MD Program
UNIVERSITY OF TORONTO

Anatomy

UNIT 4: Abdomen, Pelvis & Perineum

Labs 10-13

CLICK TO ENTER

Unit 4 Overview and Instructions

In **Unit 4**, you will learn the anatomy of the **abdomen, retroperitoneum, pelvis and perineum**. Unit 4 consists of four labs, Labs 10 through 13, spread over 18 hours of lab time.

Labs 10, 11 and 12 cover the anatomy of the GI tract and associated organs, their blood supply, nerve supply and lymphatic drainage. **They are designed to support your learning in the GI block of CPC-2.** Lab 13 covers the anatomy of the the retroperitoneum, pelvis and perineum. **It is designed to support your learning in the Urinary System block of CPC-2.** The assignment of **histology modules** on the digestive and urinary systems are aligned with the gross anatomy sessions and their contents will be assessed on the Unit 4 bell-ringer.

Lab 10 includes a pre-lab SLM that introduces students to the **anatomy of the GI system**. The lab session consists of a **single, 3-hour lab period**. The session begins with an opportunity to review, from Lab 3, the structure of the **anterolateral abdominal wall** and the **peritoneal cavity, abdominal organs, mesenteries and ligaments**. You will, however, go beyond what you learned in Lab 3, because **an introduction to the blood supply of the digestive tract** is woven throughout. **A clear understanding of this information is a prerequisite for a successful dissection of the digestive tract.** During the second half of Lab 10, you will embark upon the **dissection of the foregut**.

Lab 11 includes a pre-lab SLM on the **nerve supply of the GI tract**. The session consists of a **single, 6-hour lab period.** You will continue the **dissection of the foregut** started in Lab 10 and have sufficient time to complete an excellent dissection from which every member of your group can learn. Throughout the course of the day, students will take turns completing Exercise 11.2, a study of prosected abdominal organs.

Lab 12 includes a pre-lab SLM on the **midgut and hindgut**. It is a **single, 3-hour lab period**. During the lab you will complete a dissection of the **midgut, hindgut, duodenum, pancreas and hepatic portal vein**.

Lab 13 includes a pre-lab SLM on the **pelvis and perineum**. It consists of **two, 3-hour lab periods** during which you will learn the anatomy of the retroperitoneum, pelvis and perineum. During the first session, half the class will remove the digestive tracts from four of the eight cadavers in their labs and dissect the **retroperitoneum and kidneys**. The other half of the class will learn the anatomy of the **pelvis and perineum** using bones, models and prosected specimens. During the second lab period, students will switch tasks.

Unit 4 Summary Schedule

Lab 10

Week 28 (3-hour lab)

- initially, all students review the anterolateral abdominal wall on cadaver 1, then:
- Pairs 1 & 2: review the peritoneal cavity, then start the dissection of the foregut on cadaver 1
- Pairs 3 & 4: review the peritoneal cavity, then start the dissection of the foregut on cadaver 2

Lab 11

Week 29 (6-hour lab)

- Pairs 1 & 2: complete dissection of the foregut on cadaver 1
- Pairs 3 & 4: complete dissection of the foregut on cadaver 2
- Students will take turns completing Exercise 11.2, a study of prosected abdominal organs, as outlined here.

Lab 12

Week 30 (3-hour lab)

- Pairs 1 & 2: dissection of the midgut, hindgut duodenum, pancreas and hepatic portal vein on cadaver 1
- Pairs 3 & 4: dissection of the midgut hindgut, duodenum, pancreas and hepatic portal vein on cadaver 2

Lab 13

Week 31 (3-hour lab)

- half of class: dissection of retroperitoneum on 4 of the 8 cadavers (leaving the 4 best dissections of the digestive tract for review)
- half of the class: pelvis and peritoneum using prosections

Week 32 (3-hour lab)

- switch

Anatomy Assessment Monday of Week 33

Unit 4: Lab 10

Select an exercise to begin:

Pre-lab SLM

10A PRELAB SLM: INTRO TO THE GI SYSTEM

Lab 10 Exercises

10.1 REFLECTION OF THE ABDOMINAL WALL

10.2 THE BLOOD SUPPLY OF THE GI SYSTEM

10.3 DISSECTION OF THE FOREGUT

If you finish any exercise early…

10.4 FIELD TRIP

Review Lab 10

QUIZLANDIA 10

10A Pre-lab SLM
An Introduction to the Abdomen

Objectives

When you have successfully completed this exercise, you will be able to:

- describe the limits of the **abdominopelvic/peritoneal cavity**.
- define the terms **intraperitoneal**, **retroperitoneal** and **secondarily retroperitoneal**, as they relate to the positions of abdominal organs.
- list the organs that comprise each of the **foregut**, **midgut** and **hindgut**, and describe, in basic terms, the blood supply to each.
- name the abdominal organs that **develop in** each of the **dorsal** and **ventral mesentery**.
- describe the development and locations of the **greater** and **lesser sacs**, and the **greater omentum**.
- name the **functional subdivision** of the nervous system that supplies the parietal and visceral peritoneum with **sensory fibres**, and the implications of this with regard to the quality and location of **pain** originating in each.

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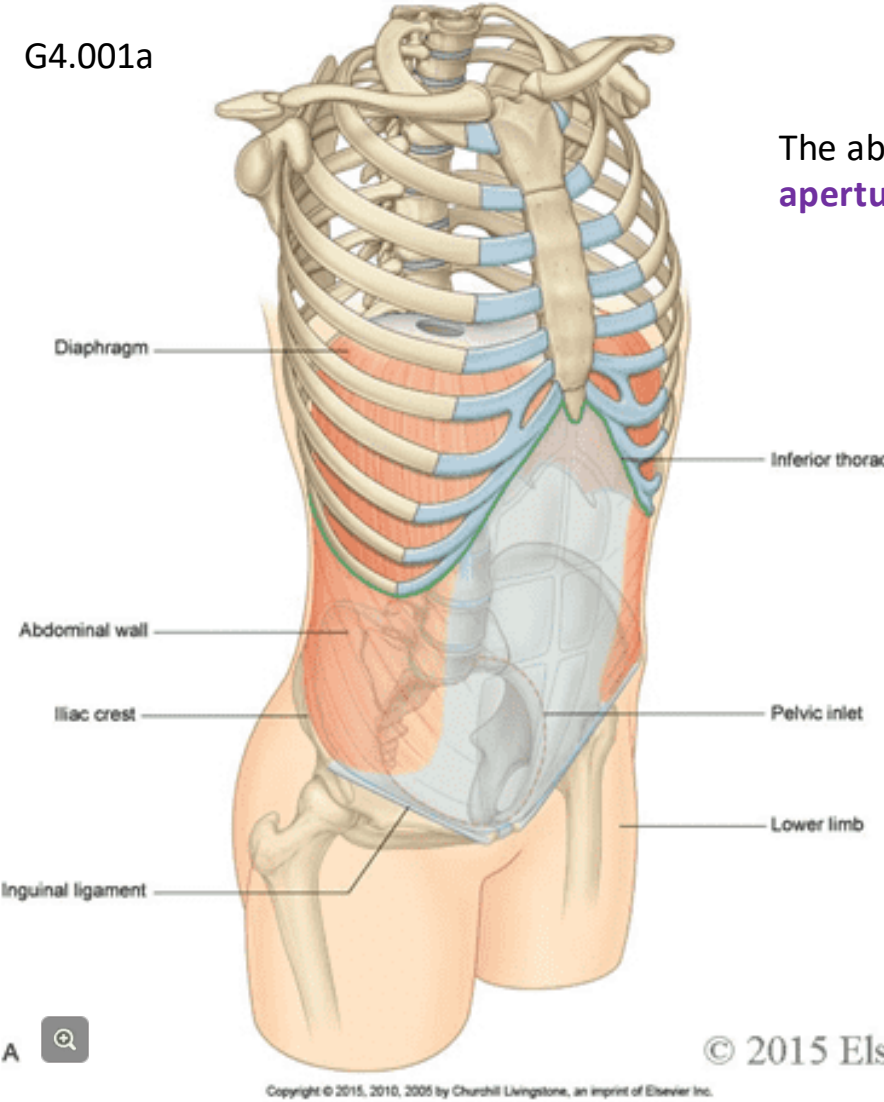


