteric nodes; distal ? inferior mesenteric nodes.
- **Nerves:**
  - *Proximal 2/3:* vagus.
  - *Distal 1/3:* pelvic splanchnic (S2–S4).

Clinical Anatomy

- **Transverse Colon Volvulus:** twisting on its mesocolon ? obstruction.
- **Cancer:** common at hepatic and splenic flexures (watershed zones).
- **Colostomy:** transverse colon often used for temporary faecal diversion.
- **Paracolic gutter spread:** right gutter leads infection to subhepatic space; left is shallower due to phrenicocolic ligament.

? Summary Table

PART	PERITONEAL TYPE	MAIN ARTERY	COMMON PATHOLOGY
Appendix	Intraperitoneal	Appendicular (SMA)	Appendicitis
Ascending colon	Retroperitoneal	Right colic (SMA)	Cancer, abscess

PART	PERITONEAL TYPE	MAIN ARTERY	COMMON PATHOLOGY
Hepatic flexure	Retroperitoneal	Middle colic (SMA)	Kinking, inflammation spread
Transverse colon	Intraperitoneal	Middle & left colic	Volvulus, carcinoma

? Left Colic Flexure (Splenic Flexure)

Anatomy

- Junction between **transverse colon** and **descending colon**.
- Located in the **left hypochondrium**, opposite the **tip of the 9th rib**, slightly higher and more acute than the hepatic flexure.
- Directed upward, backward, and medially.
- Suspended by a peritoneal fold — **phrenicocolic ligament** — extending from its angle to the diaphragm near the spleen.

Relations

- **Anteriorly:** stomach and spleen.
- **Posteriorly:** left kidney.

- **Superiorly:** diaphragm.
- **Inferiorly:** coils of jejunum.

Blood Supply

- **Artery:** *Left colic artery* (branch of IMA).
- **Vein:** *Inferior mesenteric vein* ? *splenic vein*.
- **Lymphatics:** along left colic vessels ? *inferior mesenteric nodes*.
- **Nerve supply:** sympathetic (L1–L2) and parasympathetic (pelvic splanchnic, S2–S4).

Clinical Anatomy

- **Watershed area:** junction of SMA and IMA territories ? vulnerable to ischaemia.
- **Splenic flexure syndrome:** pain due to gas distension at the flexure.
- In peritonitis, **phrenicocolic ligament** acts as a **barrier** to spread of infection upward.

? Descending Colon

Anatomy

- Extends from the **splenic flexure** to the **sigmoid colon**.
- **Length:** about 25 cm.

- Occupies the **left lumbar region**.

Peritoneal Relations

- Covered by peritoneum **anteriorly and laterally**, fixed **posteriorly (retroperitoneal)**.

Relations

- **Anterior:** coils of small intestine.
- **Posterior:** left kidney, quadratus lumborum, transversus abdominis, iliac crest.
- **Medial:** small intestinal loops.
- **Lateral:** left paracolic gutter (shallower than right due to phrenicocolic ligament).

Blood Supply

- **Artery:** *Left colic artery* (from IMA).
- **Vein:** *Inferior mesenteric vein* ? *splenic vein*.
- **Lymphatics:** to *inferior mesenteric nodes*.
- **Nerves:** sympathetic (L1–L2), parasympathetic (pelvic splanchnic, S2–S4).

Clinical Anatomy

- **Descending colon carcinoma** presents late with obstruction.
- **Left paracolic gutter** limits downward spread of pus from subphrenic abscess.
- Pain in left iliac fossa may mimic sigmoid or ureteric pain.

? Sigmoid Colon (Pelvic Colon)

Anatomy

- Begins at the end of **descending colon** in the left iliac fossa and ends at the **rectosigmoid junction** (S3).
- **Length:** about 40 cm.
- Forms an **S-shaped loop**.
- Lies in **pelvic cavity**, highly **mobile** due to its **sigmoid mesocolon** (a V-shaped peritoneal fold).

