

Practical class 2

ACCESSORY DIGESTIVE ORGANS

OBJECTIVES

By the end of the practical session you should be able to:

1. Outline the gross structure, relations, neurovascular supply and lymph drainage of the liver.
2. Define the anatomical features, relations, function and clinical considerations of the extra-hepatic biliary system.
3. Describe the anatomical relations, development, vascular supply and functions of the pancreas.
4. Describe the origin, course, distribution and relations of the arteries supplying the gastrointestinal tract.
5. Describe the portal venous system and explain its role in nutrition, and the nature and location of portosystemic anastomoses.

Background reading

Rogers: chapter 32: The liver, biliary system and pancreas
40: (Arterial supply to the gut, The hepatic portal venous system)
27: (Nerve supply to the gastrointestinal tract)

LIVER

The liver is the largest visceral organ, and is situated in the right hypochondriac and epigastric regions.

Study the prosections of the liver and note that:

- a) the liver is superficially divided into four lobes
- i) two major lobes, a larger **right** and a smaller **left lobe: divided** superiorly by the **falciform ligament** and posteriorly by the left limb of an H-shaped arrangement of ligaments and fossae.
- ii) two subsidiary lobes on the posteroinferior aspect of the liver between the limbs of the 'H': the **quadrate lobe** inferiorly, and the **caudate lobe** superiorly.
- b) the left lobe extends across the epigastrium
- c) the right lobe is situated in the right hypochondrium
- d) the cross bar of the 'H' is the hilum of the liver called the **porta hepatis** from which the **lesser omentum** runs to the **lesser curvature** of the **stomach**.
- e) the posteroinferior of the liver is related to the abdominal oesophagus, stomach, duodenum, hepatic flexure of colon, the right kidney, suprarenal gland, and the gall bladder.

What structure separates the caudate lobe from the right lobe?

What structure separates the quadrate lobe from the right lobe?

Which structures run in the free edge of the lesser omentum?

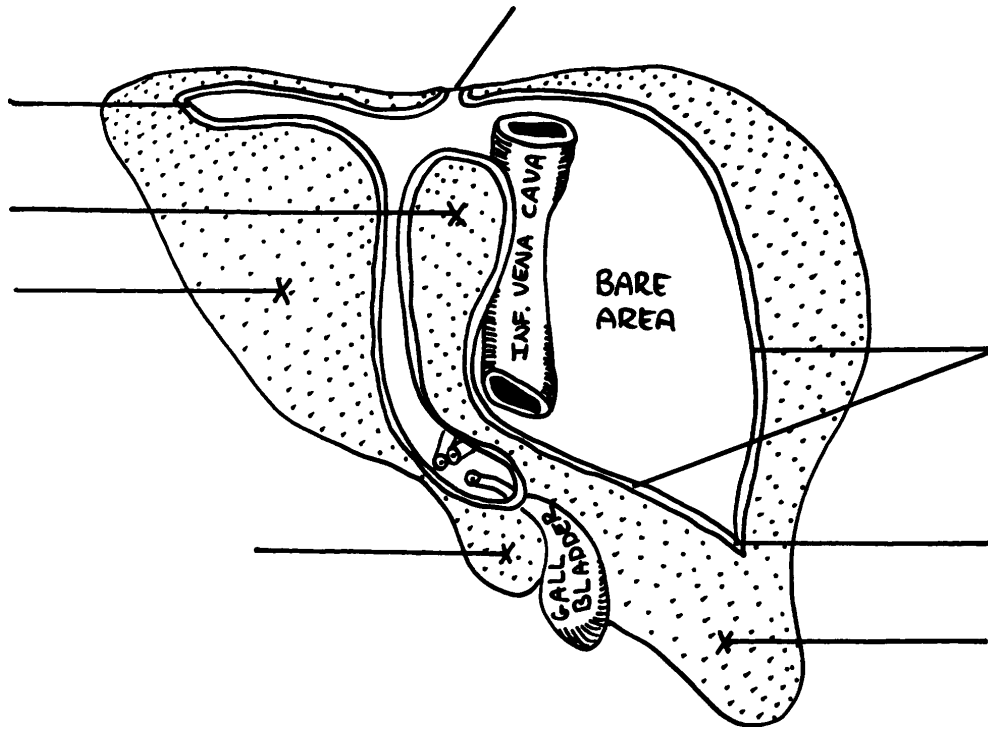
The liver drains blood from the gastrointestinal tract via the portal venous system, locate the major veins of this system listed below on the prosections.

