

Large Blood Vessels of the Gut

❖ *Give me blood, I will give you Azadi.* ❖
—Netaji Subhash Chandra Bose

INTRODUCTION

The three ventral branches of the abdominal aorta are coeliac trunk, superior mesenteric and inferior mesenteric arteries. These are the arteries of the foregut, midgut and hindgut, respectively. There are anastomoses between the branches of these three main arteries.

In this chapter, the coeliac trunk, the superior and inferior mesenteric vessels, and the portal vein will be studied.

Competency achievement: The student should be able to:

AN47.9 Describe and identify the origin, course, important relations and branches of abdominal aorta, coeliac trunk, superior mesenteric, inferior mesenteric and common iliac artery.

BLOOD VESSELS

COELIAC TRUNK

The coeliac trunk is the artery of the foregut (Figs 21.1 and 21.2). It supplies all derivatives of the foregut that lie in the abdomen, namely:

- 1 The lower end of the oesophagus, the stomach and upper part of the duodenum up to the opening of the bile duct.
- 2 Liver
- 3 Spleen
- 4 Greater part of the pancreas.

Origin and Length

The coeliac trunk arises from the front of the abdominal aorta just below the aortic opening of the diaphragm at the level of the disc between thoracic twelve and first lumbar vertebrae. The trunk is only about 1.25 cm long. It ends by dividing into its three terminal branches, namely the left gastric, common hepatic and splenic arteries (Figs 21.3 to 21.5).

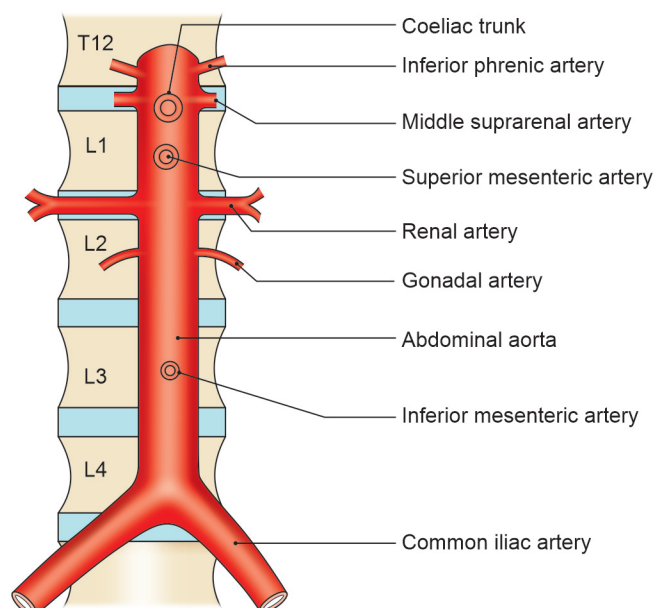


Fig. 21.1: Ventral and lateral branches of the abdominal aorta with their levels of origin

Relations

- 1 It is surrounded by the coeliac plexus of nerves (*see* Fig. 27.6).
- 2 Anteriorly, it is related to the lesser sac and to the lesser omentum (Fig. 21.2).
- 3 To its right, there are the right crus of the diaphragm, the right coeliac ganglion and the caudate process of the liver.
- 4 To its left, there are the left crus of the diaphragm, the left coeliac ganglion and the cardiac end of the stomach.
- 5 Inferiorly, it is related to the body of the pancreas and to the splenic vein (Fig. 21.2).

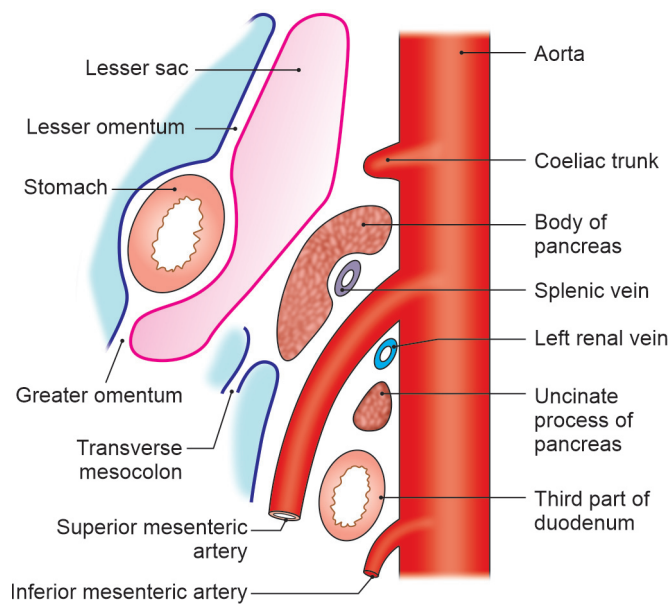


Fig. 21.2: Left view of a sagittal section through the abdominal aorta showing the origin of its three ventral branches

Branches

Left Gastric Artery

The *left gastric artery* is the smallest of the three branches of the coeliac trunk. It runs upwards to the left behind the lesser sac to reach the cardiac end of the stomach where it turns forwards and enters the lesser omentum to run downwards along the lesser curvature of the stomach. It ends by anastomosing with the right gastric artery.

It gives off:

- Two or three *oesophageal branches* at the cardiac end of the stomach.

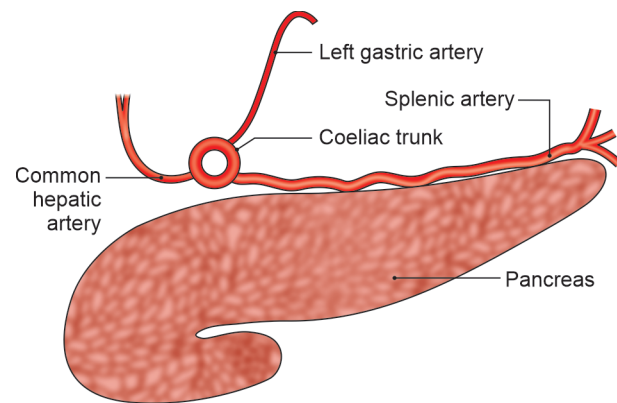


Fig. 21.3: Three branches of the coeliac trunk

- Numerous *gastric branches* along the lesser curvature of the stomach (Fig. 21.4), supplying large part of body of stomach.

Common Hepatic Artery

The *common hepatic artery* runs downwards, forwards and to the right, behind the lesser sac to reach the upper border of the first part of duodenum. Here it enters the lesser omentum. It then run upwards as proper hepatic artery in the right free margin of the lesser omentum, in front of the portal vein, and to the left of the bile duct (see Figs 18.10 and 21.4). Reaching the porta hepatis, it terminates by dividing into right and left hepatic branches.