Relations

- **Anterior:** coils of ileum, urinary bladder (in males), uterus (in females).
- **Posterior:** sacrum, rectum.

Peritoneal Relations

- Completely **covered by peritoneum** and attached to the posterior pelvic wall by **sigmoid mesocolon**.

Blood Supply

- **Arteries:** *Sigmoid branches of IMA*.
- **Veins:** *IMV ? splenic vein ? portal vein*.

- **Lymphatics:** sigmoid nodes ? inferior mesenteric nodes.
- **Nerves:**
  - *Sympathetic:* L1–L2.
  - *Parasympathetic:* pelvic splanchnic (S2–S4).

Clinical Anatomy

- **Sigmoid volvulus:** twisting of the sigmoid loop on its mesentery ? obstruction, distension, and gangrene.
- **Diverticulitis:** herniation of mucosa through weak points in muscular wall ? inflammation, pain, bleeding.
- **Carcinoma:** common site for left-sided colonic cancer; may lead to ribbon-like stools.
- **Sigmoid colostomy:** preferred site for surgical faecal diversion due to mobility.

? Histology of Colon

Layers of the Wall

1. **Mucosa**
   - *Epithelium:* simple columnar with numerous goblet cells (for lubrication).
   - *Villi:* absent.
   - *Crypts of Lieberkühn:* straight, deep, lined by absorptive cells and goblet cells.

- *Lamina propria:* rich in lymphocytes and plasma cells.

2. **Submucosa**
   - Dense connective tissue with blood vessels, lymphatics, and Meissner’s plexus.
3. **Muscularis externa**
   - Inner circular layer continuous.
   - Outer longitudinal layer condensed into **three taeniae coli**.
   - Between them lies **Auerbach’s plexus**.
4. **Serosa**
   - Peritoneal covering containing **appendices epiploicae** (fat pouches).

Key features:

- Abundant goblet cells ? lubrication for faecal passage.
- No villi, but well-developed glands.
- Taeniae coli and haustra are characteristic gross features.

> **? Development of Intestines**

---

1. Origin

- Derived from **midgut** and **hindgut** portions of the primitive gut tube.

- **Midgut:** from distal duodenum to proximal 2/3 of transverse colon.
- **Hindgut:** from distal 1/3 of transverse colon to upper part of anal canal.

---

2. Midgut Loop and Rotation

- Midgut forms a **U-shaped loop** with the **superior mesenteric artery** as its axis.
- **Physiological herniation** into umbilical cord occurs during **6th week**.
- Loop undergoes **270° counterclockwise rotation**:
  - *First 90°* during herniation.
  - *Remaining 180°* during return to abdominal cavity (~10th week).
- After rotation:
  - **Jejunum and ileum** occupy central abdomen.
  - **Caecum** descends to right iliac fossa.
  - **Colon** forms its characteristic frame.

---

3. Fixation

- Some parts lose their mesentery and become **retroperitoneal** (duodenum, ascending, and descending colon).
- Others remain **intraperitoneal** (jejunum, ileum, transverse and sigmoid colon).

---

4. Hindgut Development

- Gives rise to **distal transverse colon, descending colon, sigmoid colon, rectum, and upper anal canal**.
- Terminal part ends in **cloaca**, divided by the **urorectal septum** into:
  - *Rectum and anal canal* (posterior).
  - *Urogenital sinus* (anterior).

---

5. Clinical Correlations

- **Malrotation:** abnormal rotation ? volvulus or obstruction.
- **Omphalocoele:** failure of intestinal loops to return ? herniation at umbilicus.
- **Meckel's diverticulum:** persistence of vitelline duct.
- **Aganglionic megacolon (Hirschsprung's disease):** absence of enteric ganglia in distal colon ? obstruction.
- **Atresia/Stenosis:** due to failure of recanalisation.

