The Digestive System
Lecture 6
Small Intestine

- Is the longest part of the alimentary canal.
- It is divided into three parts, the duodenum, jejunum, and ileum.
- The greater part of digestion and food absorption takes place in this part of the intestine.
Duodenum

- Is a C-shaped tube, the concavity of which faces upwards and to the left and is filled by the head of the pancreas.
- It is about 25 cm long, extends from pylorus to duodenjejunal flexure.
- The first 2 cm are contained between the peritoneum of the lesser and greater omentum, but the remainder part is retroperitoneal.
- It is subdivided into four parts:
a. Superior (first) part:

- Is about 5 cm long.
- Passes upwards and backwards from pylorus, below epiploic foramen, and above head of pancreas.
- It lies behind the quadrate lobe of liver and the gall bladder.
Epiploic foramen
Duodenum Superior (First) Part

- Right lobe of liver
- Left lobe of liver
- Right hepatic duct
- Cystic duct
- Common bile duct
- Gallbladder
- Duodenum
- Pancreas

Duodenum (1st Part)
b. Descending (Second) Part:
- Is about 8 cm long.
- It descends on the right side of the head of the pancreas.

Relations

Anterior Relations: From above downwards, it is related to fundus of gall bladder and right lobe of liver, transverse colon, and coils of small intestine.

Posterior relations: Right kidney and right ureter.

Medial Relations: Common bile duct, main pancreatic duct, and head of pancreas.
Duodenum Descending (Second) Part
Duodenum descending (Second) Part

- Right kidney
- Duodenum - superior part
- Duodenum - descending part
- Pancreas
• The common bile ducts joins the main pancreatic duct to form the hepatopancreatic ampulla (of Vater), which opens on summit of the major duodenal papilla, half way along the second part.

• 2 cm proximal is the small opening of the accessory pancreatic duct on the minor duodenal papilla.
c. Transverse (Third) Part:

- Is approximately 8 cm long.
- Passes horizontally to the left, below head of pancreas and in front of vertebral column.

Relations
Anterior Relations:
Crossed by superior mesenteric vessels and root of mesentery of small intestine.

Posterior Relations:
Right ureter, right psoas major, inferior vena cava, and abdominal aorta.
Superior Relations:
The head of the pancreas.

Inferior Relations:
Coils of jejunum.
Root of mesentery of small intestine

(Transverse) 3\textsuperscript{rd} part of duodenum
Duodenum Horizontal (Third) Part

Duodenum (3rd Part)
d. Ascending (Fourth) Part:

- Is about 5 cm long.

- Ascends to the left of abdominal aorta as far as the level of upper border of L2 vertebra.

- Turns anteriorly to form duodenojejunal flexure, where it continues with jejunum.

- The flexure is connected to diaphragm by a peritoneal fold, the ligament of Treitz.
Relations

Anterior Relations:
Roots of mesentery of small intestine, and coils of jejunum.

Posterior Relations:
Left psoas major and left sympathetic trunk.
Root of mesentery of small intestine

(Ascending) 4th part of duodenum
Duodenum Ascending (Fourth) Part

- Duodenum
- Right kidney
- Pancreas
- Duodenum - superior part
- Duodenum - descending part
- Psoas major
- Duodenum (4th Part)
Blood supply

- Upper half by superior pancreaticoduodenal branch of gastroduodenal artery.
- Lower half by inferior pancreaticoduodenal branch of superior mesenteric artery.
- Upper half of duodenum is drained by superior pancreaticoduodenal vein into portal vein.
- Lower half by inferior pancreaticoduodenal vein into superior mesenteric vein.
Lymph Drainage
Lymphatic vessels drain upward to celiac nodes, and downwards to superior mesenteric nodes.

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Jejunum and Ileum

- The rest of small intestine are about 6m long.
- It extends from the duodenojejunal flexure to the ileocecal junction.
- It is divided into jejunum and ileum.
- The jejunum name being given to the first two-fifths and the ileum to the distal three-fifths.
- Both parts are arranged in a series of coils or loops which are attached to the posterior abdominal wall by its mesentery, and are freely mobile.
Jejunum

- The coils of jejunum lie in the upper part of the peritoneal cavity, below the left side of the transverse mesocolon.

- Its wall feels thicker than the ileum when it is grasped between index finger and thumb due to the numerous, closely packed, circular fold of its mucous membrane, the plicae circulares.

- The fat is deposited near the root and is scanty near the intestinal wall.
Jejunum

Mesentery

plicae circulares

Solitary nodule
Its mesentery is attached to the posterior abdominal wall above and to the left of the abdominal aorta.
Root of mesentery of small intestine

(Ascending) 4th part of duodenum
Ileum

- The coils of ileum lie in lower part of abdominal cavity and in the pelvis.
- In the upper part of the ileum, the plicae circulares are smaller and more widely separated than that in the jejunum.
- In the lower part of the ileum, the plicae circulares are absent.