Branches

- The *gastroduodenal artery* is a large branch which arises at the upper border of the first part of the duodenum. The part of the hepatic artery till the

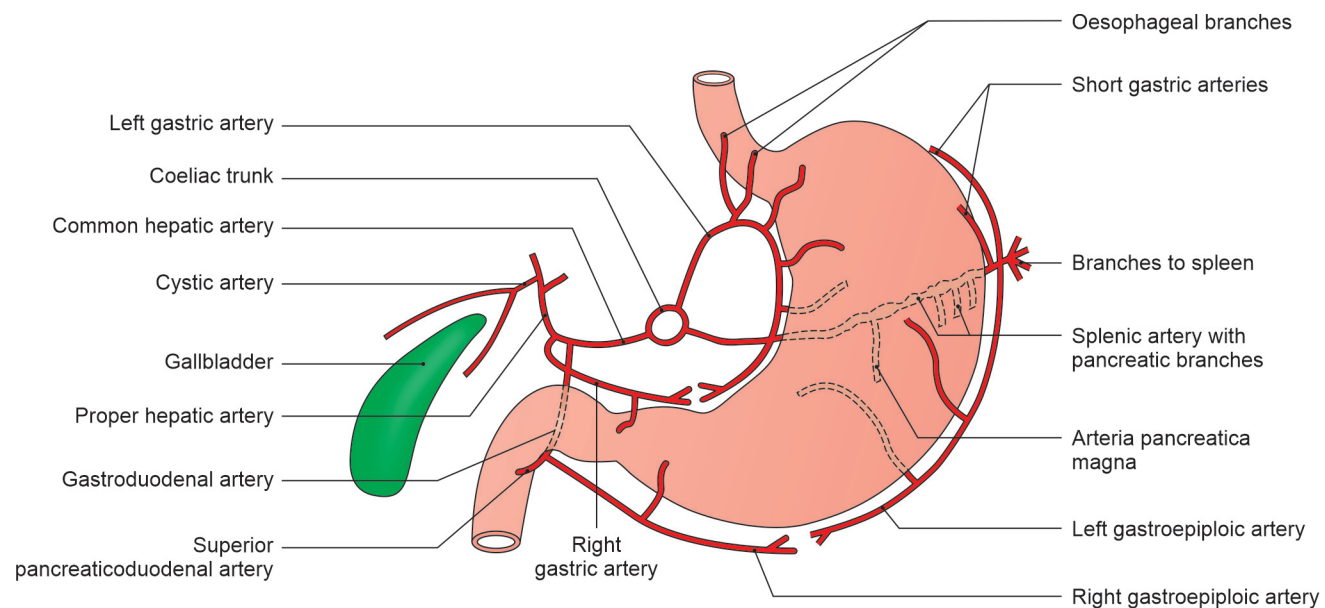


Fig. 21.4: Arteries arising from the branches of the coeliac trunk

origin of the gastroduodenal artery is called the *common hepatic artery*. The part distal to it is the *proper hepatic artery*.

The gastroduodenal artery runs downwards behind the first part of the duodenum and divides at its lower border into the right gastroepiploic and superior pancreaticoduodenal arteries.

The *right gastroepiploic artery* enters the greater omentum, follows the greater curvature of the stomach, and anastomoses with the left gastroepiploic artery.

The *superior pancreaticoduodenal artery* (often represented by two arteries—anterior and posterior) runs downwards in the pancreaticoduodenal groove, and ends by anastomosing with the inferior pancreaticoduodenal artery, a branch of the superior mesenteric.

- 2 The *right gastric artery* is a small branch which arises from the proper hepatic artery close to the gastroduodenal artery. It runs to the left along the lesser curvature and ends by anastomosing with the left gastric artery.
- 3 The *cystic artery* is a branch of the right hepatic artery. It passes behind the common hepatic and cystic ducts to reach the upper surface of the neck of the gallbladder where it divides into superficial and deep branches for the inferior and superior surfaces of the gallbladder, respectively.

Splenic Artery

The *splenic artery* is the largest branch of the coeliac trunk. It runs horizontally to the left along the upper border of the pancreas behind the lesser sac. It crosses the left suprarenal gland and the upper part of the left kidney to enter the lienorenal ligament, through which it reaches the hilum of spleen where it divides into 5 to 7 splenic branches (see Figs 19.9, 21.3 and 21.4).

It forms the stomach bed. Its tortuosity helps to regulate blood flow to the spleen in different metabolic activities. Its tortuosity allows distension of stomach without obstruction to the splenic blood flow.

Branches: It gives off the following branches:

- 1 Numerous *pancreatic branches* which supply the body and tail of the pancreas. One of the branches to the body of the pancreas is large and is known as the *arteria pancreatica magna*. Another large branch to the tail is known as the *arteria caudae pancreatis* (see Fig. 23.17). These large arteries anastomose (on the back of the pancreas) with the left branch of a *dorsal artery* which may arise from one of the following arteries—superior mesenteric, middle colic, hepatic, or coeliac.

- 2 Five to seven *short gastric arteries* arise from the terminal part of the splenic artery, run in the gastrosplenic ligament, and supply the fundus of the stomach.
- 3 The *left gastroepiploic artery* also arises from the terminal part of the splenic artery, runs downwards in the greater omentum, follows the greater curvature of the stomach, and ends by anastomosing with the right gastroepiploic artery. As the name suggests, the gastroepiploic arteries supply both the stomach and greater omentum.

SUPERIOR MESENTERIC ARTERY

The superior mesenteric artery is the artery of the midgut. It supplies all derivatives of the midgut, namely:

- 1 Lower part of the duodenum below the opening of the bile duct (Fig. 21.5).
- 2 Jejunum
- 3 Ileum
- 4 Appendix
- 5 Caecum
- 6 Ascending colon
- 7 Right two-thirds of the transverse colon
- 8 Lower half of the head of the pancreas (Figs 21.2 and 21.5).

Origin, Course and Termination

The superior mesenteric artery arises from the front of the abdominal aorta, behind the body of the pancreas, at the level of vertebra L1, one centimetre below the coeliac trunk (Figs 21.2 and 21.5). It runs downwards and to the right, forming a curve with its convexity towards the left.