? Summary Table

STRUCTURE	ARTERIAL SUPPLY	PERITONEAL RELATION	CLINICAL NOTES
Splenic Flexure	Left colic (IMA)	Retroperitoneal	Ischaemia (watershed area)

STRUCTURE	ARTERIAL SUPPLY	PERITONEAL RELATION	CLINICAL NOTES
Descending Colon	Left colic (IMA)	Retroperitoneal	Cancer, abscess
Sigmoid Colon	Sigmoid branches (IMA)	Intraperitoneal	Volvulus, carcinoma
Colon (Histology)	—	—	Goblet-rich mucosa, no villi
Development	Midgut & hindgut	—	270° rotation; malrotation, Hirschsprung's

? Mnemonics

1. Parts of Large Intestine (in order):
Cats **A**re **T**oo **L**azy **D**uring **S**leep
? **Caecum**, **Ascending**, **Transverse**, **Left/Splenic Flexure**, **Descending**, **Sigmoid**

2. Features of Large Intestine (3 T's):
Taeniae coli
Taenia omentalis
Taenia mesocolica

3. Rule of 2 for Appendix:

- 2 inches long
- 2 feet from ileocaecal valve

- In 2% population
- Two types of mucosa (gastric/pancreatic)

4. Rotation of Midgut (Development):
My **I**ntestine **R**otates **2**70°
? **Midgut**, **Intestine**, **Rotation = 270° counterclockwise**

5. Contents of Sigmoid Mesocolon:
Sigmoid **A**rtery, **V**ein, **L**ymphatics, **N**erves
? "**SAVL Nerves**"

6. Blood Supply (Colic arteries):
Inferior **L**eft **M**eans **S**uperior **Middle **Right**
? **IMA ? Left colic**, **SMA ? Middle & Right colic**

> **? Facts to Remember**

1. The **large intestine** extends from the **ileocaecal junction to the anus**, about **1.5 m long**.
2. It is divided into: **caecum, colon (ascending, transverse, descending, sigmoid), rectum, and anal canal**.
3. **Three taeniae coli** run along the colon—**taenia libera**, **taenia mesocolica**, and **taenia omentalis**.
4. The **taeniae are shorter than the intestinal wall**, producing **haustra (sacculations)**.
5. **Appendices epiploicae** (fat pouches) are numerous on the **sigmoid and transverse colon** but absent in the appendix and rectum.

6. The **marginal artery of Drummond** runs along the inner border of the colon, connecting the **SMA and IMA**.

7. The **vasa longa** and **vasa brevia** arise from the marginal artery and supply the intestinal wall.

8. **Blood supply:**
    - Midgut derivatives ? **SMA** (up to proximal 2/3 of transverse colon).
    - Hindgut derivatives ? **IMA** (from distal 1/3 of transverse colon to upper anal canal).

9. **Venous drainage:** via **superior and inferior mesenteric veins ? portal vein**.

10. **Nerve supply:**
    - *Sympathetic:* T11–L2 (via superior and inferior mesenteric plexuses).
    - *Parasympathetic:* vagus (midgut) and pelvic splanchnic nerves S2–S4 (hindgut).

11. **Lymphatic drainage:** epicolic ? paracolic ? intermediate ? main colic ? SMA/IMA nodes ? cisterna chyli.

12. **Functions of the colon:**
    - Absorption of water and electrolytes.
    - Mucus secretion for faecal lubrication.
    - Vitamin B and K synthesis by colonic flora.

13. **Development:**

- Midgut forms up to proximal 2/3 of transverse colon.
- Hindgut forms distal 1/3 of transverse colon, descending, sigmoid, and rectum.
- Midgut loop rotates **270° counterclockwise** around SMA.

14. **Fixation:** Ascending and descending colon become **retroperitoneal**; transverse and sigmoid remain **intraperitoneal**.
15. **Clinical correlation:**
    - *Watershed area:* splenic flexure (junction of SMA–IMA supply).
    - *Sigmoid volvulus:* twisting due to long mesocolon.
    - *Diverticulosis:* mucosal herniation through weak muscular points.