Hepatic
Superior mesenteric
Inferior mesenteric
Splenic

Note their arrangement with respect to the pancreas and duodenum.

The majority of the liver is peritonised, that is, it is covered by visceral peritoneum, except for the **bare area**. This region includes most of the superior surface of the right lobe as well as some of the left lobe. At the edges of the bare area, the peritoneum is reflected onto the inferior surface of the diaphragm so producing four distinct ligaments. Note that these are continuous with the **falciform ligament**.

Label these four ligaments on the following diagram, and complete the labelling.



What are the major functions of the liver?

GALL BLADDER AND BILIARY APPARATUS

The gall bladder is embedded in the inferior surface of the right lobe of the liver, its function is to store and concentrate bile.

The gall bladder does NOT synthesise bile.

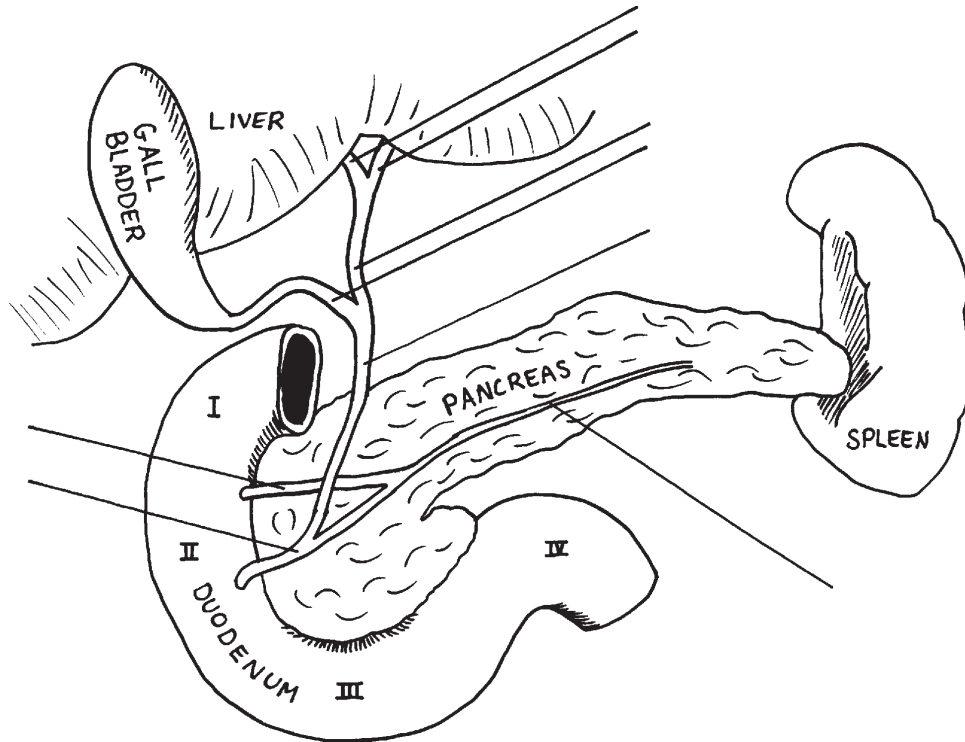
Where is bile synthesised, and how does it reach the gall bladder?

Sketch the gall bladder in the space below to indicate its fundus, body and pylorus.

The fundus of the gall bladder is related to the tip of the right 9th costal cartilage.

Identify the gall bladder under the lower free border of the liver. Trace its drainage duct (the **cystic duct**) to the junction with the **hepatic duct** where it forms the **common bile duct** which can be followed down to the second part of the duodenum.