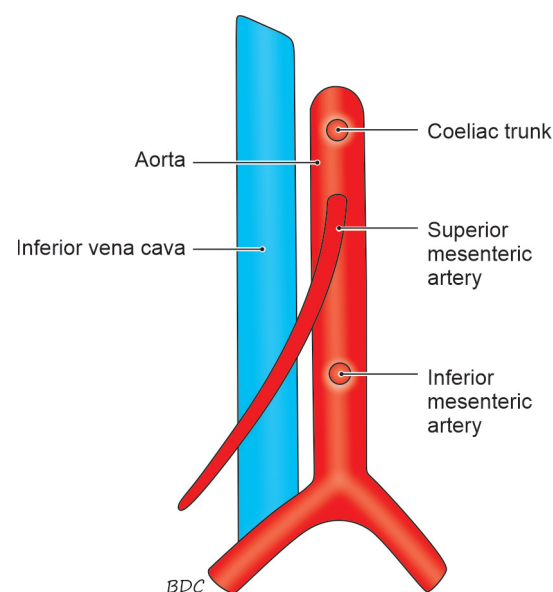
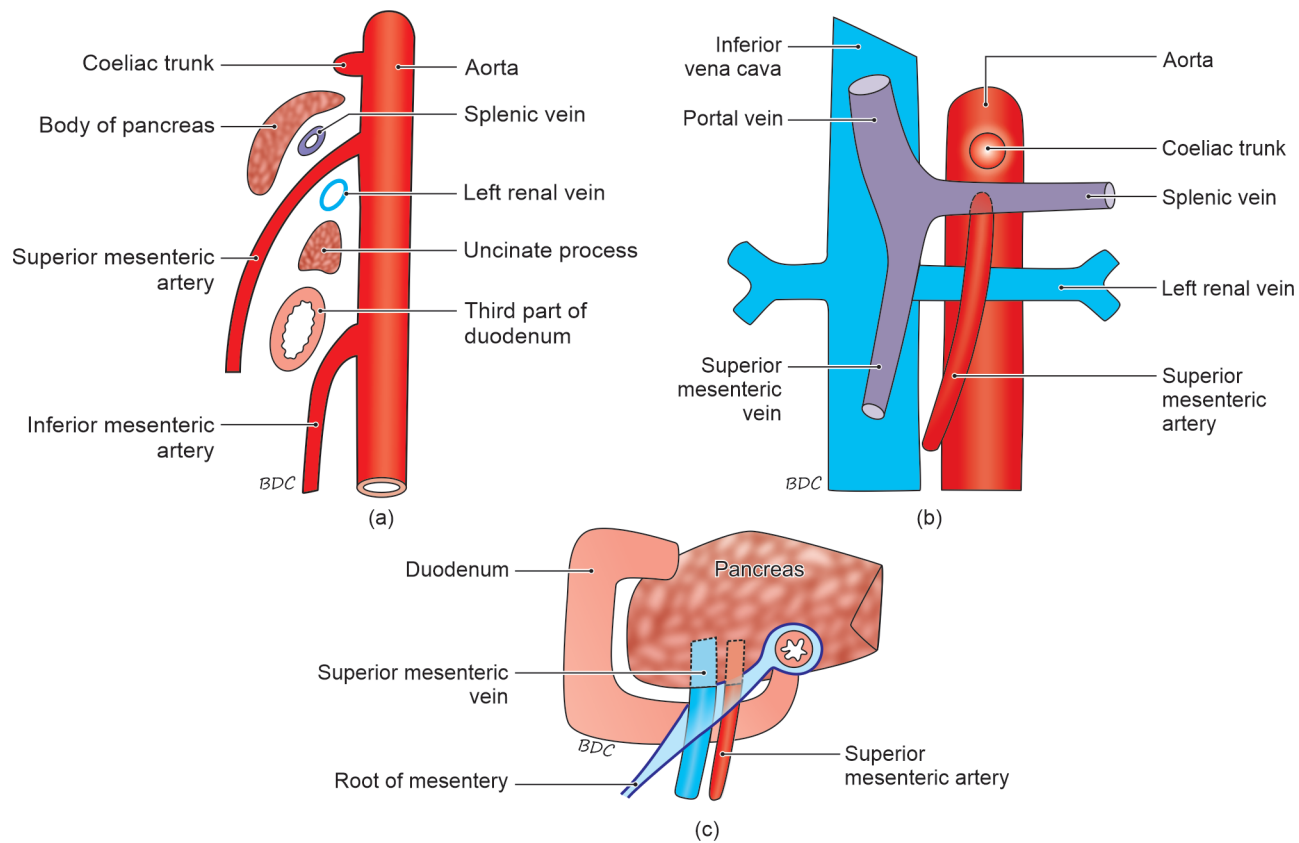


Fig. 21.5: Origin of coeliac trunk, superior mesenteric and inferior mesenteric arteries



Figs 21.6a to c: Relation of the superior mesenteric artery: (a) Left view of a sagittal section through the aorta; (b) Anterior view of the vessel after removal of the duodenum and pancreas; (c) Anterior view of the vessel with the duodenum and pancreas in place

At its origin, it lies first behind the body of the pancreas and then in front of the uncinete process. Next it crosses the third part of the duodenum, enters the root of mesentery, and runs between its two layers. It terminates in the right iliac fossa by anastomosing with a branch of the ileocolic artery.

Relations

Above the Root of the Mesentery

- 1 Anteriorly, it is related to the body of the pancreas and to the splenic vein.
- 2 Posteriorly, to the aorta, the left renal vein, the uncinete process and the third part of the duodenum (Fig. 21.6a).

Within the Root of the Mesentery

It crosses the inferior vena cava, and the right psoas. Throughout its course, it is accompanied by the superior mesenteric vein which lies on its right side. The artery is surrounded by the superior mesenteric plexus of nerves (Figs 21.6b and c).

Branches

The superior mesenteric artery gives off five sets of branches both from its right and left sides (Fig. 21.7).

- 1 Those arising from its *right side* are:
 - a. Inferior pancreaticoduodenal
 - b. Middle colic
 - c. Right colic
 - d. Ileocolic.
- 2 Those arising from its *left side* are 12–15 jejunal and ileal branches.

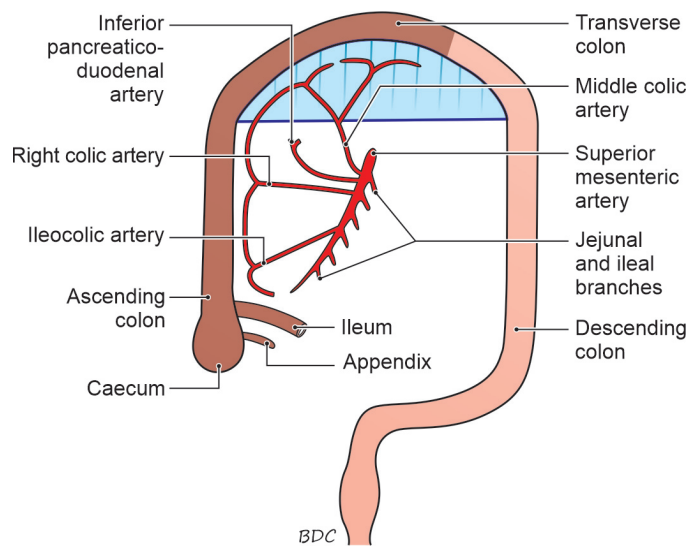


Fig. 21.7: Branches of the superior mesenteric artery

Inferior Pancreaticoduodenal Artery

Inferior pancreaticoduodenal artery arises from the superior mesenteric artery at the upper border of the third part of the duodenum. The artery soon divides into anterior and posterior branches which run in the pancreaticoduodenal groove, supplies the head of the pancreas and the duodenum, and end by anastomosing with the superior pancreaticoduodenal artery.

Middle Colic Artery

Middle colic artery arises from the right side of the superior mesenteric artery just below the pancreas. It runs downwards and forwards in the transverse mesocolon. It divides into a right branch, which anastomoses with the right colic artery, and a left branch, which anastomoses with the left colic artery. Further branches arising from these form arcades and supply the transverse colon.

Right Colic Artery

Right colic artery arises near the middle of the concavity of the superior mesenteric artery. It passes to the right behind the peritoneum, and at the upper part of the ascending colon, it divides into a descending branch, which anastomoses with the ileocolic artery, and an ascending branch, which anastomoses with the middle colic artery. The branches form an arch, from the convexity of which smaller branches are distributed to the upper two-thirds of the ascending colon and the right flexure of the colon.

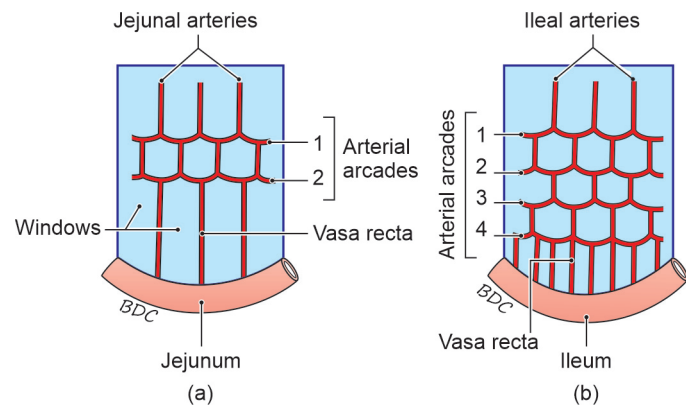
Ileocolic Artery

Ileocolic artery arises from the right side of the superior mesenteric artery. It runs downwards and to the right, and divides into superior and inferior branches. The superior branch anastomoses with the right colic artery, and the inferior branch anastomoses with the termination of the superior mesenteric artery.