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- Aggregation of lymphatic follicles, Peyer's patches are present in the mucous membrane of the lower portion of the ileum along the antimesenteric border.

- The ileal mesentery is attached to the posterior abdominal wall below and to the right of aorta.

- Fat is deposited throughout so that it extends from the root to the intestinal border.
Ileum

Mesentery

plicae circulares

Solitary nodule

Peyer's patches
Blood Supply

- Numerous jejunal and ileal branches arise from left side of superior mesenteric artery and enter the mesentery by passing between the two layers of the root.

- The jejunal branches join each other in a series of anastomosing loops to form arterial arcades: single for the upper jejunum and double lower down.

- From the arcades, straight arteries pass to the mesenteric border of the gut.
- These vessels are long and close together.

- The ileal arteries are similar but form a large series of arcades, 3 – 5, the most distal lying near the ileal wall so that the straight vessels branching off the arcades are shorter than those for the jejunum.

- Occlusion of a straight artery may lead to infarction of the segment of the jejunum or ileum supplied because these are end arteries, but occlusion of arcade vessels is usually without effect due to their numerous anastomotic connections.
Jejunum

- Straight artery
- Arterial arcades
Ileum

Straight artery

Arterial arcades
Veins correspond to the branches of the superior mesenteric artery and drain to the superior mesenteric vein.

**Lymph Drainage**

Lymphatic vessels from jejunum and ileum drain into superior mesenteric nodes.

**Nerve Supply**

The jejunum and ileum are supplied by autonomic nerve fibers, sympathetic and parasympathetic (vagal) through the superior mesenteric plexus of nerves.
Large Intestine

- Is about 1.5 m long.
- Extends from the end of ileum to anus.
- Its caliber is greatest at its commencement at cecum, and gradually diminishes as far as rectum.
- Its primary function is the absorption of water and electrolytes, and the storage of the undigested material until it can be expelled from the body as feces.
- It consists of caecum with vermiform appendix, ascending, transverse, descending and sigmoid parts of the colon, rectum, and anal canal.

- The longitudinal muscular fibers, although distributed as a complete layer, are particularly concentrated to form three longitudinal bands, the taeniae coli.

- The taeniae coli thrown the colonic wall into sacculations (the haustra of the colon).
Taenia coli

Haustra
Caecum

- Is the blind pouch of large intestine that lies in right iliac fossa below level of ileocecal junction, and above lateral half of the inguinal ligament.
- It is about 6 cm long.
- The taenia coli lie one anterior, one posteromediial and one posterolateral.
- All three converge on base of appendix.
Caecum
In most cases, it is completely covered with peritoneum and therefore freely movable, but the posterior surface may be devoid of peritoneum so that it is fixed to posterior abdominal wall.

It is often distended with gas and can then be palpated through anterior abdominal wall.

Relations
Anterior Relations: It is usually in contact with anterior abdominal wall, but the greater omentum, and, if the cecum is empty, some coils of ileum may be interposed.
Posterior Relations: Psoas and iliacus, being separated from both muscles by retrocecal recess which frequently contains vermiform appendix, femoral nerve, and lateral cutaneous nerve of thigh.
Posterior relations of caecum

- Lateral cutaneous nerve of thigh
- Iliacus
- Psoas major
- Femoral nerve
Lymph Drainage
Lymphatic vessels from cecum drain into superior mesenteric nodes.

Nerve Supply
The cecum is supplied by autonomic nerve fibers, sympathetic and parasympathetic (vagal).

Blood Supply
- The anterior and posterior caecal branches of ileocolic artery (a branch of superior mesenteric artery).
- Veins correspond to arteries and drain into superior mesenteric vein.
Appendix

- Is a narrow, blind ending muscular tube containing a large amount of lymphoid tissue.

- It varies in length (commonly about 6 – 9 cm).

- Its base opens into the posteromedial wall of cecum 2 cm below ileocelecal valve.

- It has a complete peritoneal covering, which is attached to mesentery of the small intestine by the mesoappendix.
The mesoappendix contains the appendicular vessels and nerves.

In relation to the anterior abdominal wall, the base of appendix is situated one third of the way up the line joining the right anterior superior iliac spine to the umbilicus.
The tip of the appendix is subject to a considerable range of movement and may be found in the following positions:

(1) Behind cecum (retrocecal position); or behind the lower part of ascending colon (retrocolic position), or behind both (form about 65.25% of the cases).
(2) hanging down into the pelvis against right pelvic wall (pelvic), form about 31% of cases.

(3) Below cecum (subcecal), forms about 2.25% of cases.