Complete the labelling of the extrahepatic biliary apparatus on the following diagram.



On a prosected specimen review the biliary apparatus.

Lift the head of the pancreas to locate the lower part of the common bile duct and trace it down to its junction with the **major pancreatic duct** and their joint entry into the medial aspect of the 2nd part of the duodenum.

Look into the duodenum again to view the major duodenal papilla which marks the internal orifice of entry of the hepatopancreatic duct.

Is this the only drainage point into the gut for the exocrine secretion of the pancreas?

PANCREAS

The pancreas is a diffuse gland, extending approximately horizontally across the upper abdomen from the curve of the duodenum to the hilum of the spleen

Identify the **uncinater process, head, neck, body** and **tail** of the pancreas and note its vertebral levels and relations.

What is the major blood supply to the pancreas?

What other vessels supply the pancreas?

Why is the blood supply to the pancreas so extensive?

Look at the prosected parts to check the posterior relation of the gland.

Study the diagram overleaf, and note particularly the arrangement of the three major arterial trunks which supply the digestive tract with respect to the duodenum and pancreas.

Label the following structures on the diagram:

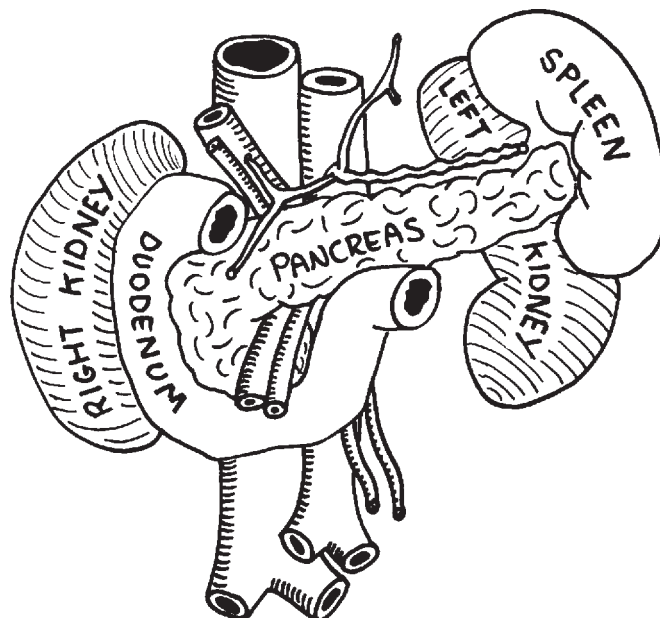
Aorta

Splenic, left gastric, common hepatic, superior and inferior mesenteric arteries

Inferior vena cava, portal, superior and inferior mesenteric veins

Bile duct

(You may find this easier after completing the next section of the workbook concerned with the blood supply to the gastrointestinal tract.)



VESSELS AND NERVES OF THE GASTROINTESTINAL TRACT

Arterial supply

Three unpaired arterial branches leave the front of the abdominal aorta to supply the gastrointestinal tract. The most proximal (**coeliac trunk**) supplies the foregut and its three derivatives (liver, pancreas and spleen). The second (**superior mesenteric**) passes through the mesentery to supply the midgut. The most distal (**inferior mesenteric**) supplies the hindgut.

You should know what the boundaries of the fore-, mid- and hind-gut are, as it will greatly simplify your understanding of the blood supply of the gastrointestinal tract. Ask one of the demonstrators if you are unsure.

COELIAC TRUNK

This divides into three branches to supply the foregut as far as the opening of the common bile duct into the duodenum, as well as the liver, spleen and pancreas.

Identify the coeliac trunk as it arises from the aorta at the upper border of the pancreas.

At which vertebral level does the coeliac trunk arise?

Note the site of potential arterial anastomosis at the greater curvature of the stomach.