- The inferior branch of the ileocolic artery gives off:
- An ascending colic branch to the ascending colon.
 - Anterior and posterior caecal branches to the caecum (see Fig. 20.29).
 - An appendicular branch which passes behind the ileum and reaches the appendix through its mesentery (see Fig. 20.29).
 - The ileal branch to the terminal portion of the ileum.

Jejunal and Ileal Branches

Jejunal and ileal branches are about 12 to 15 in number and arise from the left side of the superior mesenteric artery. They run between the two layers of the mesentery towards the gut. They anastomose with one another to form arterial arcades which give off straight



Figs 21.8a and b: Arterial arcades and vasa recta of: (a) Jejunum; (b) Ileum

branches or vasa recta to the gut. These branches supply the jejunum (Fig. 21.8a) and most of ileum (Fig. 21.8b). The terminal part of the ileum is supplied by the ileocolic artery.

On passing from jejunum to ileum, the number of arterial arcades increases from one to as many as five. The vasa recta are longer and less numerous in the jejunum than in the ileum. These are distributed alternately to opposite surfaces of the gut, and the neighbouring vessels do not anastomose with one another.

SUPERIOR MESENTERIC VEIN

- Superior mesenteric vein is a large vein which drains blood from the small intestine, the appendix, the caecum, the ascending colon and the transverse colon (Fig. 21.9).
- It begins in the right iliac fossa by the union of tributaries from the ileocaecal region. It accompanies the superior mesenteric artery. The vein lies on the right side of the artery. It terminates, behind the neck

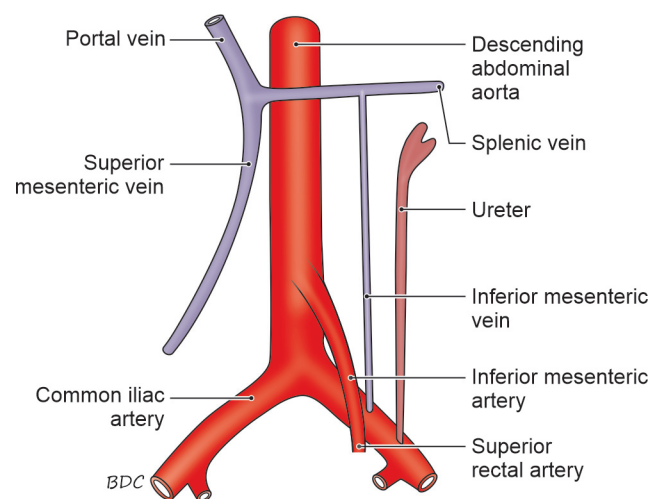


Fig. 21.9: Course of superior mesenteric vein and inferior mesenteric vessels

of the pancreas, by joining the splenic vein to form the portal vein.

- 3 Its *tributaries* are as follows.
 - a. Veins corresponding to the branches of the superior mesenteric artery
 - b. Right gastroepiploic vein
 - c. Inferior pancreaticoduodenal vein

DISSECTION

Identify the short trunk of coeliac axis artery at the level of the intervertebral disc between T12 and L1 vertebrae arising from the aorta. Dissect its relations especially with the coeliac ganglion and identify its three branches and their further divisions.

Clean the superior mesenteric vessels with its branches both from its right and left surfaces. Dissect these branches and trace them till the organs of their supply.

Identify the inferior mesenteric artery arising at the L3 vertebra. Trace its course and branches.

Identify the large portal vein formed by the union of superior mesenteric and splenic vein posterior to the neck of pancreas. Trace it upwards towards the remains of free margin of lesser omentum till the porta hepatis where it divides into two branches. Identify the veins taking part in portosystemic anastomoses.

CLINICAL ANATOMY

- Acquired diverticula of small intestine are more common in upper jejunum. These occur on the side of the mesenteric border at the site of entry of vasa recta. Vulnerability of jejunum is due to relative weakness of the longitudinal muscle coat.
- Sudden occlusion of the superior mesenteric artery, vein or both may occur due to embolism or thrombosis. It is usually followed by a rapidly spreading form of intestinal obstruction due to the haemorrhagic infarction of the involved gut.
- Superior mesenteric artery crosses third part of duodenum (Fig. 21.6c). This part of duodenum may get obstructed as it lies between abdominal aorta and superior mesenteric artery. Duodenum behaves like a nut between the two tongs formed by these two arteries (see Fig. 20.16).

INFERIOR MESENTERIC ARTERY

The inferior mesenteric artery is the artery of the hindgut. It supplies the parts of the gut that are derivatives of the hindgut and posterior part of cloaca, the anorectal canal, namely:

- 1 The left one-third of the transverse colon
- 2 The descending colon (Fig. 21.9)
- 3 The sigmoid colon
- 4 The rectum
- 5 The upper part of the anal canal, above the anal valves.

Origin

Inferior mesenteric artery arises from the front of the abdominal aorta behind the third part of the duodenum, at the level of third lumbar vertebra, and 3 to 4 cm above the bifurcation of the aorta.

Course and Termination

It runs downwards and to the left, behind the peritoneum, crosses the common iliac artery medial to the left ureter, and continues in the sigmoid mesocolon as the superior rectal artery (Fig. 21.9).

Branches

The inferior mesenteric artery gives off the left colic, and sigmoid branches (Fig. 21.10). It continues as superior rectal artery.

Left Colic Artery

Left colic artery is the first branch of the inferior mesenteric artery. It runs upwards and to the left, behind the peritoneum of the posterior wall of the left infracolic compartment and after a variable course divides into an ascending and a descending branch. The ascending branch enters the transverse mesocolon and anastomoses with the middle colic artery. The descending branch anastomoses with the highest sigmoid artery. It forms a part of the marginal artery

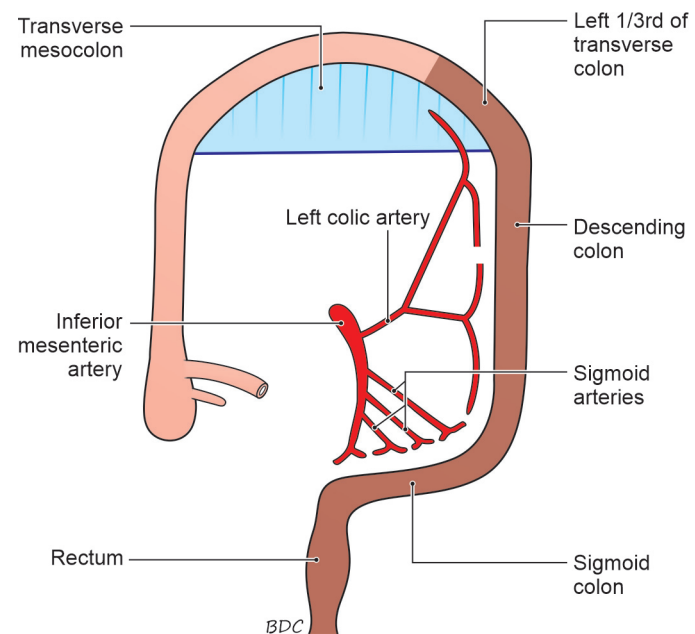


Fig. 21.10: Branches of the inferior mesenteric artery

from which branches are distributed to the left one-third of the transverse colon and to the descending colon (Fig. 21.10).