> **?? Clinicoanatomical Problems — Large Intestine, Sigmoid Colon & Development**

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1. Appendicitis

- **Cause:** Obstruction of appendicular lumen by fecolith, lymphoid hyperplasia, or worms.
- **Pain:** Initially periumbilical (T10 dermatome) ? localises to right iliac fossa (McBurney's point).
- **Complication:** Perforation ? peritonitis ? sepsis.

---

2. Diverticulitis

- **Definition:** Inflammation of a colonic diverticulum (mucosal outpouching through weak muscular wall).
- **Common Site:** Sigmoid colon.
- **Clinical Picture:** Left-sided abdominal pain, fever, blood in stool.
- **Complication:** Abscess or perforation leading to peritonitis.

---

3. Volvulus of Sigmoid Colon

- **Mechanism:** Twisting of the mobile sigmoid loop on its mesentery.
- **Result:** Intestinal obstruction, distension, gangrene.
- **Radiology:** “Coffee-bean sign” on X-ray.
- **Treatment:** Sigmoid colectomy or detorsion.

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4. Colonic Carcinoma

- **Right-sided (Ascending colon):** Occult bleeding, anaemia, palpable mass.
- **Left-sided (Descending/Sigmoid):** Altered bowel habits, obstruction, ribbon-shaped stools.
- **Metastasis:** Spreads to liver via portal vein.

---

5. Hirschsprung’s Disease (Congenital Megacolon)

- **Cause:** Absence of ganglion cells in Auerbach’s and Meissner’s plexuses (distal colon).

- **Effect:** Failure of relaxation ? functional obstruction ? proximal dilatation.
- **Site:** Usually rectosigmoid region.
- **Treatment:** Surgical resection of aganglionic segment.

---

6. Ischaemic Colitis

- **Cause:** Compromised blood flow in marginal artery (often at splenic flexure — “watershed zone”).
- **Symptoms:** Crampy pain, bloody diarrhoea.
- **Common in:** Elderly with atherosclerosis.

---

7. Paracolic Gutter Spread

- **Mechanism:** Infection/pus in peritoneal cavity tracks along paracolic gutters.
- **Right gutter:** Communicates with subhepatic and subphrenic spaces.
- **Left gutter:** Limited by phrenicocolic ligament.

---

8. Caecal Volvulus

- **Cause:** Abnormally mobile caecum twists on its mesentery.
- **Symptoms:** Acute obstruction, distension, pain in right abdomen.
- **Radiograph:** Gas-filled caecum displaced centrally or to the left.

---

9. Ileocaecal Tuberculosis

- **Site:** Terminal ileum and caecum.
- **Findings:** Ulceration, fibrosis, and stricture formation ? obstruction.
- **Clinical mimic:** Carcinoma or Crohn’s disease.

---

10. Meckel’s Diverticulitis

- **Cause:** Inflammation of a persistent vitellointestinal duct remnant.
- **Presentation:** Mimics appendicitis but located 2 ft proximal to ileocaecal valve.
- **Complication:** Ulceration or bleeding due to ectopic gastric mucosa.

---

11. Midgut Malrotation

- **Cause:** Incomplete or abnormal 270° rotation during development.
- **Effect:** Abnormal fixation ? volvulus, obstruction.
- **Infants:** Bilious vomiting within first few days of life.

---

12. Omphalocoele

- **Cause:** Failure of intestinal loops to return from physiological herniation (6th–10th week).
- **Appearance:** Umbilical sac containing intestinal loops, covered by peritoneum.

---

13. Persistent Vitelline Duct

- **Cause:** Non-obliteration of vitellointestinal duct.
- **Result:** Fistula between ileum and umbilicus ? discharge of intestinal contents from umbilicus.

---

14. Atresia or Stenosis of Intestine

- **Cause:** Failure of recanalisation of embryonic gut tube.
- **Effect:** Intestinal obstruction (vomiting, distension, failure to pass meconium).