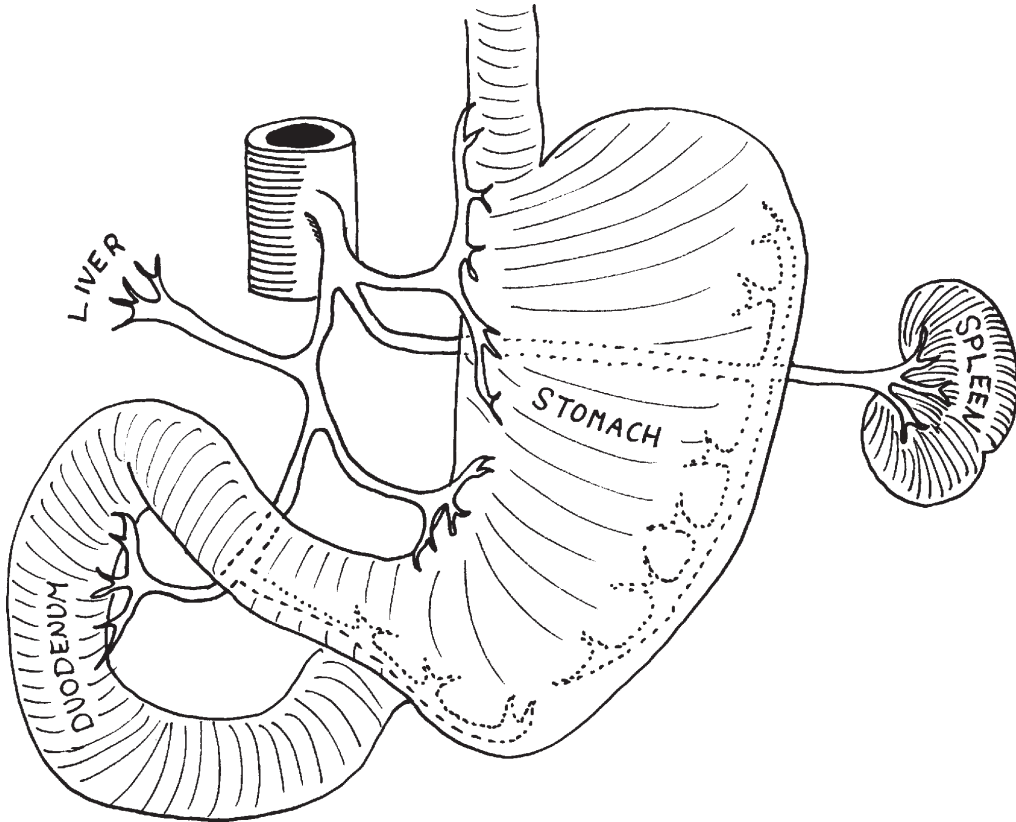
What vessels contribute to this anastomotic site?

What is the function of these anastomotic sites?

On suitable prosections trace the major arterial branches of the coeliac trunk.

Left gastric
Common hepatic
Splenic

Label these and the other vessels on the following diagram.