Sigmoid Arteries

Sigmoid arteries are 2 to 4 in number. They pass downwards and to the left, and anastomose with each other to form the lower part of the marginal artery. The uppermost branch anastomoses with the descending branch of the left colic artery, whereas the lowest sigmoid artery sends a branch to anastomose with the superior rectal artery. They supply the descending colon in the iliac fossa and the sigmoid colon.

Superior Rectal Artery

Superior rectal artery is the continuation of the inferior mesenteric artery beyond the root of the sigmoid mesocolon, i.e. over the left common iliac vessels. It descends in the sigmoid mesocolon to reach the rectum. Opposite third sacral vertebra, it divides into right and left branches which descend one on each side of the rectum. They pierce the muscular coat of the rectum and divide into several branches, which anastomose with one another at the level of the anal sphincter to form loops around the lower end of the rectum. These branches communicate with the middle and inferior rectal arteries in the submucosa of the anal canal (Fig. 21.10).

INFERIOR MESENTERIC VEIN

- 1 The inferior mesenteric vein drains blood from the rectum, the anal canal, the sigmoid colon and the descending colon. It is longer than the artery.
- 2 It begins as the *superior rectal vein* from the upper part of the internal rectal venous plexus. In the plexus, it communicates with the middle and inferior rectal veins. The superior rectal vein crosses the left common iliac vessels medial to the left ureter and continues upwards as the inferior mesenteric vein. This vein lies lateral to the inferior mesenteric artery. The vein ascends behind the peritoneum, passes lateral to the duodenojejunal flexure in the free margin of paraduodenal fold and behind the body of the pancreas. It opens into the splenic vein (Fig. 21.9).
- 3 Its *tributaries* correspond to the branches of the inferior mesenteric artery.

CLINICAL ANATOMY

Inferior mesenteric vein lies in the free margin of paraduodenal fold before draining into splenic vein. In case of strangulated internal hernia in duodenojejunal recess, these folds may be cut to enlarge the space. One needs to remember that inferior mesenteric vein (not the artery) lies in the fold, and it needs to be ligated (*see* Fig. 18.32).

MARGINAL ARTERY OF DRUMMOND

Marginal artery was described by von Haller in 1803 and its present name was given by Sudeck in 1907. The marginal artery is an arterial arcade situated along the concavity of the colon. It is formed by anastomoses between the main arteries supplying the colon, namely the ileocolic, right colic, middle colic, left colic and sigmoid arteries. It lies at a distance of 2.5 to 3.8 cm from the colon. It is closest to the colon in its descending and sigmoid parts. Vasa recta arise from the marginal artery and supply the colon (Fig. 21.11).

The marginal artery is capable of supplying the colon even in the absence of one of the main feeding trunks. This fact is utilised in surgery. However, at the junctional points between the main vessels, there may be variations in the competence of the anastomoses.

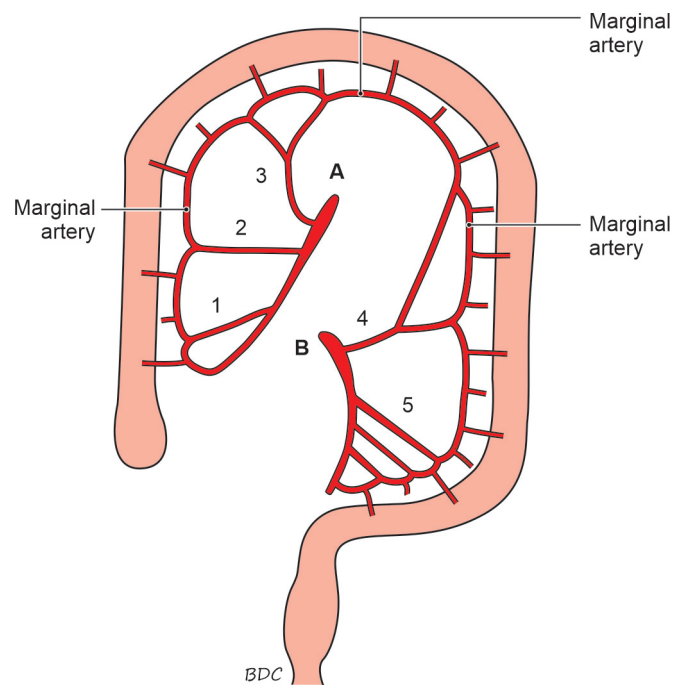


Fig. 21.11: The marginal artery. A—Superior mesenteric artery, B—Inferior mesenteric artery. 1—Ileocolic, 2—right colic, 3—middle colic, 4—left colic, 5—sigmoid arteries

Competency achievement: The student should be able to:

AN47.8 Describe and identify the formation, course, relations and tributaries of portal vein, inferior vena cava and renal vein.

PORTAL VEIN

Portal vein is a large vein which collects blood from:

- 1 The abdominal part of the alimentary tract,
- 2 The gallbladder,
- 3 The pancreas,
- 4 The spleen, and conveys it to the liver. In the liver, the portal vein breaks up into sinusoids which are

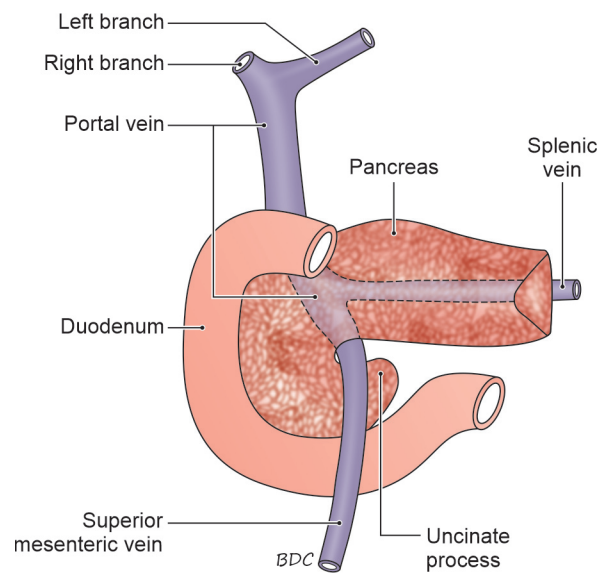


Fig. 21.12: Formation and course of the portal vein

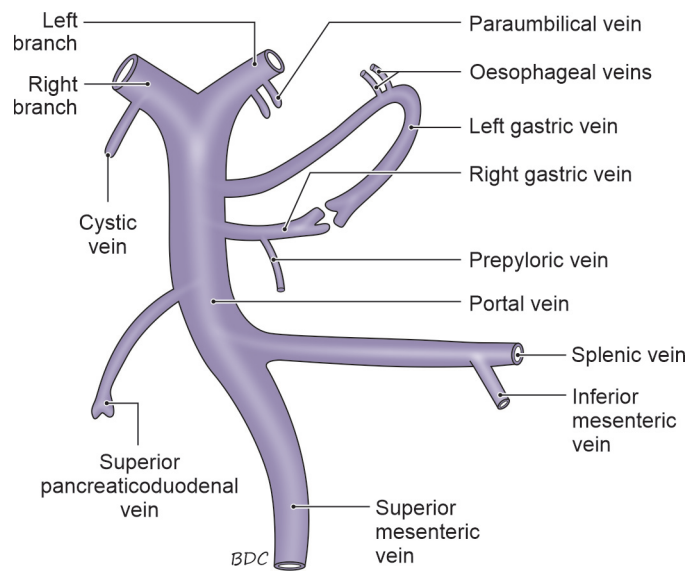


Fig. 21.13: Formation and tributaries of portal vein

drained by the hepatic veins to the inferior vena cava (Figs 21.12 and 21.13).

