Lecture -7-

Blood supply to the gut

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Abdominal Aorta

- The abdominal aorta is a continuation of the thoracic aorta beginning at the level of the T12 vertebrae.
- It is approximately 13cm long and ends at the level of the L4 vertebra. At this level, the aorta terminates by bifurcating into the **right and left common iliac arteries** that supply the lower body.

Branches od abdominal aorta

In descending order:

1- Inferior phrenic arteries: Paired parietal arteries arising posteriorly at the level of **T12**. They supply the diaphragm.

2-Coeliac artery: A large, unpaired artery arising anteriorly at the level of **T12**.

- It is also known as the celiac trunk and supplies the liver, stomach, abdominal oesophagus, spleen, the superior duodenum and the superior pancreas.

3-Superior mesenteric artery: A large, unpaired artery arising anteriorly, just below the celiac artery.

- It supplies the distal duodenum, jejuno-ileum, ascending colon and part of the transverse colon. It arises at the **lower level of L1**.

4-Middle suprarenal arteries: Small paired l arteries that arise either side posteriorly at the level of **L1** to supply the adrenal glands

5-Renal arteries: Paired visceral arteries that arise laterally at the level **between L1 and L2**. They supply the kidneys

6-Gonadal arteries: Paired visceral arteries that arise laterally at the level of **L2**. Note that the male gonadal artery is referred to as the testicular artery and in females, the ovarian artery.

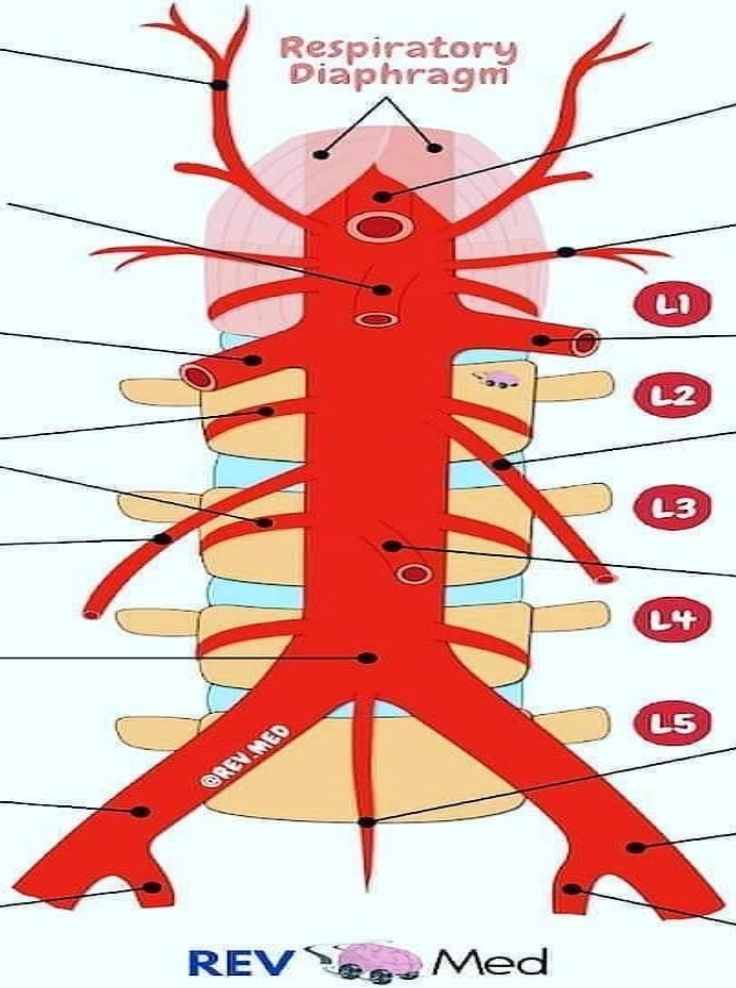
7-Inferior mesenteric artery: A large, unpaired l artery that arises anteriorly at the level of **L3**.

- It supplies the large intestine from the splenic flexure to the upper part of the rectum.

8-Median sacral artery: An unpaired artery that arises posteriorly at the level of **L4** to supply the coccyx , lumbarveretbraeand the sacrum

9-Lumbar arteries: There are four pairs of lumbar arteries that arise posterolaterally between the levels of **L1 and L4** to supply the abdominal wall and spinal cord

Abdominal Aorta



Right inferior phrenic artery

Superior mesenteric artery

Right renal artery

Lumbar arteries L1-L4

Right gonadal artery

Bifourcation at L4

Right common iliac artery

Right internal iliac artery

Celiac Trunk

Left middle suprarenal artery

Left renal artery

Left gonadal artery

Inferior mesenteric artery

Middle sacral artery

Left common iliac artery

Left internal iliac artery

REV Med

The gastrointestinal tract (GIT) is derived embryologically from the **primitive gut** which is formed from the **endoderm** lining the yolk sac. The primitive gut is divided into the **foregut, midgut,** and **hindgut.**

- **The foregut** gives rise to the esophagus , stomach, and the first and second parts of the duodenum, as well as the liver , gallbladder, and superior part of the pancreas. All the organs derived from the foregut are supplied by the branches of the **celiac trunk (artery)**.
- **The midgut** gives rise to the distal duodenum, jejunum, ileum, cecum, appendix, ascending colon, and the proximal two-thirds of the transverse colon. These are supplied by the branches of the **superior mesenteric artery (SMA)**.
- **The hindgut** gives rise to the distal one-third of the transverse colon, descending colon, rectum, and upper part of the anal canal. These structures are supplied by the branches of the **inferior mesenteric artery (IMA)**.

- # The Coeliac Trunk

Anatomical Position

The coeliac trunk is the second branch of the abdominal aorta
It arises from the anterior aspect of the aorta, at the aortic hiatus of the diaphragm (T12 level)

Major Branches

After emerging from the aorta, the coeliac trunk extends approximately 1cm before dividing into three major branches –
1-left gastric artery
2-splenic artery
3-common hepatic arterys.
Of these branches, two go left (Lt gastric and splenic) and one goes to the right- side(commom hepatic).
.