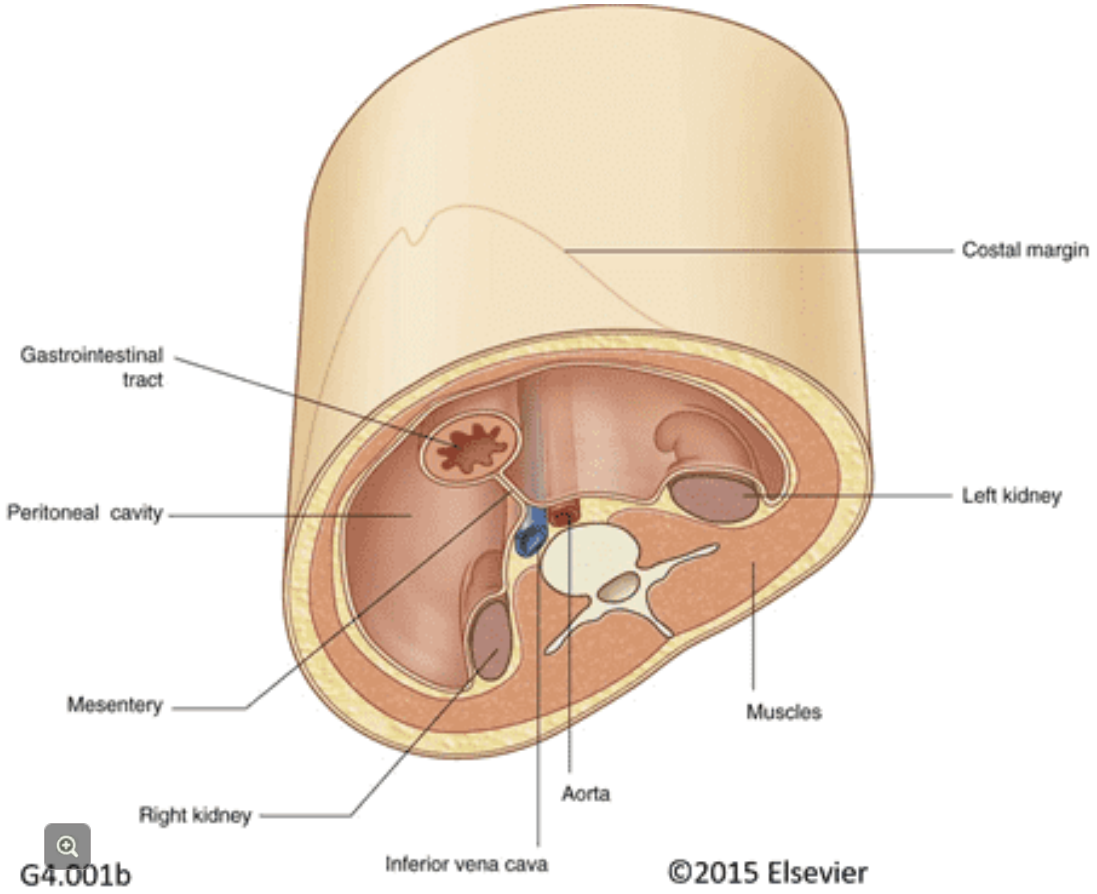
The abdominal cavity extends from the **inferior thoracic aperture**, superiorly, to the **pelvic inlet**, inferiorly.

It is separated from the thoracic cavity by the **thoracic diaphragm**, which attaches to the margins of the inferior thoracic aperture. In contrast, the abdominal cavity is **continuous with the pelvic cavity**, inferiorly.

The abdominal cavity is limited by the **abdominal wall**, the structure of which was described in Lab 3.1.

Because they are continuous with each other, the abdominal and pelvic cavities are often grouped together as the ***abdominopelvic cavity*** or the ***peritoneal cavity***.

Abdominal viscera are either **suspended within the peritoneal cavity by mesenteries**, as is the gastrointestinal (GI) tract in the accompanying diagram, **OR** they are **embedded in the extraperitoneal fascia of the posterior abdominal wall**, as illustrated by the positions of the kidneys.

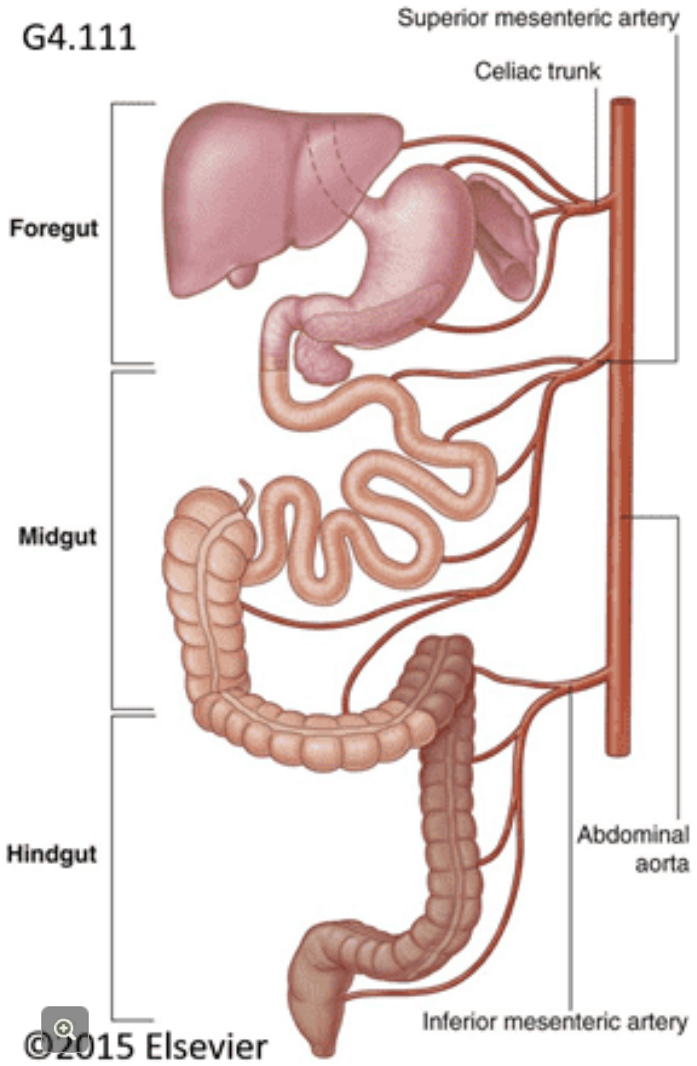


The **peritoneal cavity** separates the internal surface of the abdominal wall from the contained organs.

If they are suspended within the peritoneal cavity by mesenteries, as is the GI tract in this figure, viscera are said to be **intraperitoneal**.

If they are embedded in the extraperitoneal fascia of the posterior abdominal wall, they are said to be **retroperitoneal**.