It is called the portal vein because its main tributary, the superior mesenteric vein, begins in one set of capillaries (in the gut) and the portal vein ends in another set of capillaries in the liver.

Formation

The portal vein is about 8 cm long. It is formed by the union of the superior mesenteric and splenic veins behind the neck of the pancreas at the level of second lumbar vertebra. Inferior mesenteric vein drains into splenic vein.

Course

It runs upwards and a little to the right, first behind the neck of the pancreas, next behind the first part of the duodenum, and lastly in the right free margin of the lesser omentum.

The blood flow in portal vein is slow. Blood of superior mesenteric vein drains into right lobe. Blood of splenic and inferior mesenteric vein drains into left lobe. This is called 'streamline flow'.

The portal vein can thus be divided into infra-duodenal, retroduodenal and supraduodenal parts.

Termination

The vein ends at the right end of the porta hepatis by dividing into right and left branches which enter the liver.

Relations

Infraduodenal Part

Anteriorly: Neck of pancreas.

Posteriorly: Inferior vena cava (see Figs 20.8a and 21.14).

Retroduodenal Part

Anteriorly

- 1 First part of duodenum
- 2 Bile duct
- 3 Gastroduodenal artery.

Posteriorly: Inferior vena cava (see Fig. 20.8b).

Supraduodenal Part

Anteriorly

- 1 Hepatic artery
- 2 Bile duct (within free margin of the lesser omentum).

Posteriorly: Inferior vena cava, separated by epiploic foramen (see Fig. 18.10 inset).

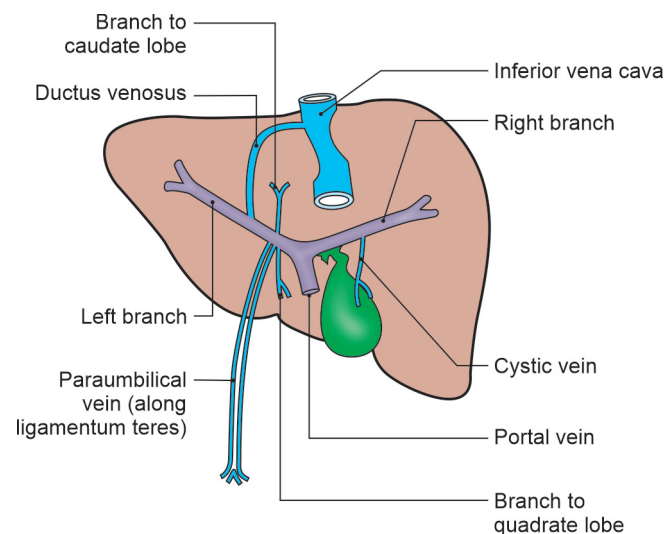


Fig. 21.14: The portal vein, its communications and branches

Intrahepatic Course

After entering the liver, each branch divides and redivides along with the hepatic artery to end ultimately in the hepatic sinusoids, where the portal venous blood mixes with the hepatic arterial blood.

Branches

- 1 The *right branch* is shorter and wider than the left branch. After receiving the cystic vein, it enters the right lobe of the liver (Fig. 21.13).
- 2 The *left branch* is longer and narrower than the right branch. It traverses the porta hepatis from its right end to the left end, and furnishes branches to the caudate and quadrate lobes. Just before entering the left lobe of the liver, it receives during foetal life:
 - a. Paraumbilical veins along the ligamentum teres.
 - b. Ductus venosus along ligamentum venosum.

Tributaries

Portal vein receives the following veins.

- 1 Left gastric
- 2 Right gastric (Fig. 21.13)
- 3 Superior pancreaticoduodenal

- 4 Cystic vein in its right branch
- 5 Paraumbilical veins in its left branch

The left gastric vein accompanies the corresponding artery. At the cardiac end of the stomach, it receives a few oesophageal veins. The right gastric vein accompanies the corresponding artery. It receives the prepyloric vein.

The paraumbilical veins are small veins that run in the falciform ligament, along the ligamentum teres, and establish anastomoses between the veins of the anterior abdominal wall present around the umbilicus and the portal vein (Fig. 21.15).

Competency achievement: The student should be able to:

AN47.10 Enumerate the sites of portosystemic anastomosis.

AN47.11 Explain the anatomic basis of hematemesis and caput medusae in portal hypertension.

Portosystemic Communications (Portocaval Anastomoses)

These communications form important routes of collateral circulation in portal obstruction. The tributaries of portal and systemic system are put in Table 21.1. Various sites of portosystemic anastomoses are put in Table 21.2 and Fig. 21.16.