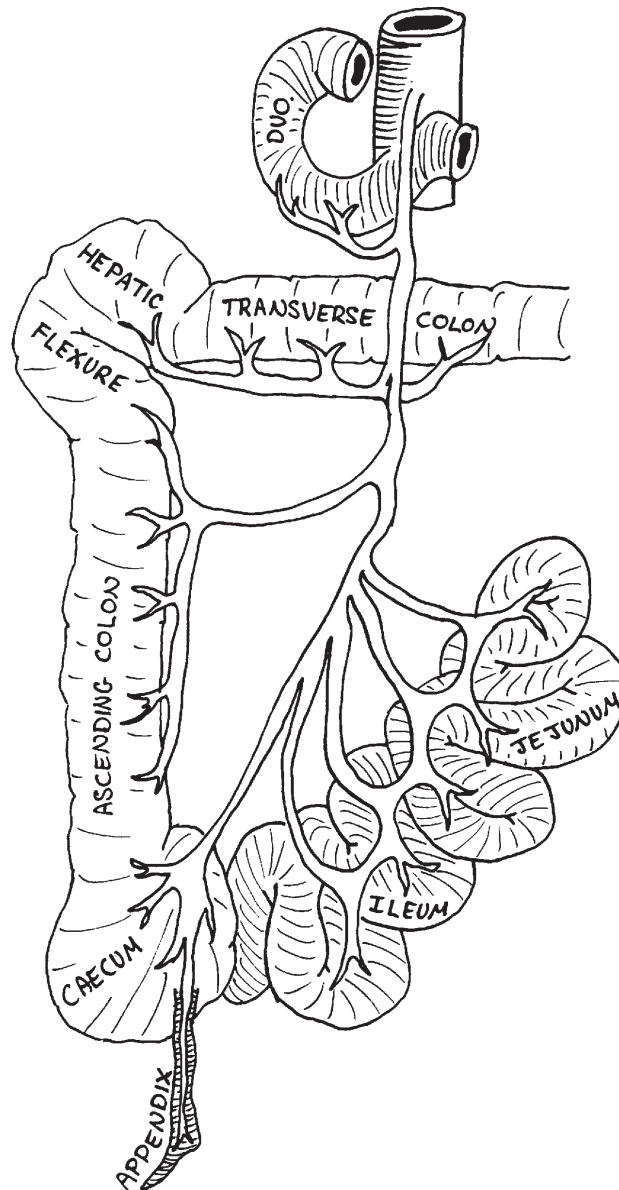
SUPERIOR MESENTERIC ARTERY

This supplies the midgut from the second part of the duodenum to the end of the second third of the transverse colon.

Find the superior mesenteric vessels in the mesentery and note the pattern of the arterial arcades at the proximal and distal ends. Try to find the following major branches:

Ileocolic
Right colic
Middle colic

On the following diagram label the major branches of the superior mesenteric artery.



What blood vessel supplies the appendix?

How does this vessel reach the appendix?

At what vertebral level does the superior mesenteric artery arise?

Does the superior mesenteric artery pass deep or superficial to the duodenum?

INFERIOR MESENTERIC ARTERY

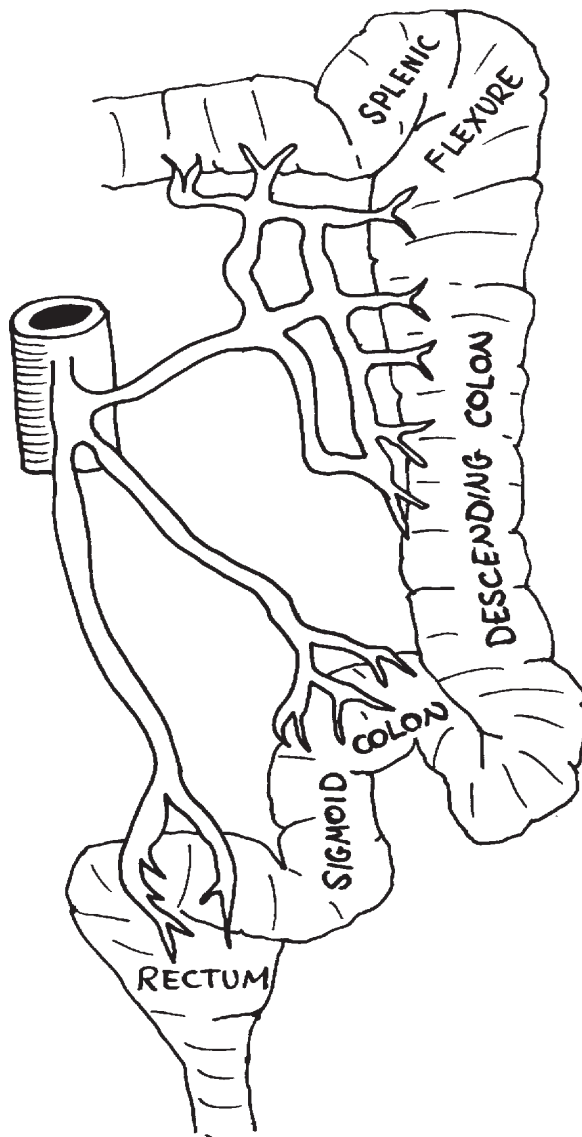
This supplies the hind-gut from the distal third of the transverse colon to the rectum. Locate the inferior mesenteric artery on the dissections available, and try to find the following major arterial branches to the hindgut.