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15. Enteric Fever (Typhoid Ulcers)

- **Pathology:** Necrosis of Peyer’s patches (ileum) ? ulceration, haemorrhage, perforation.
- **Complication:** Peritonitis and fatal bleeding.

---

16. Sigmoid Diverticulosis

- **Description:** Multiple outpouchings in sigmoid colon due to weak muscular wall.
- **Causes:** Low-fibre diet, chronic constipation, increased intraluminal pressure.
- **Symptoms:** Pain, altered bowel habits, rectal bleeding.

---

17. Rectosigmoid Junction Cancer

- **Reason for importance:** Common site for malignant change due to stasis and chronic irritation.

- **Clinical Significance:** Detected by digital rectal examination; spreads locally and via lymphatics.

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18. Splenic Flexure Syndrome

- **Mechanism:** Trapped gas at the highest point of colon.
- **Symptom:** Sharp left upper quadrant pain relieved by passing flatus.

---

19. Chronic Constipation

- **Cause:** Reduced motility or prolonged water absorption in large intestine.
- **Effect:** Hard stool, faecal impaction, sigmoid distension.

---

20. Peritonitis after Appendicular Rupture

- **Cause:** Spillage of purulent contents into peritoneal cavity.
- **Effect:** Rigid abdomen, severe pain, rebound tenderness.
- **Spread:** Along right paracolic gutter to subhepatic space.

? Summary of High-Yield Associations

CONDITION	COMMON SITE	PATHOPHYSIOLOGY
Diverticulitis	Sigmoid colon	Mucosal herniation
Volvulus	Sigmoid or caecum	Twisting of mesocolon

CONDITION	COMMON SITE	PATHOPHYSIOLOGY
Carcinoma	Sigmoid/rectosigmoid	Adenocarcinoma
Hirschsprung’s	Rectosigmoid	Aganglionic segment
Ischaemia	Splenic flexure	SMA–IMA junction
Malrotation	Midgut	Abnormal 270° rotation

? Frequently Asked Questions — Large Intestine & Development

---

1. What are the characteristic features of the large intestine?

- Presence of **three taeniae coli**.
- **Sacculations (haustra)** due to shorter longitudinal layer.
- **Appendices epiploicae** — fat pouches on the wall.
- **Wider lumen** and absence of villi.

---

2. Why does the rectum lack taeniae coli and haustra?

- In the rectum, the **three taeniae spread out to form a uniform outer longitudinal layer**, giving a smooth surface with no sacculations.

---

3. What is the function of the large intestine?

- Absorption of **water and electrolytes**.
- Formation and **temporary storage of faeces**.
- **Bacterial synthesis** of vitamins K and B complex.
- Secretion of **mucus** for lubrication of faecal matter.

---

4. What is the blood supply of the large intestine?

- **From SMA:** caecum, ascending, and proximal two-thirds of transverse colon.
- **From IMA:** distal one-third of transverse, descending, sigmoid, and upper rectum.
- These anastomose to form the **marginal artery of Drummond**.

---

5. What is the marginal artery of Drummond?

- A continuous arterial arcade along the inner border of the colon, formed by **branches of SMA and IMA**, ensuring collateral circulation.

---

6. Which part of the colon is most prone to ischaemia?

- **Splenic flexure** — a watershed zone between SMA and IMA territories (Griffith's point).

---

7. What are the peritoneal relations of the colon?

- **Ascending and descending colon:** secondarily retroperitoneal.
- **Transverse and sigmoid colon:** intraperitoneal with mesocolon.

---

8. What is the function of appendices epiploicae?

- Small peritoneal fat pouches that **reduce friction** and serve as **fat storage**, though sometimes may become inflamed.

---

9. What is the importance of the paracolic gutters?

- Serve as **pathways for peritoneal fluid or pus** spread.
- Right gutter communicates freely with subphrenic space; left is limited by **phrenicocolic ligament**.

---

10. Why is the sigmoid colon more prone to volvulus?

- Because it is **long, mobile, and has a long mesocolon**, allowing it to twist on its mesentery.