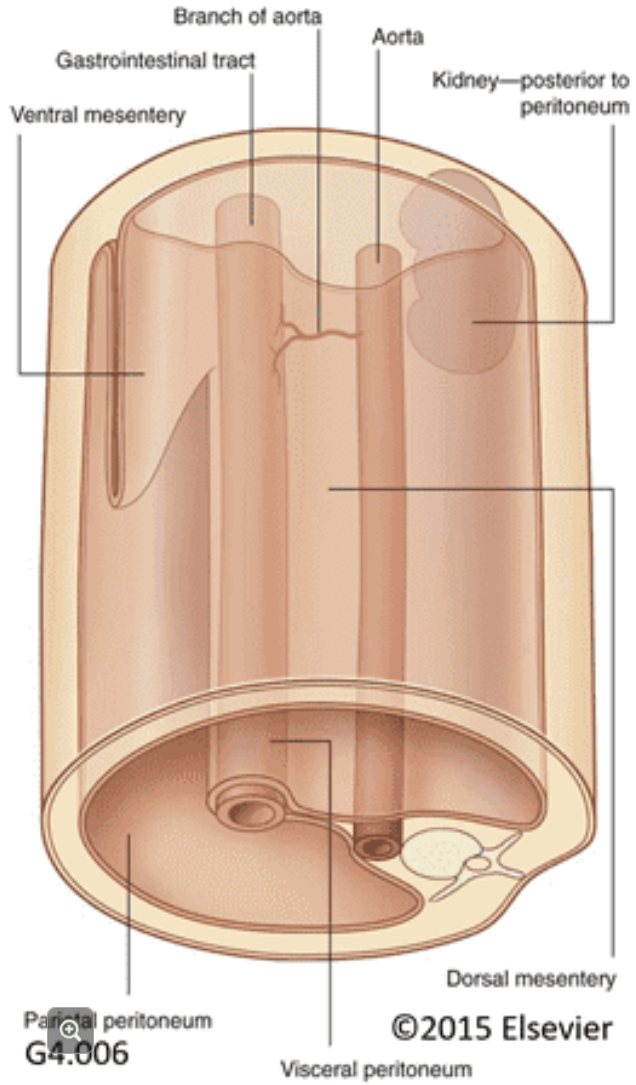
Note in the accompanying diagram that the aorta and inferior vena cava are in a retroperitoneal position, as are major nerves (Ns) and lymphatics (Ls, not illustrated).



The digestive tract is a single (albeit convoluted) tube that has three subdivisions, based on its embryological development: **the foregut, midgut and hindgut**. Each subdivision receives its blood supply from one of **three, unpaired, visceral branches of the abdominal aorta:**

- The **foregut** receives blood from the **celiac trunk**, and includes the **stomach, spleen, liver, gallbladder** and **proximal duodenum and pancreas**.
- The **midgut** receives blood from the **superior mesenteric artery**, and includes the **distal pancreas** and **duodenum**, the remainder of the **small intestine**, the **ascending colon** and the initial portion of the **transverse colon**.
- The **hindgut** receives blood from the **inferior mesenteric artery**, and includes the remainder of the **transverse colon**, the **descending** and **sigmoid colon,** and the **rectum**.

These three vessels arise from the aorta in the posterior body wall, i.e. retroperitoneally. In order for their branches to gain access to **intraperitoneal organs**, they must pass through **mesenteries** or **ligaments**.

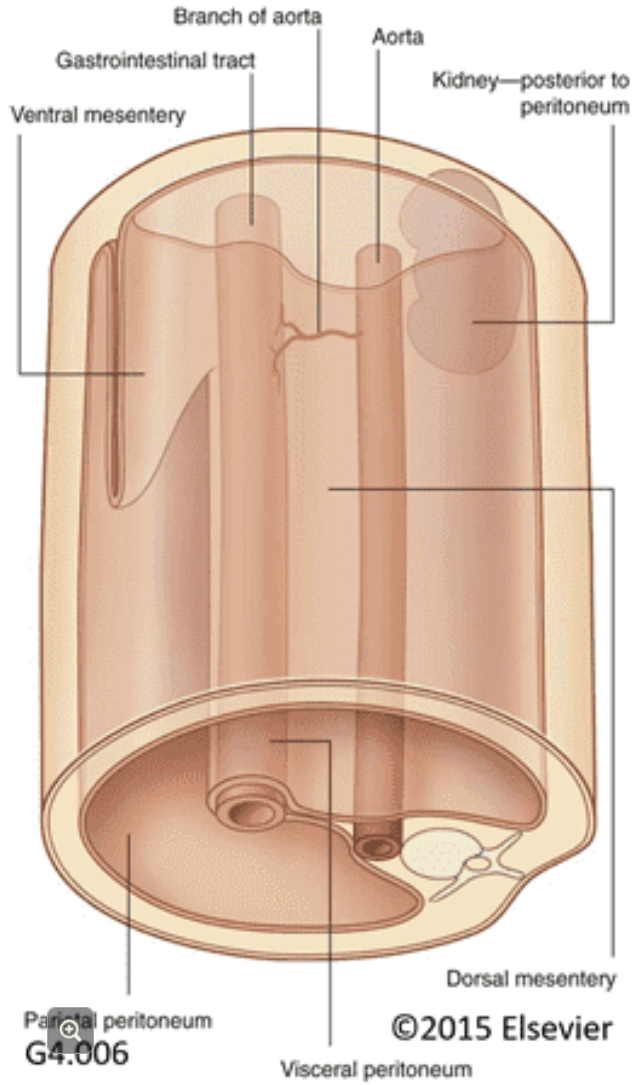


Note in the illustration that the GI tract is attached to the posterior abdominal wall along its **entire length** by a **dorsal mesentery**, but **only the foregut** is attached to the anterior abdominal wall by a **ventral mesentery**.

All surfaces within the peritoneal cavity, including both the internal surface of the body wall and those of the contained viscera, are lined by **peritoneum**, a **serous membrane** analogous to the pleura and the pericardium.

The peritoneal cavity normally contains only a small amount of serous fluid, **peritoneal fluid**, secreted by the peritoneum.

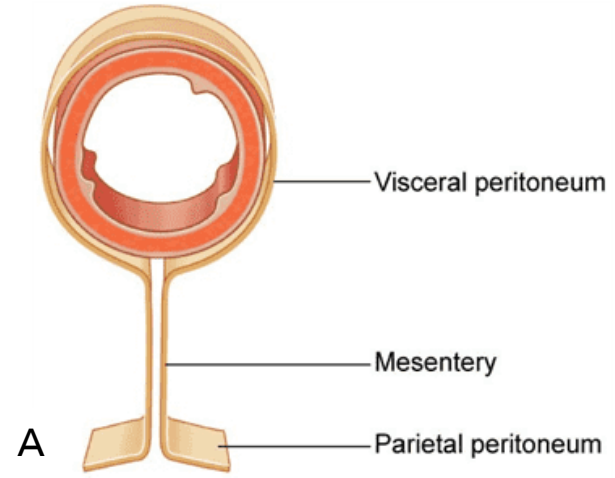
Peritoneal fluid acts as a lubricant, permitting friction-free movement of the contained organs, limited by their mesenteries.

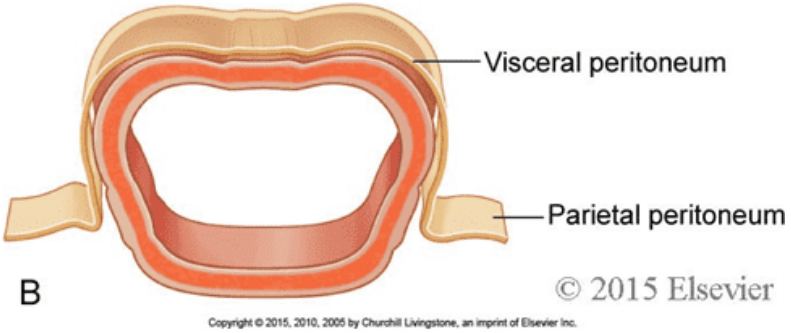


Also analogous to the pleural and pericardial cavities, the serous membrane lining the internal surface of the abdominal wall is the **parietal peritoneum**, and that covering the contained viscera is the **visceral peritoneum**.

Note that the mesenteries attaching the GI tract to the body wall are derived from the parietal peritoneum reflecting off the body wall and on to the contained gut tube, and that **the dorsal mesentery contains blood vessels arising from retroperitoneal parent vessels, such as the aorta.** In addition, but not illustrated, it contains **veins, nerves and lymphatics, too, both of which arise in the posterior abdominal wall.**

Since the GI tract is an unpaired structure, the neurovascular structures that supply it are also unpaired.