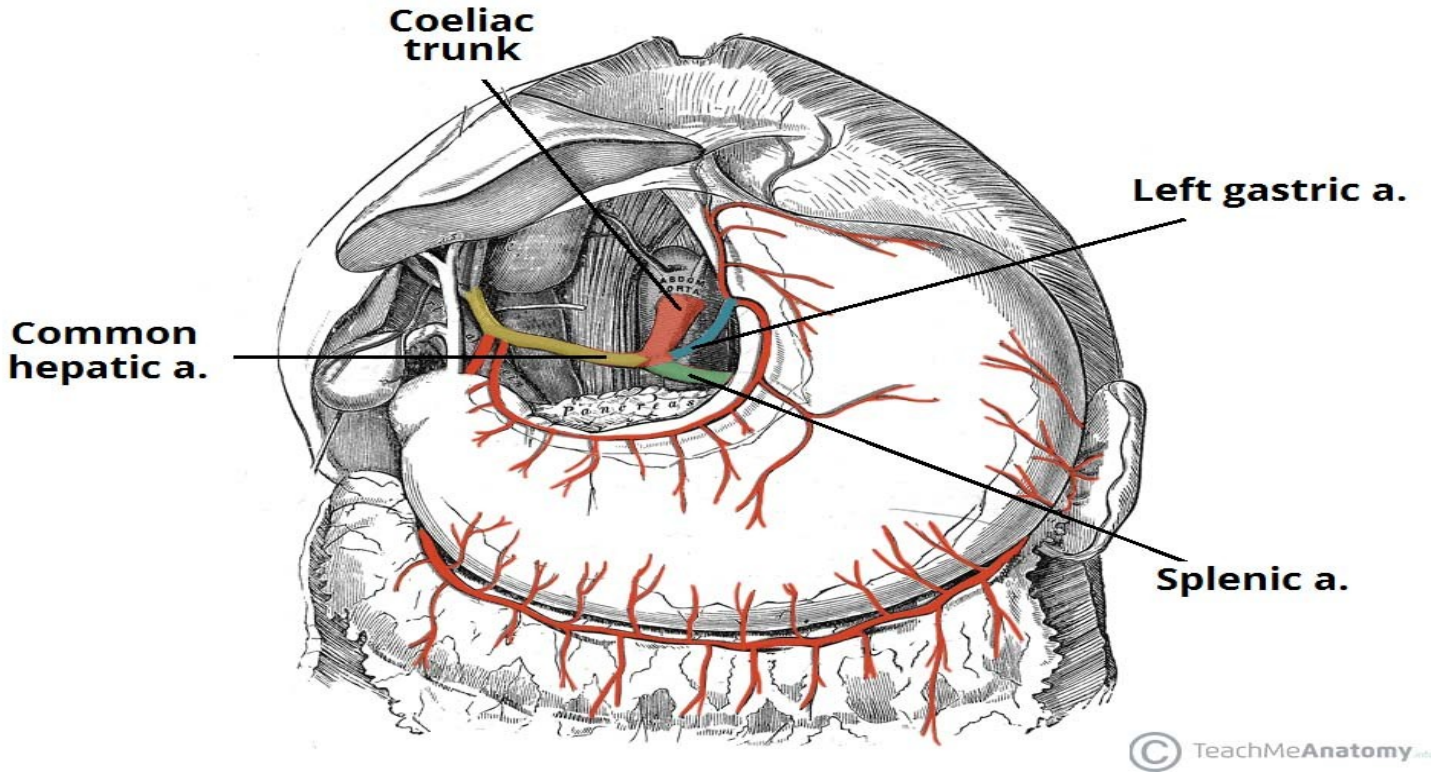
Left Gastric Artery

- The left gastric artery is the smallest of the three branches.
- It ascends across the diaphragm, giving rise to **oesophageal branches**, before continuing anteriorly along the lesser curvature of the stomach Here, it anastomoses with the right gastric artery.

;Branches

. esophageal branhes -1

gastric branches to the surfaces of the stomach -2



The major branches of the coeliac trunk

Splenic Artery

- The splenic artery arises from the coeliac trunk just inferior to the left gastric artery. It then travels left towards the spleen , running posterior to the stomach and along the superior margin of the pancreas
- During its course, it is contained within the **splenorenal ligament**.
- It terminates into five branches which supply the segments of the spleen.
- In addition to supplying the spleen, the splenic artery also gives rise to several important vessels:

-Left gastroepiploic: supplies the greater curvature of the stomach. Anastomoses with the right gastroepiploic artery.

-Short gastrics: 5-7 small branches supplying the fundus of the stomach.

-Pancreatic branches: supply the body and tail of the pancreas.

- .

The splenic artery has a tortuous appearance (similar to the facial branch of the external carotid artery) and thus is easily identifiable from other nearby vessels

;Causes of tortuosity of splenic artery

to accommodate the enlargement of spleen -1

accommodate its movement with respiration -2

to slow the circulation allowing blood to pass in the -3 branches to supply pancreas

Common Hepatic Artery

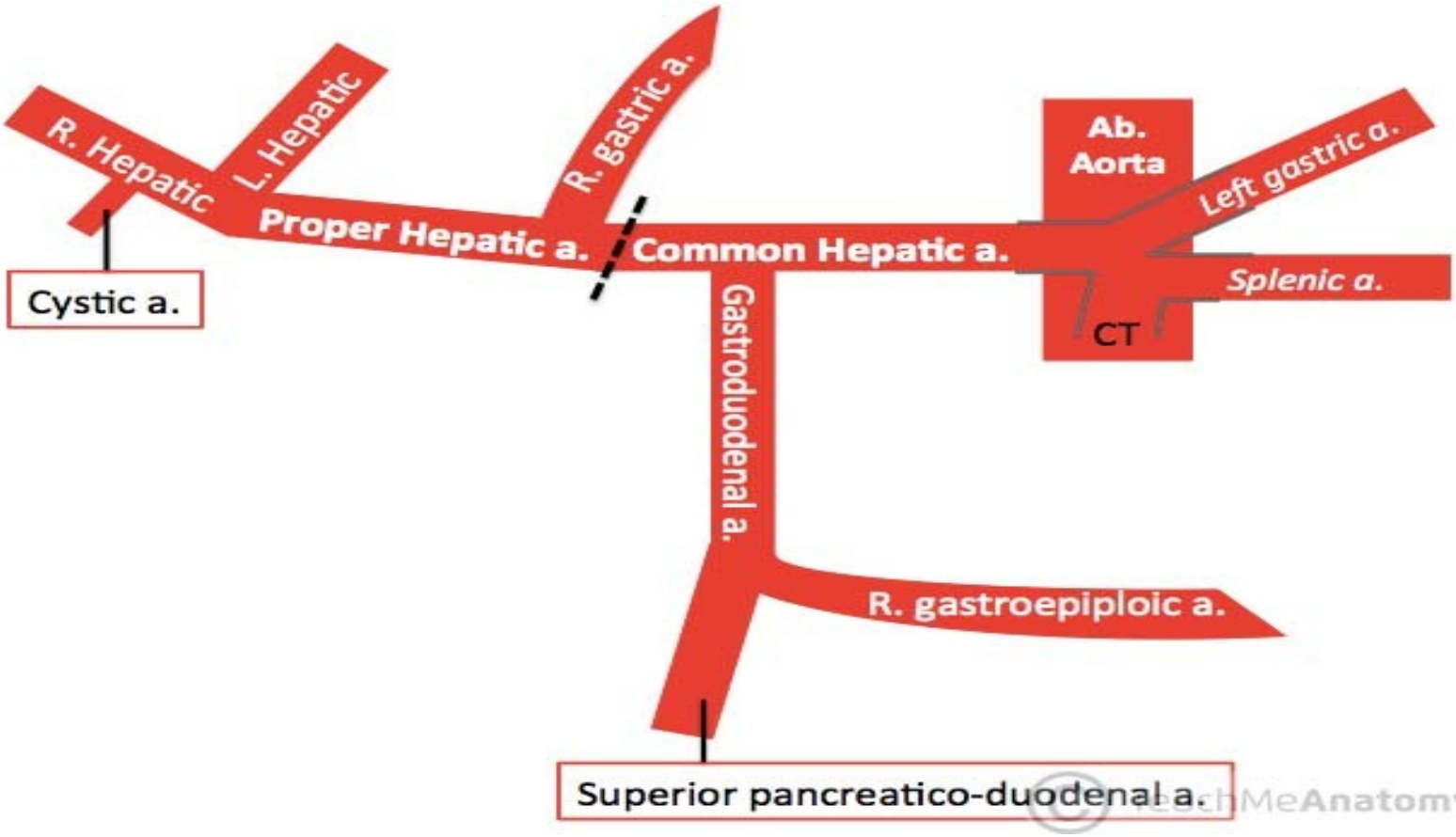
- The common hepatic artery is the sole arterial supply to the liver and the only branch of the coeliac artery to pass to the right.
- As it travels past the superior aspect of the duodenum, it divides into its two terminal branches – the proper hepatic and gastroduodenal arteries. Each of these arteries has multiple branches and variation in the arrangement of these branches is common.