---

11. What is the significance of the taeniae coli?

- They represent **condensed outer longitudinal muscle layers** that produce haustra and converge at the **appendix base**, marking it during surgery.

---

12. What are haustra and how are they formed?

- **Sacculations** of the colon caused by the **shorter taeniae coli** pulling on the intestinal wall.

---

13. Why are colonic cancers more common at flexures?

- Flexures are **sites of stasis and angulation**, leading to chronic irritation and increased epithelial turnover.

---

14. Why is the appendix called a lymphoid organ?

- Because its wall contains **abundant lymphoid follicles** extending into the submucosa, forming part of **GALT (gut-associated lymphoid tissue)**.

---

15. What is the arterial supply of the sigmoid colon?

- **Sigmoid branches of the inferior mesenteric artery (IMA)**, forming sigmoid arterial arcades within the sigmoid mesocolon.

---

16. Why is the caecum sometimes subhepatic in position?

- In infants or cases of **delayed caecal descent**, it remains high under the liver — known as **subhepatic caecum**.

---

17. What is the developmental origin of the large intestine?

- Derived from:
    - **Midgut:** up to proximal two-thirds of transverse colon.
    - **Hindgut:** distal one-third of transverse colon, descending colon, sigmoid colon, and rectum.

---

18. What is meant by physiological herniation of midgut?

- During the **6th week of development**, midgut loops temporarily herniate into the umbilical cord before returning to the abdomen by the **10th week**.

---

19. How much does the midgut rotate during development?

- The **midgut loop rotates 270° counter-clockwise** around the axis of the **superior mesenteric artery**.

---

20. What are the results of abnormal midgut rotation?

- **Non-rotation:** small intestine lies on the right side.
- **Reversed rotation:** colon lies behind the duodenum.
- **Incomplete rotation:** predisposes to volvulus and obstruction.

---

21. What is Meckel's diverticulum and why is it important?

- A **true diverticulum** from the ileum — a remnant of the vitellointestinal duct.
- Common site of **bleeding, ulceration, and inflammation** mimicking appendicitis.

---

22. What is the clinical importance of the phrenicocolic ligament?

- Supports the **spleen from below** and limits upward spread of infection along the **left paracolic gutter**.

---

23. Which regions of colon are intraperitoneal and which are retroperitoneal?

INTRAPERITONEAL	RETROPERITONEAL
Transverse colon	Ascending colon
Sigmoid colon	Descending colon
Caecum	—

---

24. What is the nerve supply of the hindgut?

- **Sympathetic:** lumbar splanchnic (L1–L2).
- **Parasympathetic:** pelvic splanchnic nerves (S2–S4).
- These regulate colonic motility and reflex defecation.

---

25. What is Hirschsprung's disease?

- **Congenital absence of enteric ganglion cells** (Auerbach's and Meissner's plexuses) in distal colon ? failure of peristalsis ? megacolon.

---

26. Why does pain from sigmoid colon refer to the left lower quadrant?

- Because visceral afferents from sigmoid colon pass through **L1–L2 segments**, corresponding to that dermatome.

---

27. What are the common sites for volvulus?

- **Sigmoid colon** (most common).

- **Caecum** (less common).
- Due to excessive length and mobility of mesentery.

---

28. What is the significance of the ileocaecal valve?

- Prevents regurgitation of colonic contents into ileum, thus avoiding bacterial contamination of small intestine.

---

29. What are the main functions of colonic bacteria?

- Synthesize **vitamin K** and **B-complex vitamins**.
- Produce **short-chain fatty acids**.
- Protect against pathogenic bacteria.

---

30. Why does volvulus cause severe abdominal distension?

- Twisting obstructs both **lumen and blood vessels**, leading to **closed-loop obstruction**, rapid distension, and gangrene.