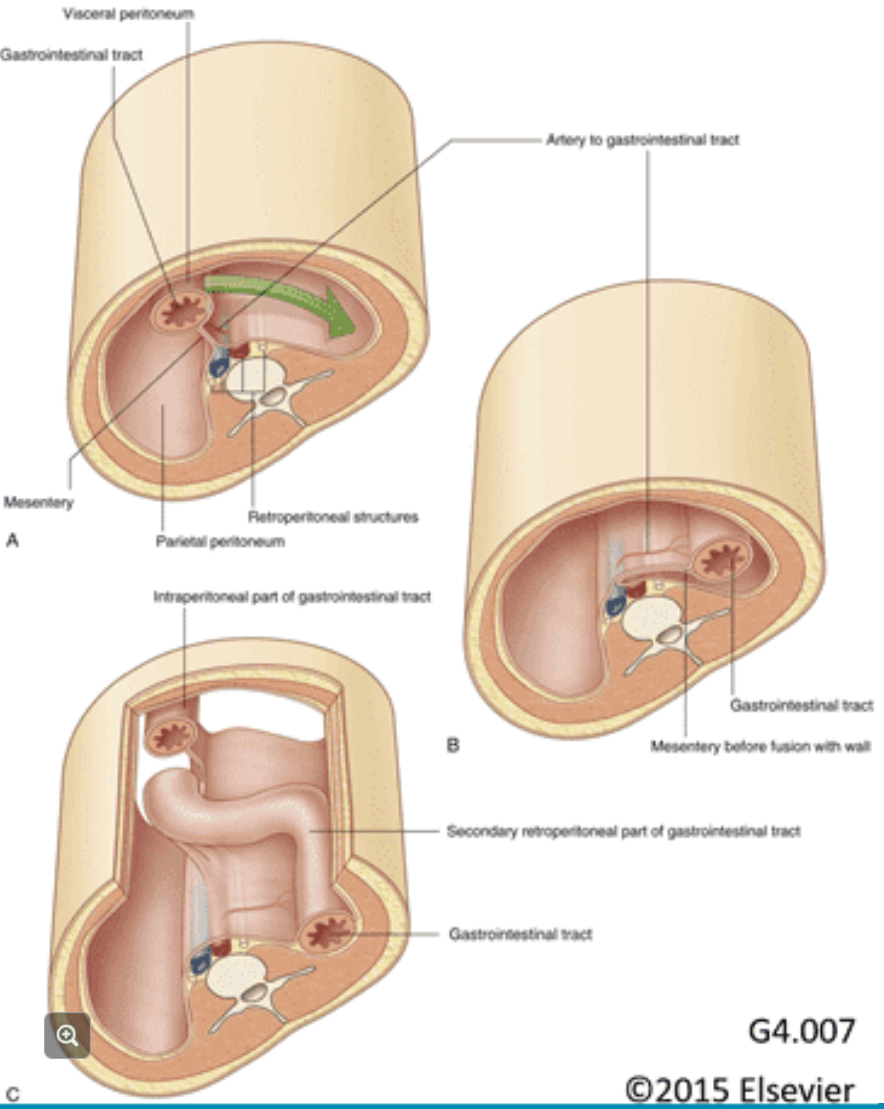


During embryonic development, the GI tract begins in an **intraperitoneal** position (Fig. A).

As development continues, certain portions of the GI tract become fixed to the posterior body wall (Fig. B). They are described as being **secondarily retroperitoneal**.

How does this happen?

What happens to their blood supply, nerve supply and lymphatic drainage?



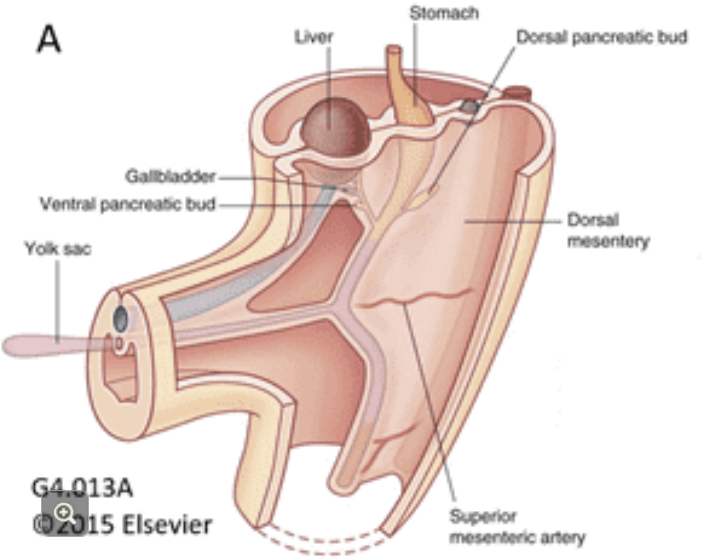
Read the following with reference to the accompanying figure.

As stated, the GI tract begins in an **intraperitoneal** position (Fig. A).

During development, some portions of the GI tract migrate to the posterior body wall (Fig. A, green arrow; Fig. B).

These portions **become fused** to the posterior body wall (Fig. C), thus becoming **secondarily retroperitoneal**.

Note in Fig. C, as these portions of the GI tract lose their mesenteries with fusion to the posterior body wall, **the unpaired neurovascular structures supplying them also become secondarily retroperitoneal.**

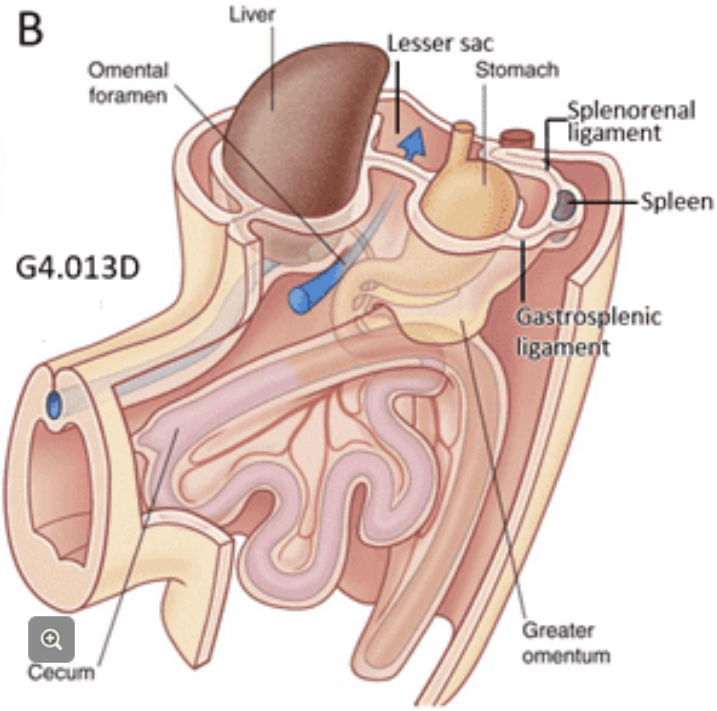


A. Some abdominal viscera, such as the liver, gall bladder, pancreas and spleen, **develop within the mesenteries associated with the GI tract**.

The **liver and gallbladder** develop within the **ventral mesentery**.

The **spleen** develops in the **dorsal mesentery**.

The **pancreas** develops from two buds, one in each mesentery.



B. As parts of the GI tract fuse to the posterior body wall, a portion of the peritoneal cavity becomes isolated as the **omental bursa** or **lesser sac**, separate from the remainder of the peritoneal cavity, which is now called the **greater sac**.