Proper Hepatic

- The proper hepatic artery ascends through the lesser omentum towards the liver. It gives rise to:
- Right gastric: supplies the pylorus and lesser curvature of the stomach.
- Right and left hepatic: divide inferior to the porta hepatis and supply their respective lobes of the liver.
- Cystic: branch of the right hepatic artery – supplies the gall bladder.

Gastroduodenal

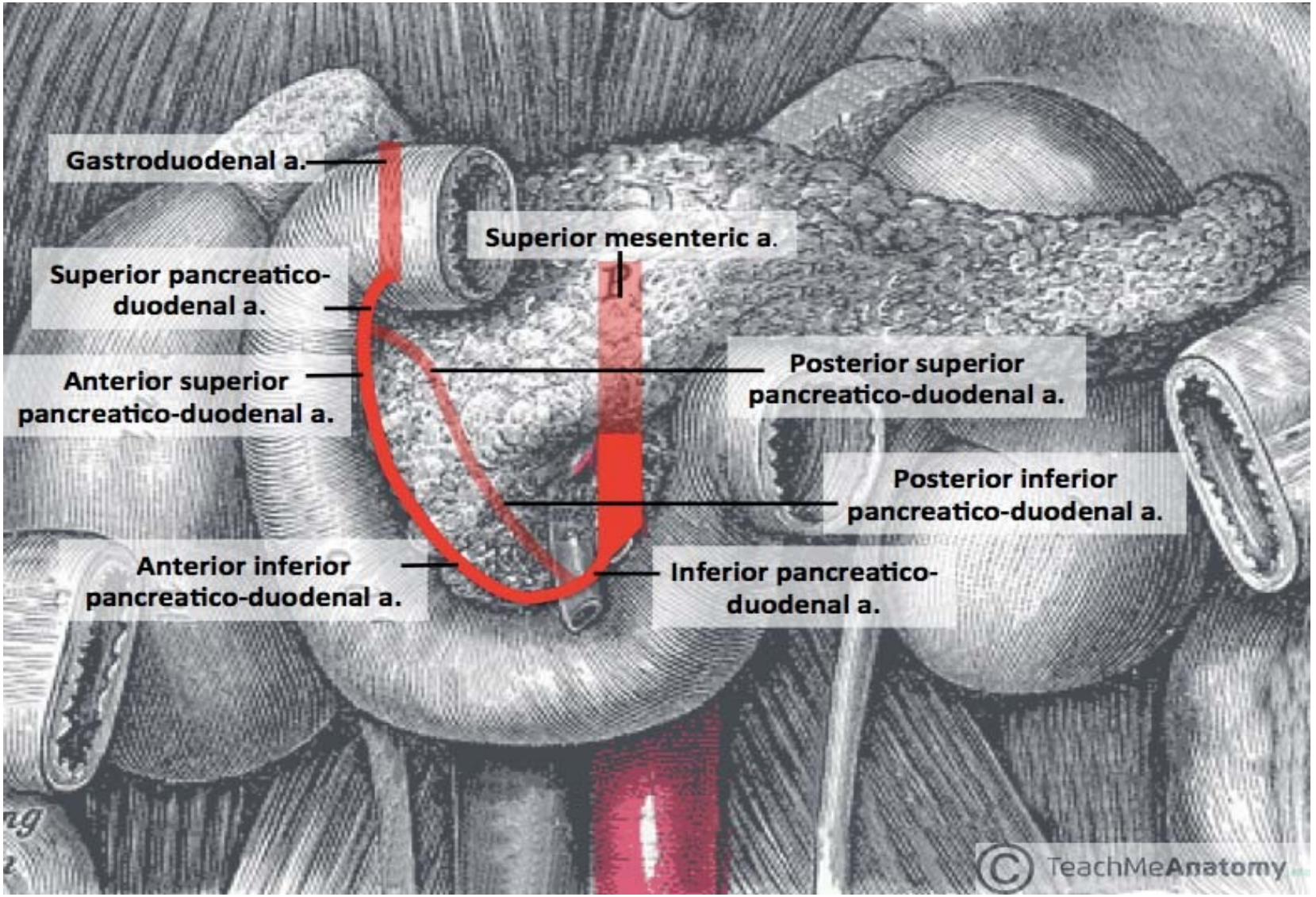
- The gastroduodenal artery descends posterior to the superior portion of the duodenum. Its branches are:
- Right gastroepiploic**:** supplies the greater curvature of the stomach . Found between the layers of the greater omentum, which it also supplies.
- Superior pancreaticoduodena**l:** divides into an anterior and posterior branch, which supplies the head of the pancreas



Branches of the common hepatic artery

Anastomoses

- **Stomach**
- The stomach is the only organ to receive arterial supply from all three branches of the coeliac trunk. This is achieved through a system of anastomoses along the **greater** (gastroepiploic arteries) and **lesser** (gastric arteries) **curvatures**.
- **Pancreas**
- The **pancreaticoduodenal arcade** is a network of arteries that surround and supply the head of the pancreas.
- There are two main arteries – each has an anterior and posterior branch, that anastomose (e.g. anterior to anterior) forming a ring structure:
- **Superior pancreaticoduodenal**– a branch of the gastroduodenal artery.
- **Inferior pancreaticoduodenal** – branch of superior mesenteric artery (SMA).



the pancreaticoduodenal arcade. Note: transparent arteries are posterior to the pictured structures

The Superior Mesenteric Artery

The superior mesenteric artery (SMA) is a major artery of the abdomen.

It arises from the abdominal aorta, and supplies arterial blood to the organs of the **midgut** – which spans from the major duodenal papilla (of the duodenum) to the proximal 2/3 of the transverse colon

Anatomical Position

The superior mesenteric artery is the second of the three major anterior branches of the abdominal aorta

It arises anteriorly from the abdominal aorta at the level of the **L1 vertebrae**, immediately inferior to the origin of the coeliac trunk.