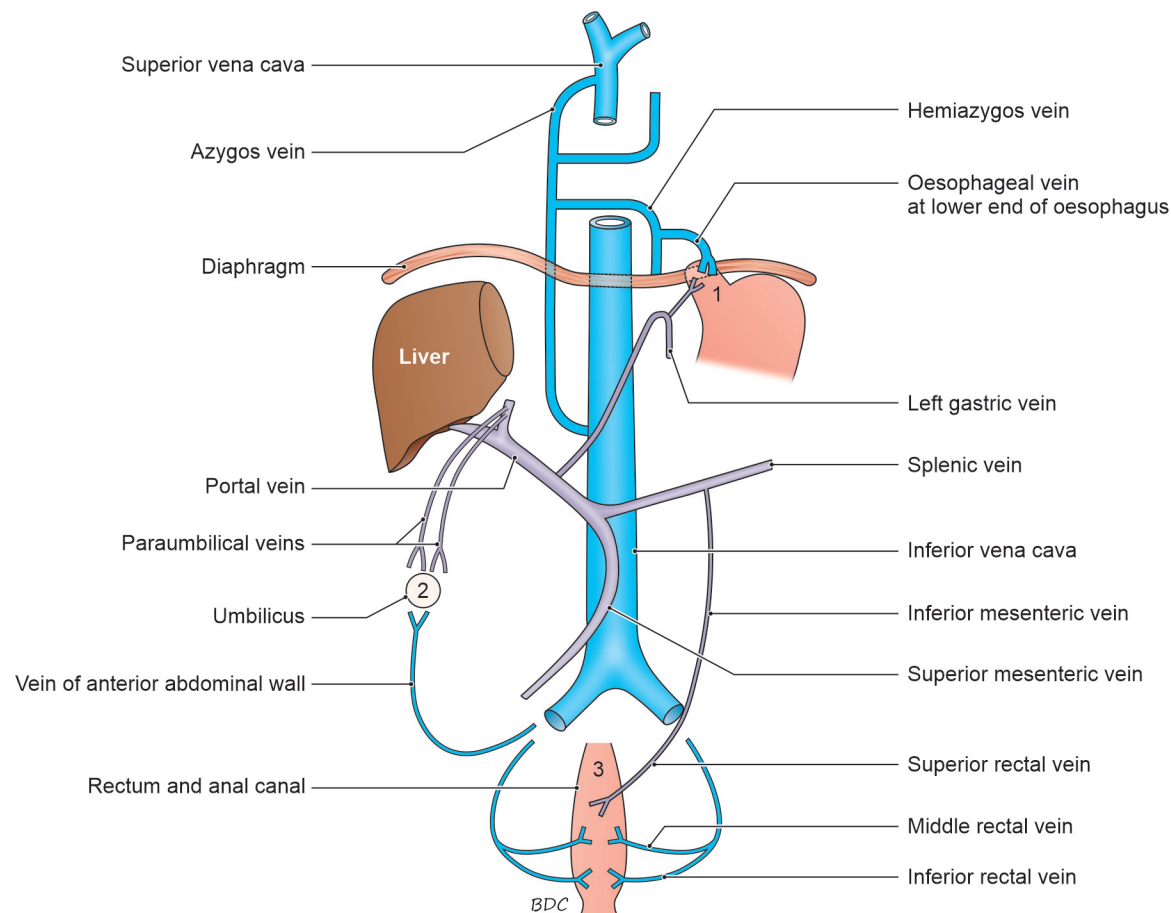


Fig. 21.15: Important sites of communication of portal and systemic veins: (1) Lower end of oesophagus, (2) around umbilicus, and (3) anal canal

Table 21.1: Tributaries of portal venous system and systemic venous system including clinical conditions

S.no.	Tributaries	Clinical conditions
1. Abdominal part of oesophagus	Some oesophageal veins drain via left gastric vein into the portal vein Some oesophageal veins drain into hemiazygos → vena azygos → superior vena cava	In liver cirrhosis, these tributaries anastomose, giving rise to <i>oesophageal varices</i> These varices may rupture to cause haematemesis (see Fig. 19.4)
2. Umbilicus	A few paraumbilical veins run along ligamentum teres and left branch of portal vein (Fig. 21.15). Veins around umbilicus drain via superior and inferior epigastric veins into superior and inferior vena cava, respectively	In liver cirrhosis, the paraumbilical veins open up to transfer portal venous blood into systemic circulation. It results in caput medusae (see Fig. 16.5b)
3. Anal canal	Superior rectal vein continues up as inferior mesenteric vein which drains into portal vein. The middle and inferior rectal veins drain into inferior vena cava (Figs 21.15 and 21.16)	Liver cirrhosis causes anastomoses between superior rectal and other rectal veins (Fig. 21.15). These anastomosing veins result in piles or haemorrhoids
4. Bare area of liver	Central veins and sublobular veins are part of portal circulation. Intercostal veins and phrenic veins end in systemic circulation	There is some anastomoses between portal vein and systemic veins No significance
5. Veins of ascending and descending colon	Veins of colon end in the portal circulation. Veins of posterior abdominal wall end up in systemic veins	There is some anastomoses between these 2 sets of tributaries These may get injured in procedures done in these areas
6. Patent ductus venosus of liver	It joins left branch of portal vein to inferior vena cava	It may be accompanied by other congenital anomalies

Table 21.2: Sites of portocaval/portosystemic anastomoses

S.no.	Position	Portal vein	Systemic vein
1.	Lower end of oesophagus	Left gastric	Oesophageal veins
2.	Lower end of rectum	Superior rectal	Middle and inferior rectal veins
3.	Umbilicus	Paraumbilical	Above – Superior epigastric Lateral thoracic Below – Superficial epigastric Inferior epigastric Sides – Posterior intercostal and lumbar
4.	Posterior abdominal wall	Splenic	Left renal vein
5.	Bare area of liver	Portal radicles	Diaphragmatic
6.	Falciform ligament	Paraumbilical	Diaphragmatic
7.	Ligamentum venosum	Left branch of portal	Inferior vena cava

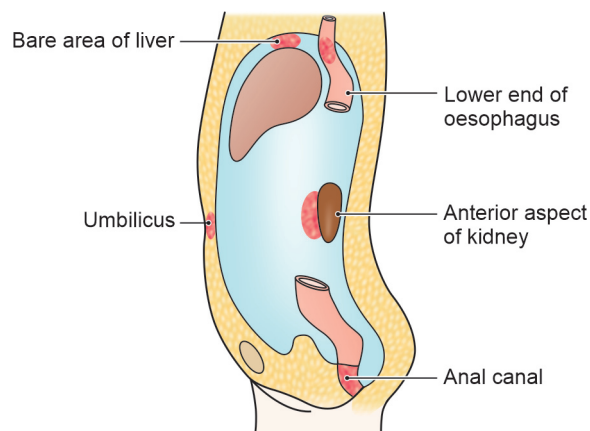


Fig. 21.16: Sites of portosystemic anastomoses

CLINICAL ANATOMY

- *Portal pressure*: Normal pressure in the portal vein is about 5–15 mm Hg. It is usually measured by splenic puncture and recording the intrasplenic pressure.
- *Portal hypertension* (pressure above 40 mm Hg): It can be caused by the following.
 - a. Cirrhosis of liver, in which the vascular bed of liver is markedly obliterated.
 - b. Banti's disease
 - c. Thrombosis of portal vein.
 The effects of portal hypertension are as follows.
 - a. Congestive splenomegaly

- b. Ascites
 c. Collateral circulation through the portosystemic communications. It forms:
- Caput medusae around the umbilicus, which is of diagnostic value to the clinician (see Fig. 16.5b).
 - Oesophageal varices at the lower end of oesophagus which may rupture and cause dangerous or even fatal haematemesis (see Fig. 19.4).
 - Haemorrhoids in the anal canal may be responsible for repeated bleeding felt per rectum (see Fig. 33.14).

In cases of cirrhosis of liver, sometimes a shunt operation is done, where one of the main portal channels (splenic, superior mesenteric, or portal vein) is directly anastomosed with either inferior vena cava or the left renal vein (Fig. 21.17).

- Since the blood flow in portal vein is slow, and streamlined, the toxic infective substances absorbed from small intestine pass via the superior mesenteric vein into the right lobe of liver leading to toxic changes or amoebic abscess in right lobe. The blood lacking in amino acids, etc. which is absorbed via the inferior mesenteric vein affect the left lobe, leading to its fibrosis or cirrhosis (Fig. 21.18).
- The lower end oesophagus is one of the sites of portocaval anastomoses. Some oesophageal veins drain into left gastric vein and then into portal vein. Other oesophageal veins drain into hemiazygos and then into vena azygos and superior vena cava. In liver cirrhosis, portal venous pressure is raised, leading to oesophageal varices, which may rupture leading to haematemesis (see Fig. 19.4).