? Quick Recall Table

TOPIC	KEY ANSWER
Features of colon	Taeniae, haustra, appendices epiploicae
Most mobile part	Transverse & sigmoid colon

TOPIC	KEY ANSWER
Most fixed parts	Ascending & descending colon
Watershed area	Splenic flexure
Lymph drainage	Epicolic ? paracolic ? mesenteric ? SMA/IMA nodes
Development	Midgut + Hindgut rotation (270°)
Common pathology	Diverticulosis, volvulus, carcinoma

? Multiple Choice Questions — Large Intestine & Development of Intestines

---

1. The length of the large intestine in an adult is approximately:
a. 2.5 m
b. 1.5 m
c. 3.5 m
d. 0.5 m
?? **Answer:** b. 1.5 m

---

2. The part of the colon which is completely intraperitoneal is:
a. Ascending colon
b. Descending colon
c. Transverse colon
d. Rectum
?? **Answer:** c. Transverse colon

---

3. The sigmoid colon receives its blood supply from which artery?
a. Superior mesenteric artery
b. Inferior mesenteric artery

c. Internal iliac artery

d. Middle colic artery

?? **Answer:** b. Inferior mesenteric artery

---

4. The taeniae coli converge at the base of the:

a. Caecum

b. Appendix

c. Ascending colon

d. Sigmoid colon

?? **Answer:** b. Appendix

---

5. The marginal artery of Drummond is formed by:

a. Superior and inferior pancreaticoduodenal arteries

b. Internal iliac and median sacral arteries

c. Superior and inferior mesenteric arteries

d. Coeliac and superior mesenteric arteries

?? **Answer:** c. Superior and inferior mesenteric arteries

---

6. Which of the following features is *absent* in the rectum?

a. Haustra

b. Taeniae coli

c. Appendices epiploicae

d. All of the above

?? **Answer:** d. All of the above

---

7. The most common site of diverticulosis is:

a. Ascending colon

b. Caecum

c. Sigmoid colon

d. Rectum

?? **Answer:** c. Sigmoid colon

---

8. The watershed area between SMA and IMA territories is:

a. Hepatic flexure

b. Splenic flexure

c. Caecum

d. Sigmoid colon

?? **Answer:** b. Splenic flexure

---

9. The midgut rotates around which artery during development?

a. Coeliac trunk

b. Inferior mesenteric artery

c. Superior mesenteric artery

d. Umbilical artery

?? **Answer:** c. Superior mesenteric artery

---

10. During development, the midgut rotates through how many degrees?

a. 90° clockwise

b. 90° counterclockwise

c. 180° clockwise

d. 270° counterclockwise

?? **Answer:** d. 270° counterclockwise

---

11. The distal one-third of the transverse colon develops from the:

a. Midgut

b. Hindgut

c. Foregut

d. None of the above

?? **Answer:** b. Hindgut

---

12. The commonest site of volvulus in the large intestine is:

a. Caecum

b. Transverse colon

c. Sigmoid colon

d. Rectum

?? **Answer:** c. Sigmoid colon

---

13. Which ligament supports the spleen from below?

a. Gastrocolic ligament

b. Phrenicocolic ligament

c. Hepatocolic ligament

d. Gastrosplenic ligament

?? **Answer:** b. Phrenicocolic ligament

---

14. The lymph from the descending colon drains primarily into:

a. Superior mesenteric nodes

b. Inferior mesenteric nodes

c. Coeliac nodes

d. Lumbar nodes

?? **Answer:** b. Inferior mesenteric nodes

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15. The caecum is supplied by branches of which artery?

a. Left colic artery

b. Right colic artery

c. Ileocolic artery

d. Middle colic artery

?? **Answer:** c. Ileocolic artery

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16. The rectosigmoid junction lies at the level of which vertebra?