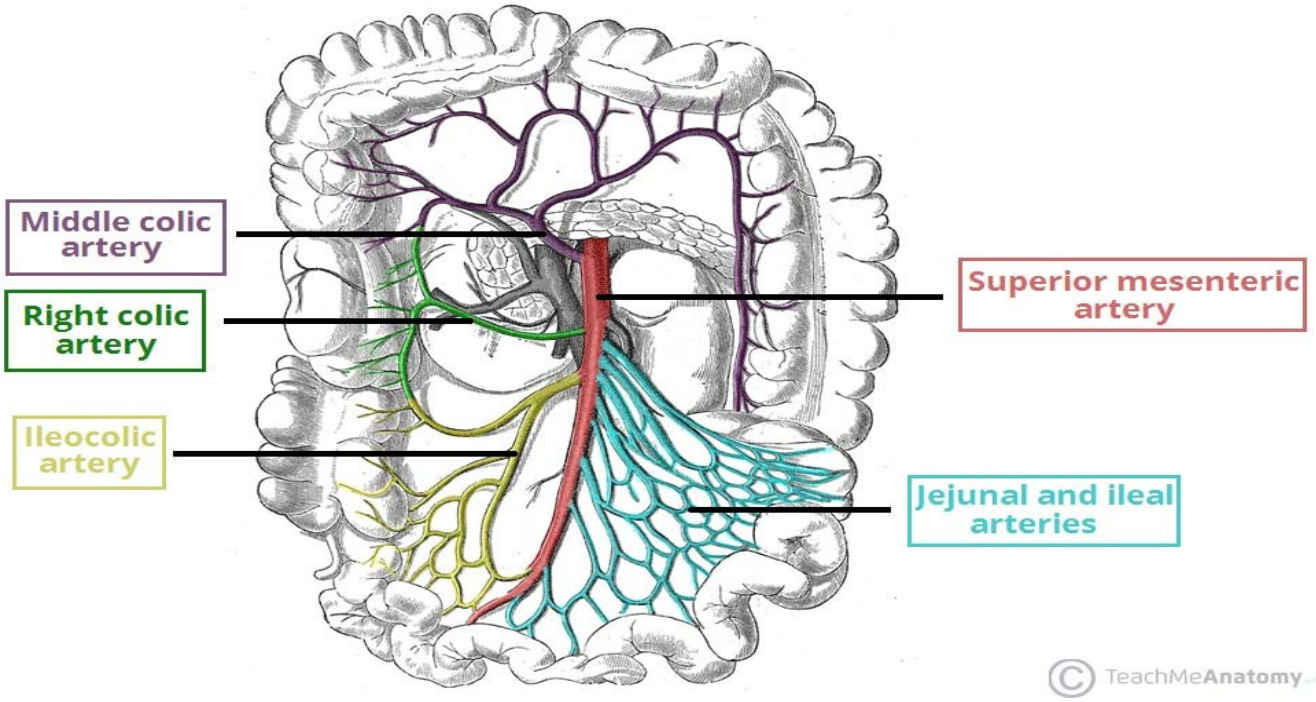
After arising from the abdominal aorta, the superior mesenteric artery descends down the posterior aspect of the abdomen. At this point, it has several important anatomical relations:

- **Anterior to the SMA** – pyloric part of the stomach, splenic vein and neck of the pancreas.
- **Posterior to the SMA** – left renal vein, uncinate process of the pancreas and inferior part of the duodenum.

  The uncinate process is the only part of the pancreas that *hooks* around the back of the SMA.

Major Branches

- The superior mesenteric artery then gives rise to various branches that supply the small intestines, cecum, ascending and part of the transverse colon



The superior mesenteric artery and its branches.

1- inferior Pancreaticoduodenal Artery

The inferior pancreaticoduodenal artery is the first branch of the SMA. It forms anterior and posterior vessels, which anastomose with branches of the **superior pancreaticoduodenal artery** (derived from the coeliac trunk).

- This network supplies the inferior region of the head of the pancreas , the uncinate process, and the duodenum

2-Jejunal and Ileal Arteries

The superior mesenteric artery gives rise to numerous arteries that supply the jejunum and ileum.

The arteries pass **arcades** between the layers of the mesentery and form **anastomotic** – from which smaller, straight arteries (known as the "vasa recta") arise to supply the organs

The jejunal blood supply is characterised by a smaller number of arterial arcades, but longer vasa recta. In contrast, the ileal blood supply is marked by more arterial arcades with shorter vasa recta.

3-Middle and Right Colic Arteries

The right and middle colic arteries arise from the right side of the superior mesenteric artery to supply the colon:

- **Middle colic artery** – supplies the transverse colon.
- **Right colic artery** – supplies the ascending colon.

4-Ileocolic Artery

- The ileocolic artery is the final major branch of the superior mesenteric artery. It passes inferiorly and to the right, giving rise to branches to the ascending colon, appendix, cecum, and ileum.

The Inferior Mesenteric Artery

The inferior mesenteric artery (IMA) is a major branch of the abdominal aorta. It supplies arterial blood to the organs of the hindgut – the distal 1/3 of the transverse colon, splenic flexure, descending colon, sigmoid colon and rectum.

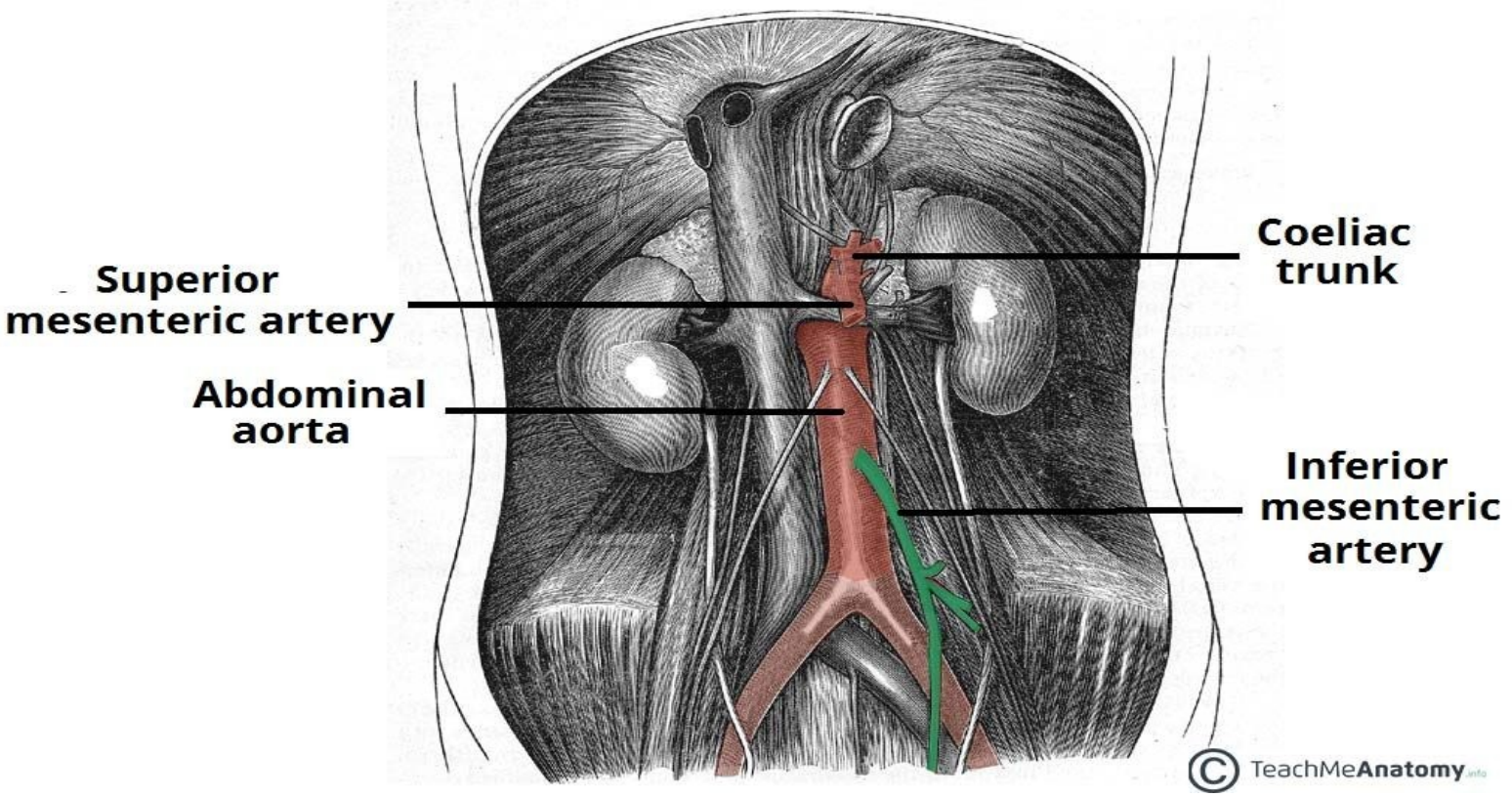
Anatomical Position

The inferior mesenteric artery is the last of the three major anterior branches of the abdominal aorta

. It arises at **L3**, near the inferior border of the duodenum, 3-4 cm above where the aorta bifurcates into the **common iliac arteries**.