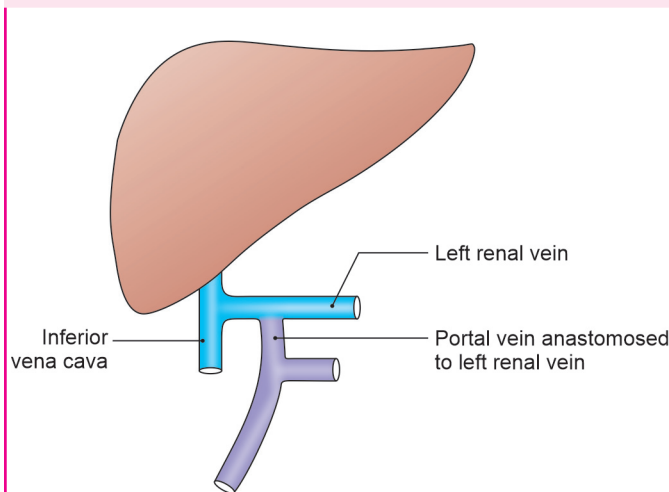


Fig. 21.17: Shunt operation between left renal vein and portal vein

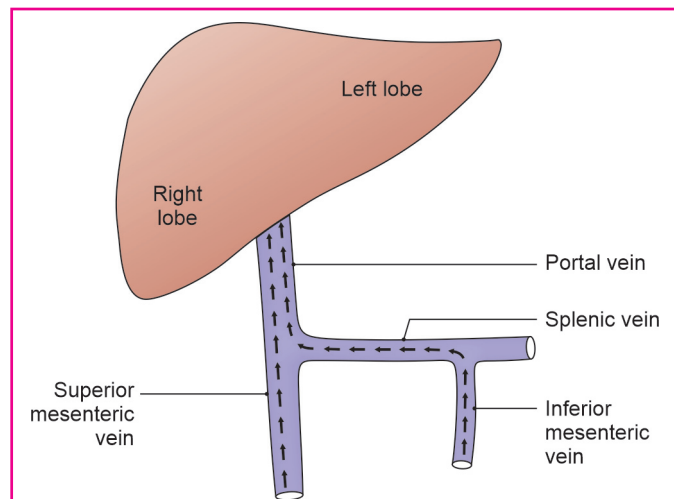


Fig. 21.18: Streamline flow of blood in the portal vein

DEVELOPMENT

Portal vein develops from the following sources.

- Infraduodenal part, from a part of the left vitelline vein distal to the dorsal anastomosis.
- Retroduodenal part, from the dorsal anastomosis between the two vitelline veins.
- Supraduodenal part, from the cranial part of the right vitelline vein.



FACTS TO REMEMBER

- Coeliac trunk is the first short unpaired ventral visceral branch of the abdominal aorta which supplies structures derived from the foregut.
- Superior and inferior mesenteric arteries supply structures derived from midgut and hindgut, respectively.
- Inferior mesenteric vein lies in the free margin of paraduodenal recess and is not accompanied by its artery in this region.
- Branches of portal vein anastomose with the branches of systemic circulation at a few places.
- Portal vein supplies 80% blood to liver, while hepatic artery gives 20%.

CLINICOANATOMICAL PROBLEM

A middle-aged alcoholic patient complained of a lot of blood in his vomit.

- What causes haematemesis?

Ans: The lower end of oesophagus is one of the sites of portocaval anastomoses. Some oesophageal veins drain into left gastric vein and then into portal vein. Other oesophageal veins drain into hemiazygos and then into vena azygos and superior vena cava.

In liver cirrhosis, portal venous pressure is raised, leading to oesophageal varices, which may rupture leading to blood in the vomit.

Normally, the anastomoses between tributaries of portal vein and those of superior vena cava is very little. These anastomotic channels develop in an attempt to take portal blood into caval blood.

FURTHER READING

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- Jackson JE. Vascular anatomy of the gastrointestinal tract. In: Butler P, Mitchell AWM, 1999.
- Kakar S, Raheja S, Anand C, Gupta SR. Reevaluation of the blood supply of sigmoid colon. *IJCP* 1994;4(9):26–30.



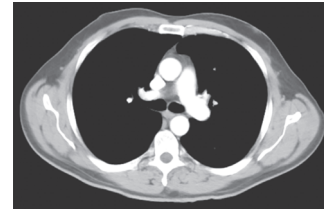
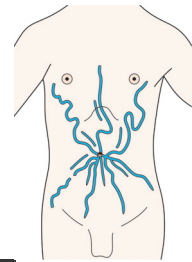
Frequently Asked Questions

Clinical Essay Question

1. A 48-year-old male with a history of alcoholism is brought into the ER with severe epigastric pain and haematemesis. Upon physical examination you find him to be jaundiced and tachycardic with low blood pressure. Other physical findings include spider nevi (haemangiomas) on the cheeks, neck, upper extremities, and torso; ascites; splenomegaly; and tortuous dilated veins radiating from the umbilicus (caput medusae). The patient also tells you that he often has bloody stools, which prompts you to perform a rectal examination during which you find internal haemorrhoids. After completing your work-up, you correctly make a diagnosis of alcoholic cirrhosis of the liver.
 - Identify the clinical condition. Mention the structure involved and add the tributaries and anastomosis of the same.

Short Answer Questions

1. What is the clinical condition? Mention the sites of portocaval anastomosis and veins involved.
2. Identify the pointed structure. Mention its branches and clinical importance.



3. Describe the branches of caeliac trunk.

Very Short Answer Questions

1. What is marginal artery of Drummond?
2. Name the branches of superior mesenteric artery.



Multiple Choice Questions

1. Inferior mesenteric vein opens into:
 - a. Portal vein
 - b. Inferior vena cava
 - c. Splenic vein
 - d. Superior mesenteric vein
2. Which of the following arteries is not a direct branch of coeliac trunk?
 - a. Left gastric
 - b. Common hepatic
 - c. Splenic
 - d. Inferior pancreaticoduodenal
3. Cystic artery is a branch of:
 - a. Right hepatic
 - b. Left hepatic
 - c. Coeliac trunk
 - d. Common hepatic
4. Jejunal and ileal branches for small intestine arise from:
 - a. Coeliac trunk
 - b. Superior mesenteric artery
 - c. Inferior mesenteric artery
 - d. Abdominal aorta
5. Appendicular artery is a branch of:
 - a. Middle colic
 - b. Right colic
 - c. Ileocolic
 - d. Left colic
6. Portal vein is formed by union of which veins?
 - a. Union of inferior mesenteric and splenic
 - b. Union of superior mesenteric and splenic
 - c. Superior mesenteric and inferior mesenteric
 - d. Splenic, superior mesenteric and inferior mesenteric

7. Ligamentum venosum is attached to which vein?
 - a. Right branch of portal
 - b. Left branch of portal
 - c. Both the branches of portal
 - d. None of the above
8. Portocaval anastomoses occur at the following sites, *except*:
 - a. Umbilicus
 - b. Lower end of oesophagus
 - c. Stomach
 - d. The bare area of liver
9. Hepatic flexure is supplied by which artery?
 - a. Ileocolic
 - b. Middle colic
 - c. Right colic
 - d. Jejunal branches
10. Superior rectal artery is continuation of:
 - a. Superior mesenteric
 - b. Coeliac trunk
 - c. Inferior mesenteric
 - d. Abdominal aorta

Answers

1. c 2. d 3. a 4. b 5. c 6. b 7. b 8. c 9. c 10. c

VIVA VOCE

- Name the branches of coeliac trunk.
- Name the branches of superior mesenteric artery from the right side.
- How many arterial arcades are present in jejunum and ileum?
- Name the branches of inferior mesenteric artery.
- How is marginal artery formed?
- Where and how is the portal vein formed?
- What is the importance of portosystemic anastomoses at the lower end of oesophagus and anal canal?