Left colic
Sigmoidal
Superior rectal

On the following diagram, label the major branches of the inferior mesenteric artery. Make sure that you know the distribution of these vessels.

At which vertebral level does the inferior mesenteric artery arise?

Does the inferior mesenteric artery pass above or below the duodenum.



What is the marginal artery, and what vessels contribute to it?

Venous return

The venous drainage of the gut essentially mirrors the arterial supply but with several important differences. It is critical to appreciate that ALL nutrient-laden blood from the gut, passes via the **portal vein** to the liver (the hepatic portal system), before returning to the systemic system.

What is a portal system?

Locate the hepatic portal vein on the prosections available.

It is important to understand the arrangement of the major vessels which contribute to the portal vein; these are the **splenic, superior and inferior mesenteric veins**. Note that there is no “coeliac vein”.

The venous drainage of the foregut is fairly complex and ultimately drains into the splenic, superior mesenteric and portal veins. That of the midgut is quite regular. Each branch of the superior mesenteric artery is accompanied by a vein, all of which ultimately drain into the superior mesenteric vein, a large trunk which lies to the right of the artery. Locate this vessel on the prosections. Confirm that it receives the splenic vein behind the neck of the pancreas. Here, it acquires a new name, the portal vein. Note that it is named portal vein above and superior mesenteric vein below the level of entry of the splenic vein, but the two represent a single continuous trunk. The inferior mesenteric vein drains the hind-gut in a similarly regular fashion and enters the splenic vein part way along its length.

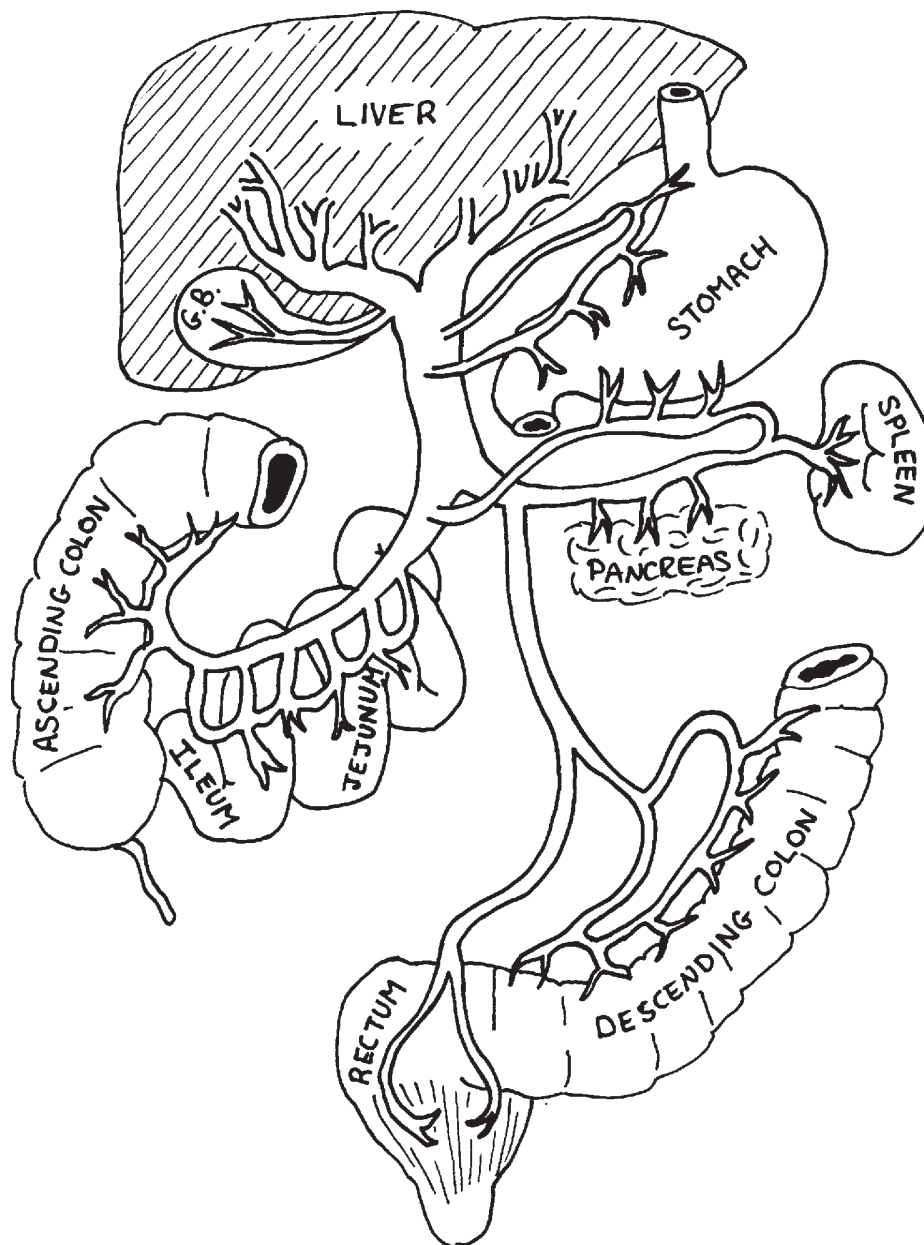
Sketch the arrangement of the major vessels which contribute to the portal vein in the space below.