As the artery arises from the aorta, it descends anterior to the aorta before moving to the left side.

It is a **retroperitoneal** structure – situated behind the peritonium



The origin of the IMA from the abdominal aorta. It is the third major branch.

Major Branches

The branches of the inferior mesenteric artery supply the structures of the embryonic **hindgut**. These include the distal 1/3 of the transverse colon, splenic flexure, descending colon, sigmoid colon and rectum.

There are three major branches that arise from the IMA – the **left colic artery**, **sigmoid artery** and **superior rectal artery**.

1- Left Colic Artery

The left colic artery is the first branch of the IMA. It supplies the distal 1/3 of the transverse colon and the descending colon.

After arising from the aorta , it travels anteriorly to the psoas major muscle, left ureter and left internal spermatic vessels, before dividing into ascending and descending branches:

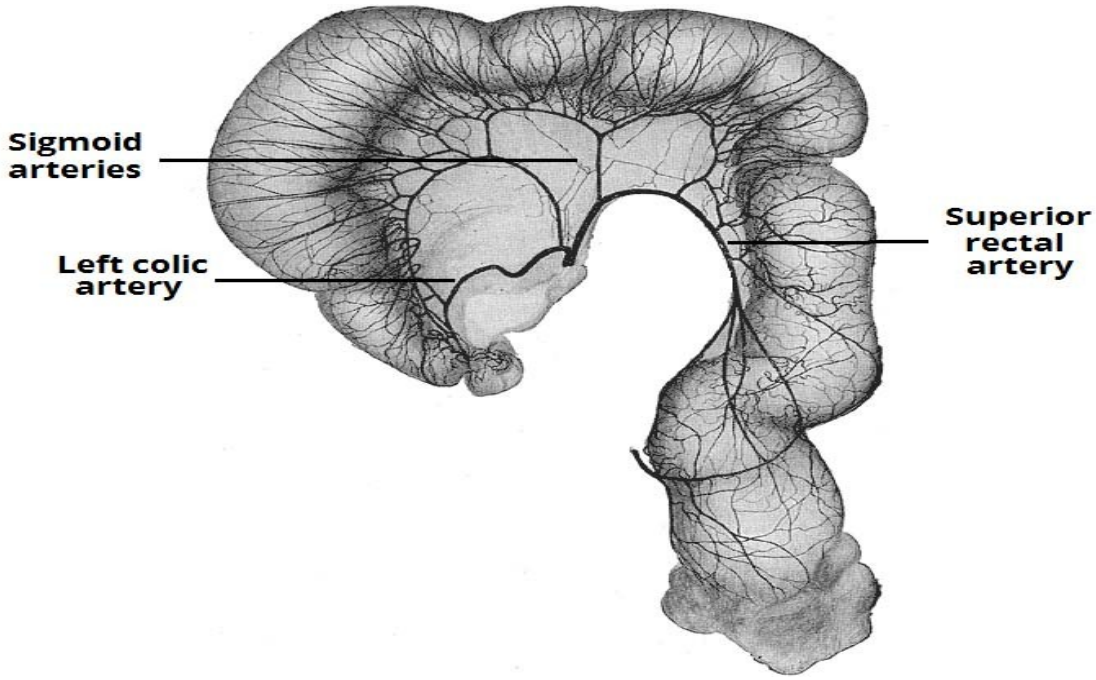
- **Ascending branch** – crosses the left kidney anteriorly, before entering the mesentery of the transverse colon, moving superiorly. It supplies the distal 1/3 of the transverse colon, and the upper aspect of the descending colon.
- **Descending branch** – moves inferiorly to supply the lower part of the descending colon. It anastomoses with the superior sigmoid artery

2-Sigmoid Arteries

- The sigmoid arteries supply the descending colon and the sigmoid colon.
- There are typically 2-4 branches, with the upper most branch termed the **superior sigmoid artery**.
- They run inferiorly, obliquely and to the left, crossing over the **psoas major**, left **ureter** and **left internal spermatic vessels**

3-Superior Rectal Artery

- The superior rectal artery is a continuation of the inferior mesenteric artery, supplying the rectum. It descends into the pelvis, crossing the left common iliac artery and vein.
- At the S3 vertebral level, the artery divides into two terminal branches – one supplying each side of the rectum . Within the walls of the rectum, smaller divisions of these branches eventually communicate with the **middle** and **inferior rectal arteries**