a. L5

b. S1

c. S3

d. S5

?? **Answer:** c. S3

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17. Failure of descent of the caecum results in:

a. Volvulus

b. Subhepatic caecum

c. Hirschsprung’s disease

d. Megacolon

?? **Answer:** b. Subhepatic caecum

18. The mucosa of the colon differs from that of the small intestine by:

a. Absence of villi

b. Presence of taeniae coli

c. Abundant goblet cells

d. All of the above

?? **Answer:** d. All of the above

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19. The congenital absence of enteric ganglion cells in distal colon is known as:

a. Megarectum

b. Megacolon

c. Hirschsprung’s disease

d. Meckel’s diverticulum

?? **Answer:** c. Hirschsprung’s disease

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20. The vitellointestinal duct normally obliterates by:

a. 3rd week

b. 5th week

c. 7th week

d. 9th week

?? **Answer:** c. 7th week

? Quick Review Summary

CONCEPT	KEY ANSWER
Length of large intestine	1.5 m
Intraperitoneal parts	Transverse & Sigmoid colon
Marginal artery	SMA + IMA
Taeniae coli converge	At base of appendix

CONCEPT	KEY ANSWER
Watershed zone	Splenic flexure
Common site of volvulus	Sigmoid colon
Rotation of midgut	270° counterclockwise
Hindgut derivatives	Distal 1/3 of transverse colon ? rectum
Caecal artery	Ileocolic
Rectosigmoid level	S3 vertebra

? Viva Voce — Large Intestine & Development

1. What distinguishes the large intestine from the small intestine?
Presence of taeniae coli, haustra, and appendices epiploicae; wider calibre; absence of villi.

2. Where do the taeniae coli meet?
At the base of the appendix.

3. What are haustra?
Sacculations formed because the taeniae coli are shorter than the intestinal wall.

4. Name the parts of the colon that are intraperitoneal.
Transverse and sigmoid colon.

5. Which parts of the colon are retroperitoneal?
Ascending and descending colon.

6. What is the arterial supply of the colon?
SMA supplies midgut derivatives up to two-thirds of transverse colon; IMA supplies the distal

one-third and hindgut parts.

7. What is the marginal artery of Drummond?
An anastomotic arcade between SMA and IMA along the inner border of the colon.

8. What is the venous drainage of the colon?
To the portal system via the superior and inferior mesenteric veins.

9. What is the nerve supply of the colon?
Sympathetic—thoracolumbar (T10–L2); parasympathetic—vagus for midgut, pelvic splanchnic (S2–S4) for hindgut.

10. What is the lymphatic drainage of the colon?
Epicolic ? paracolic ? intermediate ? main mesenteric nodes.

11. Why is the splenic flexure called the watershed area?
Because it is the junction of SMA and IMA territories—most prone to ischaemia.

12. What is the function of the large intestine?
Absorption of water & electrolytes, formation of faeces, vitamin K and B-complex synthesis.

13. Why does the rectum have no taeniae coli?
The three taeniae spread out to form a continuous longitudinal coat.

14. What is the function of the ileocaecal valve?
Prevents backflow of colonic contents into the ileum.

15. What is Meckel’s diverticulum?
A true diverticulum of the ileum—persistent vitellointestinal duct, 2 inches long, 2 feet from the ileocaecal valve.

16. Which part of the colon is most mobile?
Sigmoid colon.

17. What is Hirschsprung’s disease?
Congenital absence of enteric ganglia in distal colon leading to functional obstruction and megacolon.

18. What are appendices epiploicae?
Peritoneal fat tags along the colon.

19. What is the developmental rotation of the midgut?

270° counter-clockwise around the SMA axis.

20. Which parts of the gut arise from the hindgut?

Distal ? of transverse colon, descending colon, sigmoid colon, rectum, upper anal canal.

21. What is the ligament of Treitz?

Suspensory muscle of the duodenum marking the duodenojejunal flexure.

22. What are the common sites of volvulus?

Sigmoid colon > caecum.

23. What causes haustra to disappear in pathology?

In ulcerative colitis—loss of muscular tone gives a “lead-pipe” colon on X-ray.

24. What is the average length of the large intestine?

About 1.5 metres.

25. What is the clinical significance of the appendix position?

Helps locate appendicitis; McBurney’s point marks the junction of lateral and middle third of the line from ASIS to umbilicus.