Should flow in the portal vein become compromised, pressure in the vessel will be increased resulting in portal hypertension. This results in blood from the gut ‘short-circuiting’ the portal vein and returning directly to the heart via the systemic system. This occurs by way of **porto-systemic anastomoses**. (Revise the meaning of the term 'anastomosis'.) Essentially there are 3 major sites at which capillaries of the portal and systemic systems are in close apposition, and when portal blood pressure is raised above a certain level, blood will flow into the systemic veins from the portal veins.

Complete the following table, which indicates the vessels involved in the three major porto-systemic anastomoses.

Site	Oesophagus	Umbilicus	R
Portal vessel	Oesophageal	Para-umbilical	Supe
Systemic vessel			

Locate these sites on the following diagram of the portal system.



Label the major vessels of the portal system on the previous diagram. Then, using your knowledge of the arterial supply, complete the labelling of the minor vessels.

What are the clinical consequences of portal hypertension, and how might it be detected?

Nerve supply

All parts of the gut and its derivatives are innervated by parasympathetic and sympathetic nerves. Most come from the **coeliac plexus** but the **inferior hypogastric (pelvic) plexus** contributes parasympathetic fibres to the hindgut.

The coeliac plexus receives its parasympathetic input from the two **vagi**.

What effect do these nerves have on the motility and sphincter tone of the stomach?

a) Parasympathetic activation.

b) Sympathetic activation.

The parasympathetic activity of the vagus is opposed by the sympathetic fibres reaching the abdomen by 3 major pairs of **splanchnic nerves**.

Which parts of the stomach secrete acid and pepsin and which secrete gastrin?

What and where is a myenteric plexus of Auerbach and what and where is the plexus of Meissner?

Living anatomy of the gastrointestinal system

OBJECTIVES

After completing this part of the practical, you should be able to carry out the following on a living subject:

1. Use appropriate landmarks to mark and demonstrate the named regions of the abdominal walls.
2. Use appropriate landmarks to demonstrate the positions of the following intra-abdominal structures; outline the variations caused by physique, posture, breathing and fullness:

Stomach
Liver
Gall bladder
Appendix
Colon

3. Palpate the following structures:

Abdominal aorta
Descending colon

4. Demonstrate the use of percussion to detect gas-filled spaces in the abdomen.

Working in pairs, take turns to repeat the observations on each other. Subjects will need to display the abdominal body wall.