The major branches of the IMA supplying the sigmoid colon and rectum

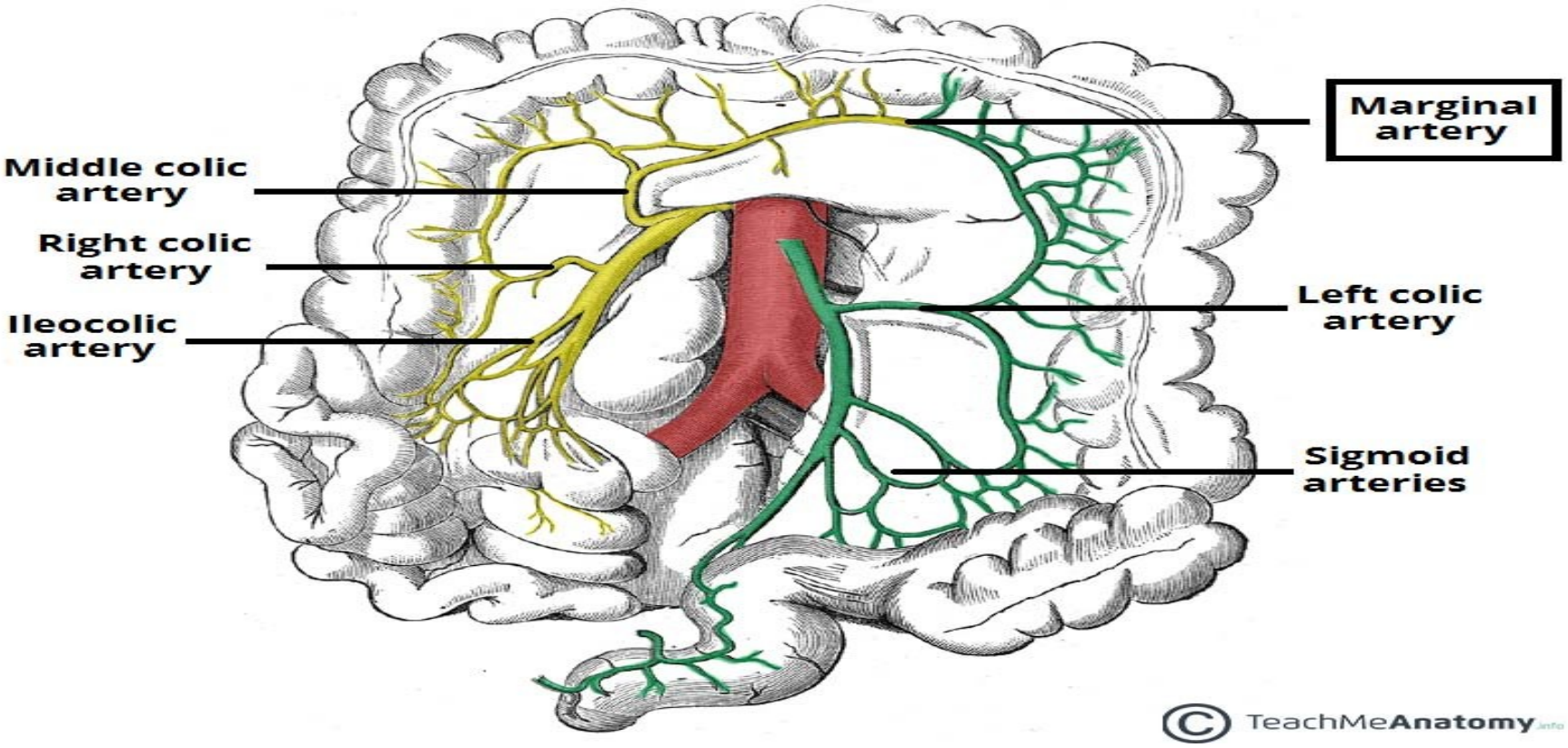
Anastomoses

- There are two major anastomoses of the IMA, both involving a union with branches of the **superior mesenteric artery:**

1-Marginal artery (of Drummond) – forms a continuous arterial circle along the inner border of the colon. Straight vessels (vasa recta) arise from the artery to supply the colon. It is formed by the union of several branches; the ileocolic, right colic and middle colic of the SMA and left colic and sigmoid branches of the IMA.

2-Arc of Riolan – anastomosis between the middle colic branch of SMA and the left colic branch of IMA. It is less common than the marginal artery, and indeed its existence has been questioned by some surgeons.

- The **splenic flexure** can be described as a **watershed area** – a term used when an area has dual blood supply from the most distal branches of two large arteries.
- Whilst this has the advantage of being more resistant to ischaemia if one of the arteries becomes occluded, it makes the area more sensitive to systemic hypoperfusion.



The marginal artery of Drummond.

Venous Drainage of the Abdomen

- There are two venous systems that drain abdominal structures :

1-the **portal venous system** and

2-the **systemic venous system**.

- The portal system transports venous blood to the liver for processing, whilst the systemic venous system returns blood to the right atrium of the heart

Systemic Venous System

- The systemic venous system transports deoxygenated blood to the **right atrium** of the heart. The major vessel in this system is the **inferior vena cava**.

Inferior Vena Cava

- The inferior vena cava is the common convergence of venous drainage from all structures below the diphragm .
- It is located on the posterior abdominal wall; anteriorly to the vertebral column and to the right of the abdominal aorta .
- The vessel is formed by the union of the **common iliac veins** at the L5 vertebral level. It ascends superiorly, and leaves the abdomen by piercing the central tendon of the **diaphragm** at the T8 level (the caval hiatus).
- Within the thorax, the inferior vena cava drains into the **right atrium** of the heart.

Tributaries

- The inferior vena cava is responsible for the venous drainage of all structures below the diaphragm. It receives tributaries from:

1-Common iliac veins – formed by the external and internal iliac veins. They drain the lower limbs and gluteal region.

2-Lumbar veins – drain the posterior abdominal wall.

3-Renal veins – drain the kidneys , left adrenal gland and left testis \ovary .

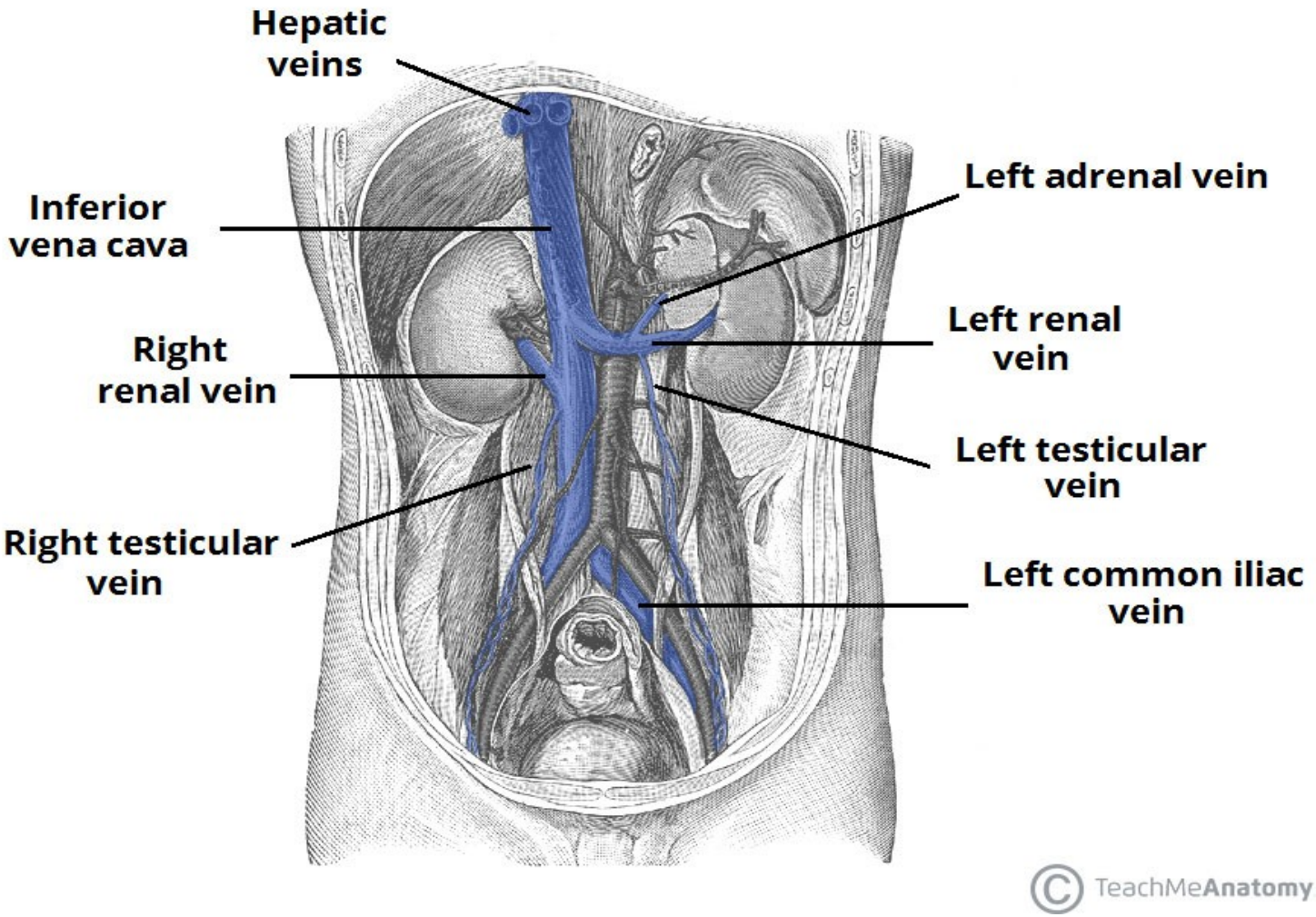
4-Right testicular or ovarian vein – drains the right testes in males and the right ovary in females (the left testicular or ovarian vein drains into the left renal vein).