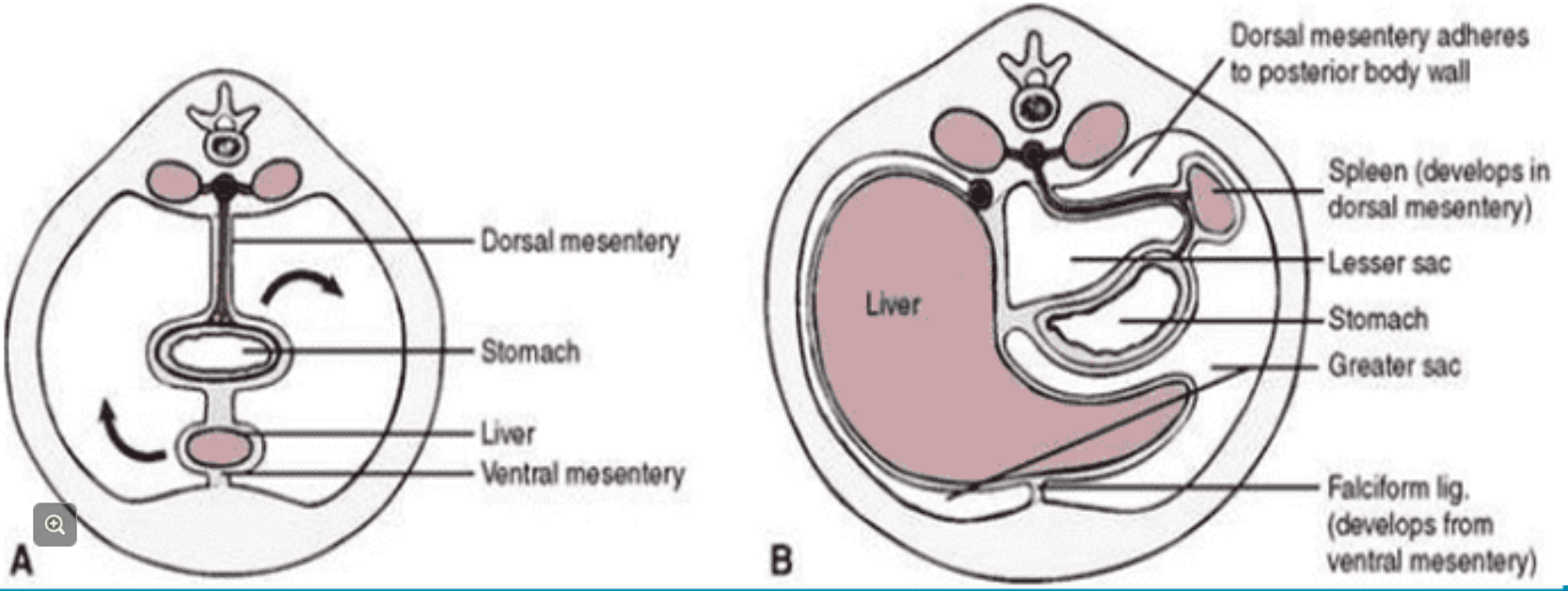
An opening between these two subdivisions of the peritoneal cavity remains, as the **omental** or **epiploic foramen**.

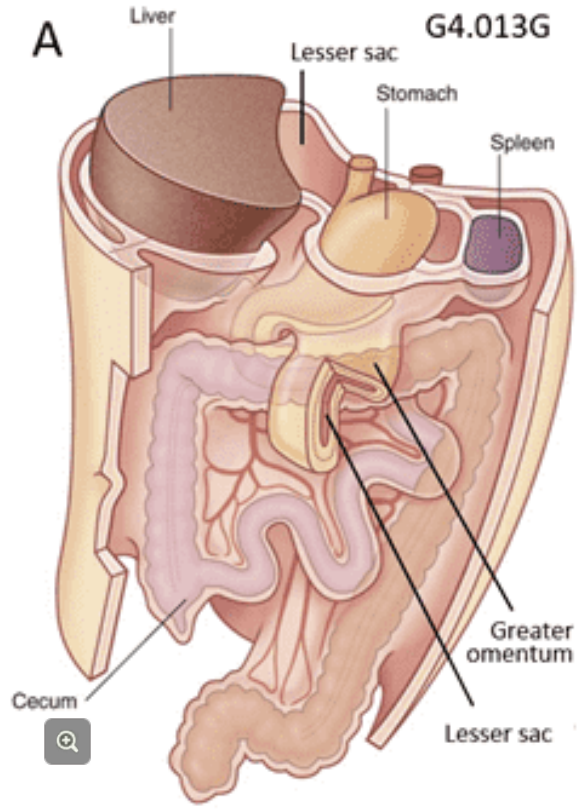
Note that the **spleen**, and the ligaments that attach it to the **stomach** and the **posterior body wall**, **form the left lateral border of the lesser sac**. Note the **greater omentum** developing from the dorsal mesentery.

A. The celiac artery arises from the abdominal aorta, and its branches extend through the dorsal mesentery to supply the developing foregut. The gut rotates such that the stomach moves to the left and the liver to the right.

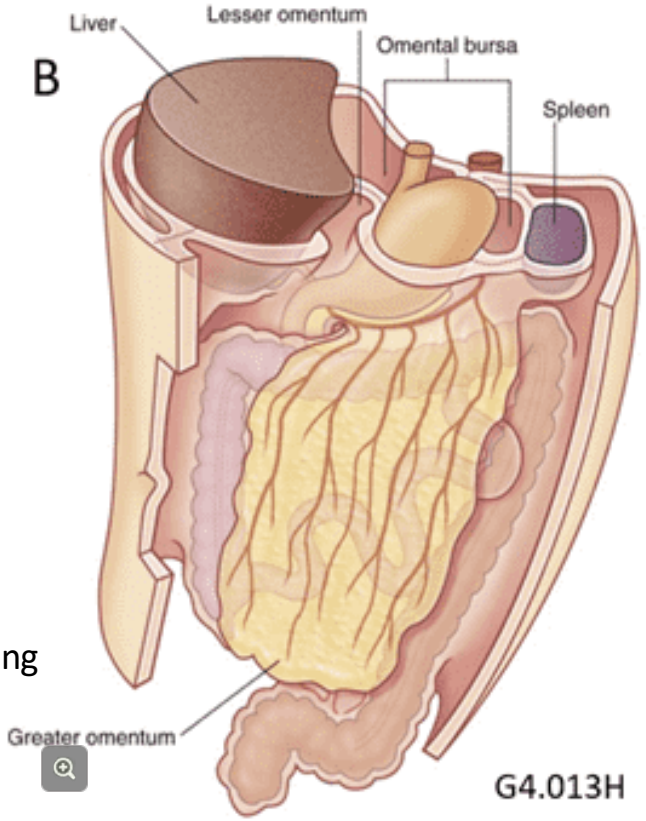
B. The liver, greatly enlarged, occupies most of the upper right quadrant. It remains attached to the ventral body wall by the falciform ligament. It remains attached to the stomach by the lesser omentum.

The spleen develops within the dorsal mesentery. The initial portion of the dorsal mesentery fuses to the posterior body wall. This leaves the **splenorenal ligament** attaching the spleen to the posterior body wall, containing the **splenic artery**, a branch of the celiac artery. Branches of the splenic artery pass through the **gastrosplenic ligament** to reach the greater curvature of the stomach.





A. The **greater omentum** extends from the greater curvature of the stomach to the posterior body wall. As it enlarges, and extends over the transverse colon, there is initially an **extension of the lesser sac (omental bursa) between its layers**.



B. Eventually, the two layers of the greater omentum fuse, obliterating this temporary extension of the lesser sack between its layers.

The lesser sac persists **posterior to the stomach and liver**.

INFO

Parietal peritoneum

is supplied with sensory fibres by the somatic sensory nerves of the body wall. Pain with irritation of the parietal peritoneum is therefore **somatic in nature**; it is **sharp and well-localized**.

INFO

In contrast, visceral peritoneum

is supplied with sensory fibres by the autonomic nervous system. Pain with irritation of the visceral peritoneum, like that due to irritation of a viscus, is **colicky** **and poorly-localized**.

10.1 Reflection of the Anterolateral Abdominal Wall

What you'll need:

SPECIMENS

- Cadaver 1

In Lab 3, the anterolateral body wall was studied via dissection using cadavers 1. The abdominal wall was opened and the peritoneal cavity and its contents explored using cadavers 2.

In exercise 10.1, **all students** will start by reviewing the **layers of the anterolateral abdominal wall** on cadavers 1. **This is examinable material** and well worth reviewing.

Pairs 1 and 2 will then open the peritoneal cavity in such a way as to leave the **falciform ligament** intact. You will recall that the falciform ligament is a derivative of the ventral mesentery that **connects the liver to the anterior body wall**. Pairs 1 and 2 will then explore the peritoneal cavity and its contents, as outlined in **exercise 10.2**.