(4) front of the terminal part of ileum (preileal), forms about 1% of cases; or behind the terminal part of ileum (postileal), forms about 0.5% of the cases.
Various Position of tip of Appendix

- Preileal
- Postileal
- Ileum
- Retrocecal
- Cecum
- Subcecal
- Pelvic
Blood Supply: The appendicular branch of posterior caecal artery. Appendicular vein drains into posterior caecal vein.

Lymphatic Drainage: Lymph vessels from appendix drain into superior mesenteric nodes.

Nerve Supply:
▪ Autonomic fibers are derived from the sympathetic and parasympathetic nerve.
Superior mesenteric artery

Ileocolic artery

Posterior cecal artery

Appendicular artery
These fibers enter the appendix via superior mesenteric plexus.

Afferent nerve fibers concerned with conduction of visceral pain from appendix enter spinal cord at level of T10 segment.

Ileocecal Orifice

The distal end of ileum enters through a horizontal slit guarded above and below by folds of the wall of the gut tube produced by invagination of ileum into cecum ileocecal valve.
- The circular muscle of the lower end of the ileum forms the ileocecal sphincter, as called by physiologists.
- This sphincter controls the flow of contents from ileum into colon.
Ileocecal Orifice

Ileocecal orifice
Ileocecal Orifice

Ileocecal orifice
Upper and lower fold of Ileocecal orifice
3. The colon
Includes ascending colon, transverse colon, descending colon, and sigmoid colon:

A. Ascending Colon
- Is about 15 cm long.
- It is placed retroperitoneally in right lumbar and hypochondriac regions of the abdominal cavity.
Ascending colon
- It extends upwards from cecum to inferior surface of right lobe of liver, where it bends sharply to the left, forming the right colic (hepatic) flexure, and becomes continuous with the transverse colon.

- The peritoneum covers the front and sides of ascending colon, binding it to posterior abdominal wall.
Ascending colon
Right colic (hepatic) flexure
Liver
Ascending colon
Relations

Anterior Relations:
From before backwards, the anterior abdominal wall, greater omentum, and coils of small intestine.

Posterior Relations:
- Quadratus lumborum, origin of transverses abdominis, iliacus, and lower end of R. kidney.
- The lateral cutaneous nerve of the thigh, and frequently the ilioinguinal and iliohypogastric nerves cross behind it.
Posterior relations of Ascending colon

- Iliohypogastric nerve
- Ilioinguinal nerve
- Transversus abdominis
- Iliacus
- Lateral cutaneous nerve of thigh
Blood Supply
The ileocolic and right colic branches of superior mesenteric artery. Veins correspond to arteries and drain into superior mesenteric vein.

Lymph Drainage
Lymph vessels from ascending colon drain into superior mesenteric nodes.

Nerve Supply
Sympathetic and parasympathetic (vagal) nerve fibers supply this part of colon via superior mesenteric nerve plexus.
Superior mesenteric artery

Ileocolic artery

Right colic artery
4. Transverse Colon
- is about 50 cm long.
- Begins at right colic flexure.
- It extends across abdomen, occupying the umbilical region, and then left hypochondriac region, where it bends sharply downwards and backwards, beneath spleen, forming the left colic (splenic) flexure.
- It is hangs downwards, suspended by the transverse mesocolon from the pancreas, and arches across the abdomen with its convexity anteroinferiorly.

- The left colic (splenic) flexure lies at a higher level than, and on a plane posterior to, right colic flexure.

- It is attached to the diaphragm, opposite 10\textsuperscript{th} and 11\textsuperscript{th} ribs by a peritoneal fold, named the phrenicocolic ligament, which lies below the lateral end of the spleen.
Relations

Anterior Relations: Anterior abdominal wall and greater omentum.

Posterior Relations: 2\textsuperscript{nd} part of duodenum, head of pancreas, and coils of small intestine.

Superior relations: Liver, gall bladder, greater curvature of stomach, and lateral end of spleen.

Inferior Relations: Small intestine.
Liver
Spleen
Stomach
Greater omentum
gallbladder

Superior and anterior relations of transverse colon
Transverse colon

Head of pancreas

Descending (2nd part) of duodenum

Posterior relations of transverse colon
Blood Supply

- The proximal two-thirds of the transverse colon is supplied by middle colic branch of superior mesenteric artery. The distal third by left colic branch of inferior mesenteric artery.

- Veins correspond to arteries and drain into superior and inferior mesenteric veins.

Lymph Drainage

- Lymph vessels from proximal two-thirds of transverse colon drain into superior mesenteric nodes.
Superior mesenteric artery

Middle artery
Vessels from distal third of transverse colon drain into inferior mesenteric nodes.

Nerve Supply

- Sympathetic and parasympathetic (vagal) nerve fibers via superior mesenteric plexus supply proximal two-thirds of transverse colon.

- The distal third is supplied by sympathetic and parasympathetic (pelvic splanchnic) nerve fibers via inferior mesenteric plexus.