5-Right suprarenal vein – drains the right adrenal gland (the left adrenal vein drains into the left renal vein).

6-Inferior phrenic veins – drain the diaphragm

7-Hepatic veins – drain the liver

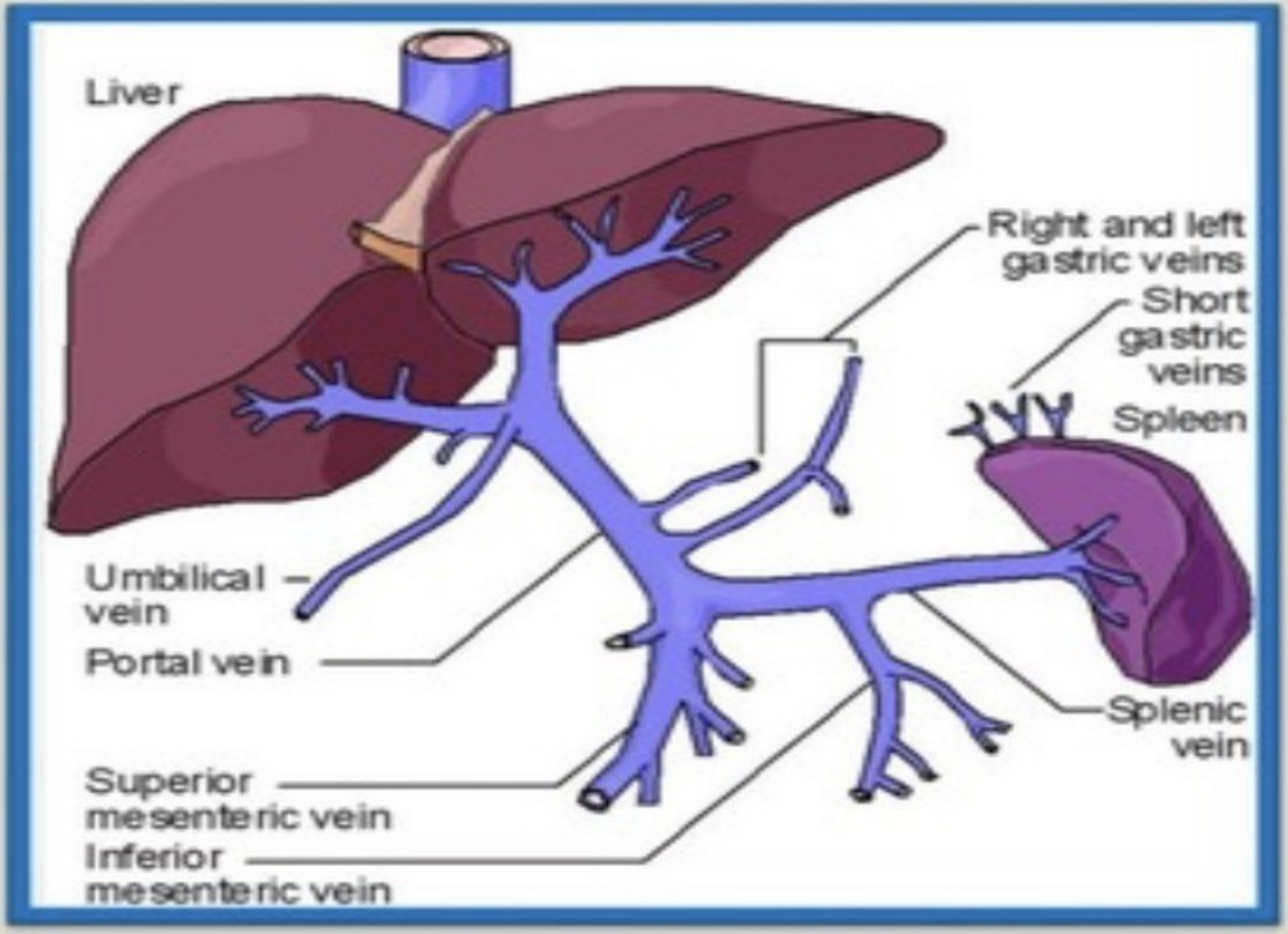
- There are no tributaries from the spleen, pancreas, gallbladder or the abdominal part of the GI tract – as these structures are first drained into the **portal venous system**. However, venous return from these structures ultimately enters the inferior vena cava via the hepatic veins (after being processed by the liver)



The inferior vena cava and major tributaries. Note how the left adrenal vein and left testicular vein empty into the left renal vein.

Portal Venous System

- The portal system carries venous blood (rich in nutrients that have been extracted from food) to the liver for **processing**.
- The major vessel of the portal system is the **portal vein**. It is the point of convergence for the venous drainage of the spleen, pancreas, gallbladder and the abdominal part of the gastrointestinal tract.
- the portal vein is formed by the union of the **splenic vein** and the **superior mesenteric vein**, posterior to the neck of the pancreas, at the level of L2.
- As it ascends towards the liver, the portal vein passes posteriorly to the superior part of the duodenum and the **bile duct**.
- Immediately before entering the liver, the portal vein divides into right and left branches which then enter the parenchyma of the liver separately.


Liver
Right and left gastric veins
Short gastric veins
Spleen
Umbilical vein
Portal vein
Splenic vein
Superior mesenteric vein
Inferior mesenteric vein

Termination of portal vein ; in porta hepatis by dividing to RT and LT branch

Length about 8 cm

;Course and relation

. Has two part retrodudenal and supra dudenal

;Retrodudenal .part-1

Ascend up word and to the RT behind 2nd inch of 1st part of duodenum

; Relation

Posteriorly … IVC

Anteriorly …. CBD (common bile duct) &gastroduod artery

;Supraduodenal .part-2

Ascending in the free margin of lesser omentum

– Relation

Posteriorly …. epiploic foramen

Anteriorly .1-CBD anterior and to the right

Hepatic art. Anterior and to the left-2

- **Terminal branches of the potal vein to RT and LT portal veins**

Relations

… anterior

RT and LT hepatic duct-1

. Rt and left branch of hepatic artery-2

; Posterior

IVC which separate it by caudate process of caudate lobe

Notes : two ligaments .attach to the left branch of portal vein

ligmantum teres (oblitration of umbilical vein)-1

ligamentum venosum; oblitration ductus -2 veinosum of the feotus which reach to the IVC

Tributaries

- The portal vein is formed by the union of the splenic vein and superior mesenteric vein. It receives additional tributaries from:
- **Right and left gastric veins** – drain the stomach
- **Cystic veins** – drains the gallbladder
- **Para-umbilical veins** – drain the skin of the umbilical region.
- **Splenic Vein**
- The **splenic vein** is formed from a variety of smaller vessels as they leave the hilum of the spleen
- Unlike the splenic artery, the splenic vein is straight and it maintains contact with the **body of the pancreas** as it crosses the posterior abdominal wall. As it reaches the neck of the pancreas, the splenic vein joins the superior mesenteric vein to form the portal vein.