Pairs 3 and 4, after reviewing the anterolateral abdominal wall, will move to **cadaver 2** and **exercise 10.2**.

The anterior abdominal wall will be reflected but **not removed**, so that the flaps of the body wall can be used at the end of the dissection period to cover the abdominal contents and thereby protect them from dehydration between laboratory sessions. When you are finished the lab, **remember to place moist cloths both**

i) on the abdominal contents, between them and the body wall, and

ii) over the flaps of the body wall, before closing the body bag.

By using the cut lines illustrated, you will see clearly the attachment of the **falciform ligament** to the anterior body wall, but at the same time, you will have wide access to the abdominal contents.

Dissection Synopsis: The body wall will be opened, thus exposing the peritoneal contents and spaces. Once this is completed, you will move on to Exercise 10.2, during which you will review the peritoneal cavity and contents, and be introduced to the blood supply of the digestive tract.

Cadaver 1 has been used to study the muscles of the anterolateral abdominal wall.
Review these muscles now.

TASK

IDENTIFY the rectus abdominis, external oblique, internal oblique and transversus abdominis. Identify the anterior and posterior lamina of the rectus sheath. Reflect any layers that are loose.

If the posterior lamina of the rectus sheath is not exposed bilaterally, expose it now by bisecting the rectus abdominus at the level of the umbilicus and reflecting it upward and downward.

The instructions from lab 3 on how to reflect the rectus abdominus to expose the posterior lamina of the rectus sheath are found here:

Identify the arcuate line, below which the posterior lamina of the rectus sheath consists only of the transversalis fascia, subserous (extraperitoneal) fascia and parietal peritoneum.

Above the arcuate line the posterior lamina of the rectus sheath includes, in addition to the transversalis fascia, subserous (extraperitoneal) fascia and parietal peritoneum, contributions from the aponeuroses of the transversus abdominus and internal oblique muscles.

Pairs 3 and 4 may now go to Cadaver 2 and study the peritoneal folds of the inguinal flap, as outlined below in slides 8 and 9 of this exercise.

Pairs 1 and 2 will next open the peritoneal cavity of Cadaver 1, as described in the next three slides.

Exposing the Rectus Abdominis

On one side of the cadaver only, you will next open the anterior lamina of the rectus to expose the rectus abdominus. Start just above the umbilicus, and about 2.5 cm lateral to the linea alba.

TASK

USING forceps, lift the anterior **lamina of the rectus sheath away from the muscle.**

Gently pierce the anterior lamina of the rectus sheath with the sharp end of your large scissors. Keeping the anterior lamina of the rectus sheath away from the muscle belly, use your scissors to extend this cut laterally across the width of the rectus abdominis, to the linea semilunaris.

Return to your starting point, and using the same technique, extend the opening superiorly, 2.5 cm from the linea alba, as far as the costal margin.

Again, return to your starting point and this time extend this cut inferiorly to the pubic crest, this time only about 1 cm from the linea alba.

TASK

USE your fingers to separate **the anterior lamina of the rectus sheath from the muscle belly.**

Observe that the anterior lamina of the rectus sheath is strongly adhered at the tendinous intersections. Lay your scissors flat and cut the attachment of the anterior lamina to the tendinous intersections.

Reflect the anterior lamina of the rectus sheath laterally, leaving it attached along the semilunar line, to fully expose the rectus abdominis muscle.

Instructions continue here:

The Inferior Epigastric Arteries and Veins

TASK

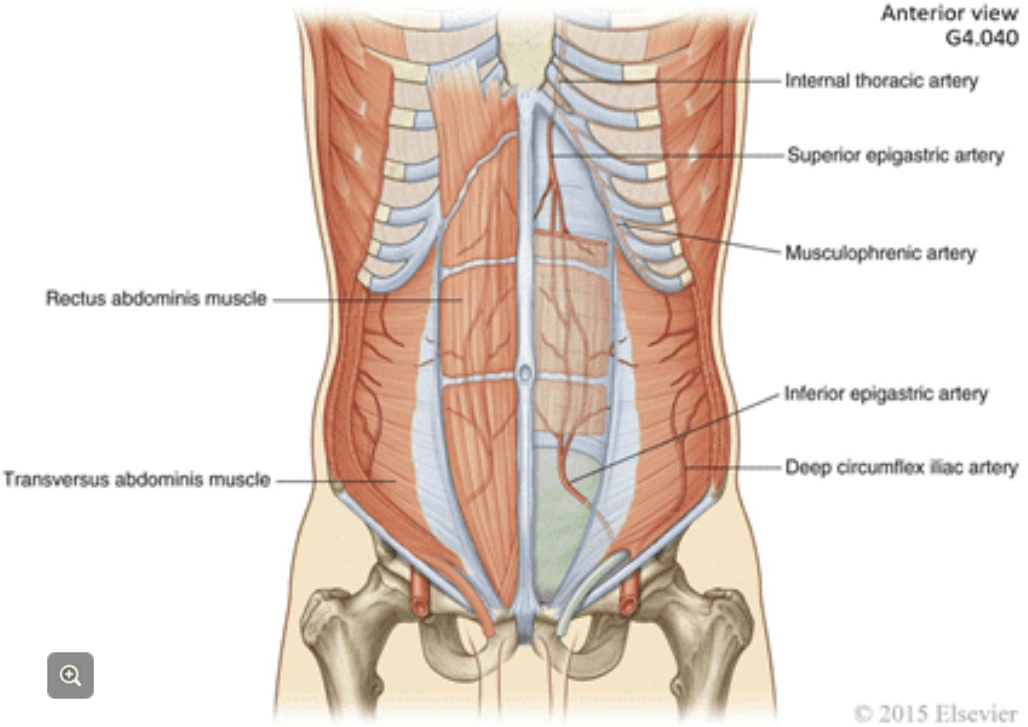
REFLECT the rectus abdominis medially.

On its deep surface, identify the superior and inferior epigastric arteries and veins, which anastomose within the rectus sheath.

Look at the posterior lamina of the rectus sheath and find the arcuate line. Notice that it is at the level of the arcuate line that the inferior epigastric vessels enter the rectus sheath from the subserous fascia.

Below the arcuate line, only transversalis fascia, extraperitoneal fascia and parietal peritoneum separate the rectus sheath from the abdominal contents.

Identify the linea alba, formed by the interlacing fibres of the aponeuroses of the three flat muscles.



The Inferior Epigastric Arteries and Veins

TASK

REFLECT the rectus abdominis medially.

On its deep surface, identify the superior and inferior epigastric arteries and veins, which anastomose within the rectus sheath.

Look at the posterior lamina of the rectus sheath and find the arcuate line. Notice that it is at the level of the arcuate line that the inferior epigastric vessels enter the rectus sheath from the subserous fascia.

Below the arcuate line, only transversalis fascia, extraperitoneal fascia and parietal peritoneum separate the rectus sheath from the abdominal contents.

Identify the linea alba, formed by the interlacing fibres of the aponeuroses of the three flat muscles.