Bony landmarks and reference planes

In modern clinical practice the abdomen is usually divided into four quadrants (R & L upper, R & L lower) which meet at the umbilicus. However, here we describe an older scheme which is often used for anatomical description.

We shall now attempt to draw an OXO grid arrangement on the subject, to indicate nine major regions.

1. Identify the **clavicle** and mark its mid-point (**mid-clavicular point**).
2. Identify the **pubic tubercle**, which can be palpated through clothing on the superior border of the pubis 2-3cm from the midline. Bisect the line joining this to the **anterior superior iliac spine** to find the **mid-inguinal point**.
3. On each side draw a vertical line on the abdomen, which if extended both ways would cross the mid-clavicular and **mid-inguinal points**.

4. Lightly mark a horizontal line on the anterior abdominal wall joining the levels of the **costal margins** in the mid-clavicular line (the **subcostal plane**).

5. Palpate the **iliac crest** between the mid-axillary line and the **anterior superior iliac spine** to find the projecting lip called the **iliac tubercle**. Draw a horizontal line connecting the two iliac tubercles (the **intertubercular plane**).

You have now subdivided the anterior abdominal wall into nine regions which are used to aid navigation in the otherwise rather featureless area. The most commonly used names for these regions are given below:

R. HYPOCHONDRIAC	EPIGASTRIC	L. HYPOCHONDRIAC
R. LUMBAR	UMBILICAL	L. LUMBAR
R. ILIAC	HYPOGASTRIC (pubic)	L. ILIAC

Sketch the abdomen in the space below and indicate these regions.

Positions of the visceral organs

Many of the visceral organs of the abdomen are highly variable in position, depending on individual build, body position, state of filling of the organ, etc. Nonetheless a reasonable estimate may be made in most cases.

1. The **liver**: occupies most of the right hypochondrium and epigastrium. Its upper border (in mid-respiration) is marked by a line from the right 5th rib and costal cartilage across the lower end of the sternum to the left 5th intercostal space in the mid-clavicular line to the costal margin in the right mid-axillary line.
2. The **gall bladder**: lies at the tip of the 9th costal cartilage; this is best recognised as the point at which the lateral border of the right rectus muscle crosses the costal margin.
3. **Stomach**: the most consistently placed part is the pylorus. In the supine subject this lies on a plane crossing both costal margins at the mid-clavicular line (i.e. where the lateral border of rectus

abdominis crosses the costal margin), about 1-2cm to the right of the midline. However, the pylorus descends several cms on standing up. Most of the rest of the stomach lies above and to the left of the pyloric position, and the fundus may lie as high as the fifth rib in the left mid-clavicular line.

4. The **appendix**: the most constant part of the appendix is its base, this point lies 2/3 of the way down a line joining the umbilicus to the right anterior superior iliac spine, and the surface marking is termed **McBurneys point**.
5. The **colon**: the ascending colon rises from **McBurney's point** to the transpyloric plane; the transverse colon hangs down to umbilical level then rises to the left lumbar regions; the sigmoid colon crosses to the centre of the hypogastric area.

Why is the pylorus the most consistently located part of the stomach?

Palpation of abdominal organs

The ease with which intra-abdominal structures can be felt depends on the physique of the subject and the experience of the examiner. You should however be able to do the following. Note that the abdomen is most relaxed (and palpation therefore easiest) if the subject lies supine with hips and knees flexed.

1. **Abdominal aorta**: can be felt pulsing powerfully by lumbar vertebral bodies just to the left of the midline. Note: a ruler with one end placed on the mid-abdomen and held down firmly can often be seen to flick in response to aortic pulsations.
2. **Descending colon**: may often be felt in the left lumbar region because of the relative solidity of its contents.

Radiographs

Look at the display of radiographs to appreciate the ways in which contrast media can be used to visualise abdominal viscera.

What evidence of visceral position can be seen in a plain film?

Auscultation and percussion of the abdominal viscera

1. Ask a demonstrator to show you how to listen to the bowel sound with the help of a stethoscope.
2. The demonstrator will also show you the method for percussion of the liver.