Tributaries to the splenic vein include:

- **Short gastric veins** – drain the fundus of the stomach.
- **Left gastro-omental vein** – drains the greater curvature of the stomach.
- **Pancreatic veins** – drain the pancreas
- **Inferior mesenteric vein** – drains the colon .

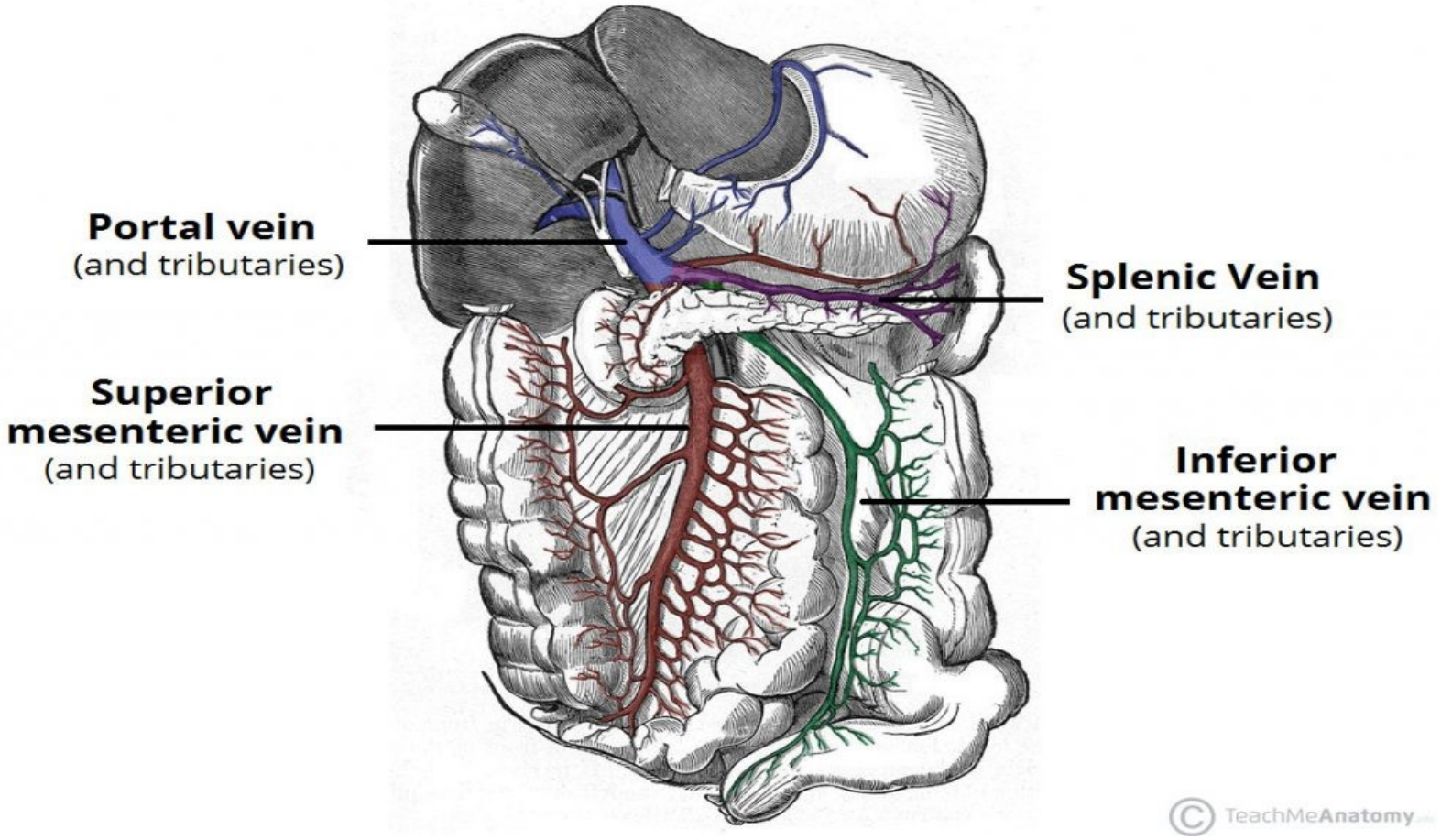
inferior mesenteric vein drains blood from the rectum, sigmoid colon, descending colon and splenic flexure. It begins as the superior rectal vein and ascends, receiving tributaries from the sigmoid veins and the left colic veins. As it ascends further it passes posteriorly to the body of the pancreas and typically joins the splenic vein.

Superior Mesenteric Vein

- The superior mesenteric vein drains blood from the small intestine, cecum, ascending colon and transverse colon.
- It begins in the **right iliac fossa**, as a convergence of the veins draining the terminal ileum, cecum and appendix.
- It ascends within the mesentery of the small intestine, and then travels posteriorly to the neck of the pancreas to join the splenic vein.

Tributaries

- Tributaries to the superior mesenteric vein include:
- **Right gastro-omental vein** – drains the greater curvature of the stomach.
- **Anterior** and **posterior inferior pancreaticoduodenal veins** – drain the pancreas and duodenum .
- **Jejunal vein** – drain the jejunum
- **Ileal vein** – drain the ileum
- **Ileocolic vein** – drains the ileum, colon and cecum.
- **Right colic vein** – drains the ascending colon.
- **Middle colic vein** – drains the transverse colon.
- Many of these tributaries are formed as an accompanying vein for each branch of the superior mesenteric artery.



The hepatic portal venous system.

Porto-systemic anastemosis

-Porto-systemic anastomosis also known as portocaval anastomosis is the collateral communication between the portal and the systemic venous system. The portal venous system transmits deoxygenated blood from most of the gastrointestinal tract and gastrointestinal organs to the liver

-When there is a blockage of the portal system, portocaval anastomosis enable the blood to still reach the systemic venous circulation. Even though this is useful, bypassing the liver may be dangerous, since it is the main organ in charge for detoxication and breaking down of substances found in the gastrointestinal tract, such as mediactions but the poisons as well

The various anastomoses and the sites in which they occur are described below;

1-The anastomosis between the left gastric veins, which are portal veins, and the lower branches of oesophageal veins that drain into the azygos and hemiazygos veins , which are systemic veins. The site of this anastomosis is the lower oesophagus.

2-The anastomosis between the superior rectal veins, which are portal veins, and the inferior and middle rectal veins, which are systemic veins. The site of this anastomosis is the upper part of the anal canal .

3-The anastomosis between the paraumbilical veins, which run in the ligamentum teres as portal veins, and small epigastric veins, which are systemic veins. The site of this anastomosis is the umbilicus.

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4-The anastomosis between the intraparenchymal branches of the right division of the portal vein and retroperitoneal veins (systemic veins) that drain into the azygos, hemiazygos and lumbar veins (systemic veins). The site of this anastomosis is the bare area of the liver.

5-The anastomosis between omental and colonic veins (portal veins) with the retroperitoneal veins (systemic veins) in the region of hepatic and splenic flexure.

6-Another anastomosis is between the ductus venosus (portal vein) and the inferior vena cava (systemic vein). This is very rare and at the site of patent ductus venosus


Thank
You
YOU'RE THE BEST!