TASK

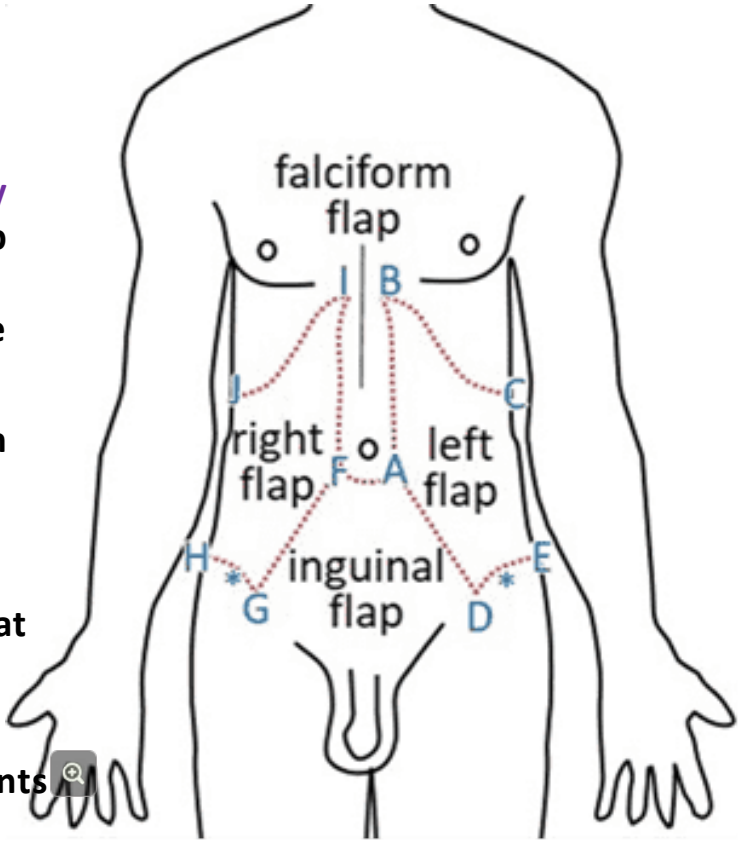
REFER to the accompanying figure

to guide your cuts. You will use large scissors to pierce the abdominal wall at A, using the following instructions:

With the posterior lamina of the rectus sheath exposed bilaterally, use large forceps to grasp the umbilicus, or an adjacent tendinous intersection, and pull the anterior body wall away from the abdominal contents. Using the sharp point of large scissors, pierce the remaining body wall about 3 cm to the left of the umbilicus, at A. Make the hole large enough that you can insert a finger through it.

Insert the index finger of your non-dominant hand through the hole at A and lift the anterior body wall away from the abdominal contents. Carefully, insert the blunt tip of your scissors through the hole, alongside your finger, and cut parallel to, but 3 cm to the left of, the linea alba, stopping at the costal margin at B.

Cut along the left costal margin to the midaxillary line at C, again lifting the body wall away from the abdominal contents as you work. This ensures that you do not pierce the abdominal contents.



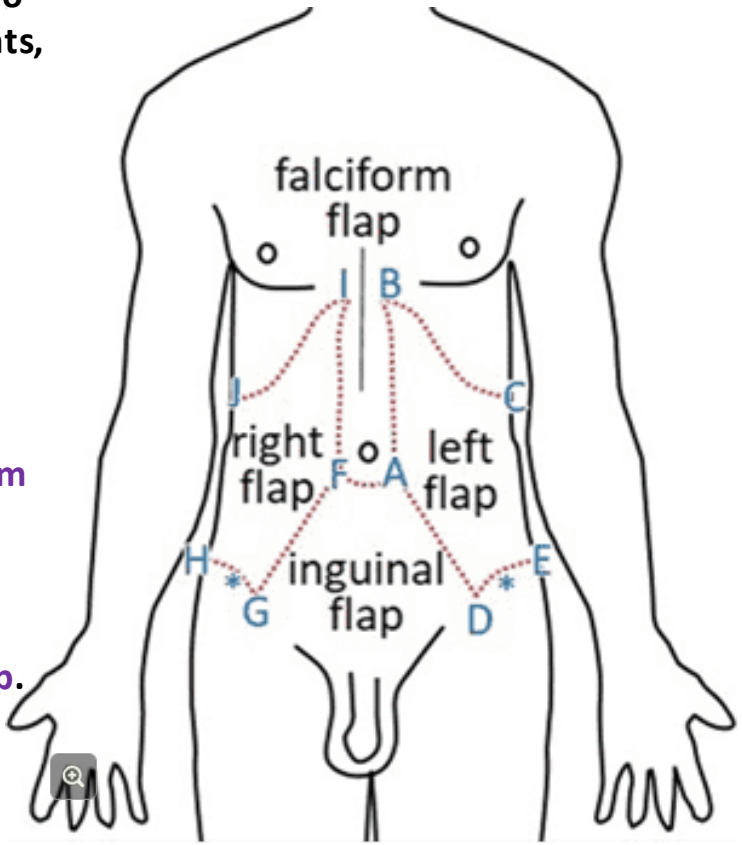
TASK

IDENTIFY, through palpation,

the left anterior superior iliac spine (ASIS), *. Return to A, lift the body wall away from the abdominal contents, and cut to the inguinal ligament at D, 3 cm medial to the ASIS. From D, cut along the inguinal ligament toward the ASIS, and then continue the cut along the iliac crest to the midaxillary line at E. You have now created the left flap.

Use your non-dominant hand to pull what will be the inguinal flap away from the abdominal contents. Make a curved cut from A to F, avoiding the umbilicus. Identify, through palpation, the right anterior superior iliac spine (ASIS), *. Cut from F to the inguinal ligament at G, again 3 cm medial to the ASIS.

From G, cut along the inguinal ligament toward the ASIS, and then continue the cut along the iliac crest to the midaxillary line at H. You have now created the inguinal flap.



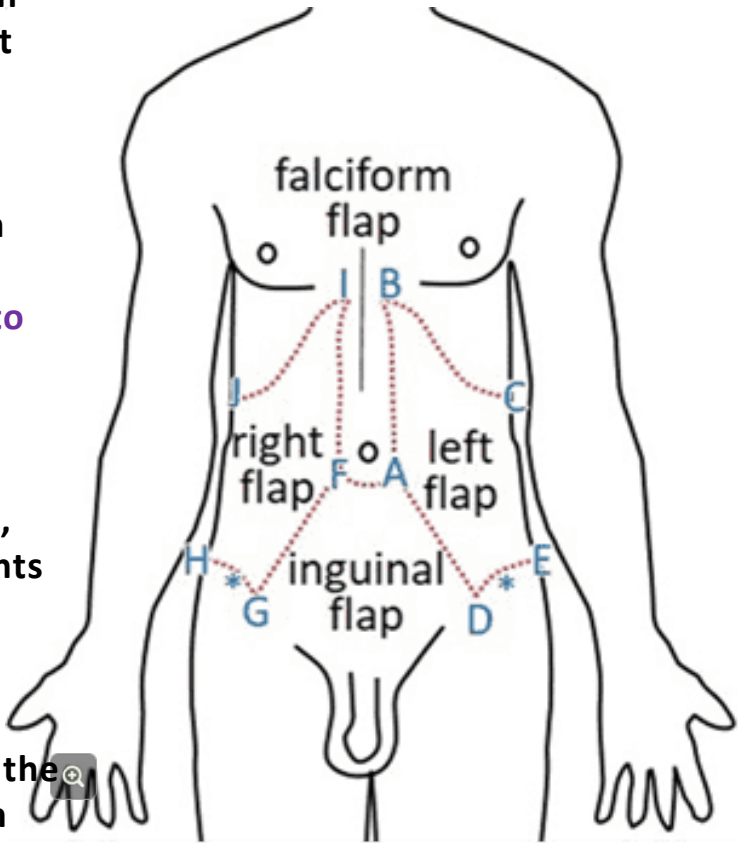
TASK

SLIDE your non-dominant hand

under what will be the right flap and identify, through feel, the falciform ligament of the liver. It is a remnant of the ventral mesentery that attaches the liver to the underside of the diaphragm and the deep surface of the abdominal wall as far inferiorly as the umbilicus. It will be slightly to the right of the linea alba. Maintain contact with the falciform ligament with a finger of your non-dominant hand as you cut from F to I. This cut should be about 3 cm to the right of the linea alba, and should leave the falciform ligament intact, attached to the internal surface of the falciform flap.

Cut along the right costal margin to the midaxillary line at J, again lifting the body wall away from the abdominal contents as you go. You have now created the right flap.

Lift the falciform flap and identify the falciform ligament. Observe its connection to the liver. Identify the round ligament of the liver (ligamentum teres) in the free edge of the falciform ligament. It is the obliterated umbilical vein which brought oxygenated blood from the placenta to the fetus.



TASK

REFLECT the inguinal flap inferiorly,

and identify three folds of peritoneum on its internal surface:

A. in the midline, identify the median umbilical fold, which extends from the umbilicus to the apex of the bladder. The median umbilical fold contains the urachus, a remnant of the allantoic duct.

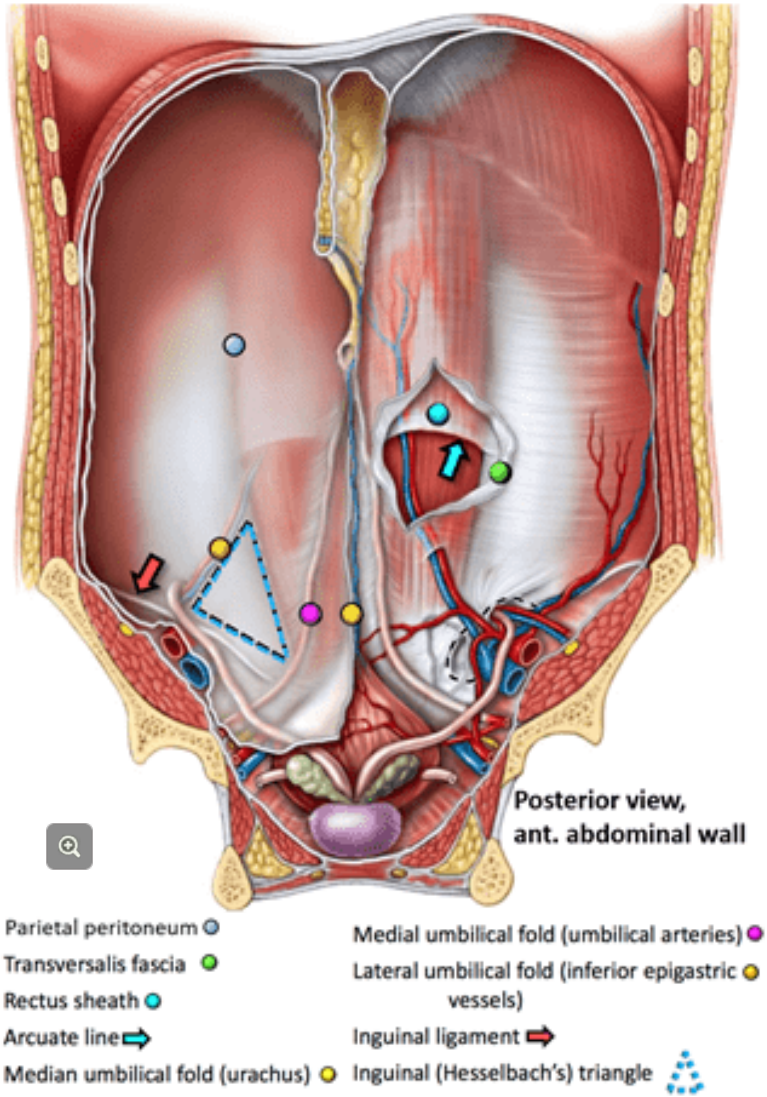
B. lateral to the median umbilical fold, identify the bilaterally-paired medial umbilical folds, which contain the remnants of the umbilical arteries. They run in the anterior abdominal wall to the umbilicus. In the fetus, they returned deoxygenated blood to the placenta.

C. lateral to the medial umbilical folds, identify the bilaterally-paired lateral umbilical folds. These folds contain the inferior epigastric arteries and veins. You learned in Unit 1 that they supply blood to the anterior abdominal wall.

INFO

These folds of peritoneum are distinct

and reliable landmarks used in laparoscopic surgeries of the inguinal region.

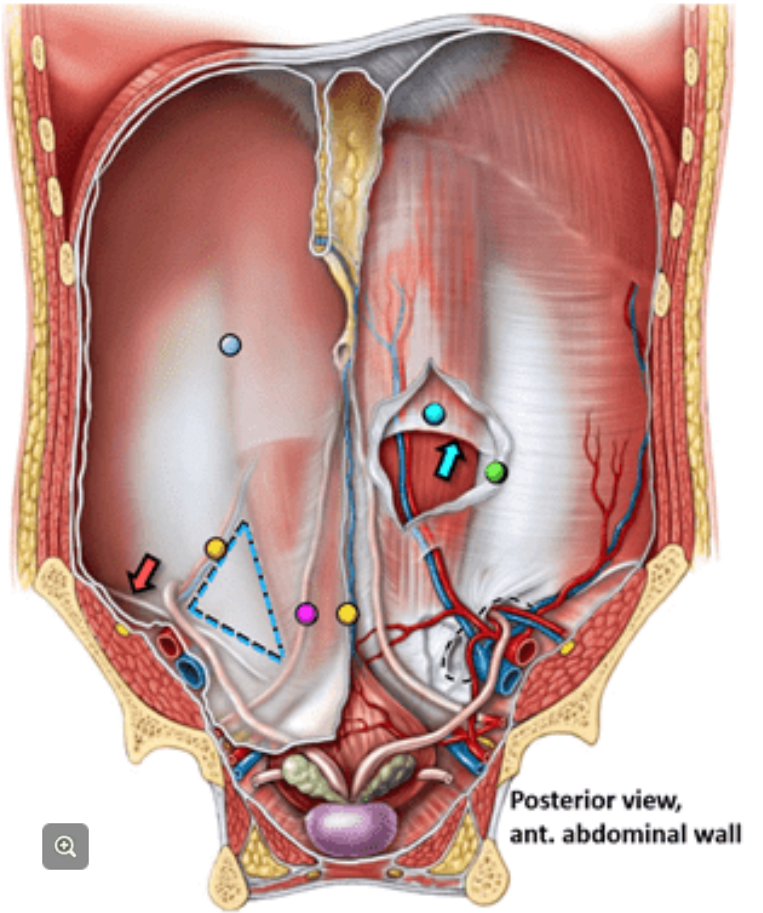


TASK

IDENTIFY the deep inguinal ring

as a shallow depression in the parietal peritoneum just lateral to the lateral umbilical fold and superior to the inguinal ligament.

If your cadaver is male, look for the vas deferens and testicular neurovascular bundle through the parietal peritoneum, approaching the deep ring. You may or may not be able to see it, depending on the amount of subserous adipose present in your cadaver.



10.2 The Blood Supply of the GI System

What you'll need:

SPECIMENS

- Cadaver 1 or 2

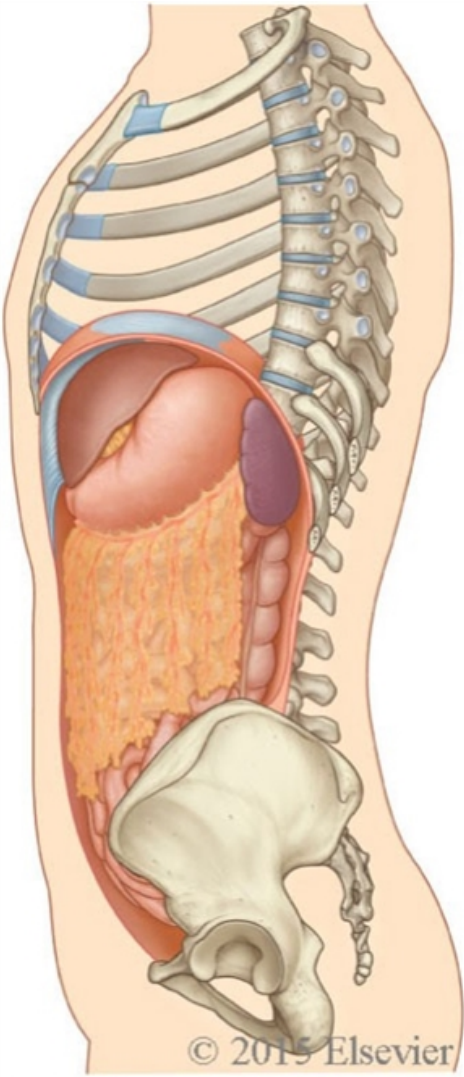
In exercise 10.2, you will study the **peritoneal cavity, abdominal organs, mesenteries and ligaments**, to which you were first introduced in Lab 3.

This exercise will, however, go beyond what you learned in Lab 3, as an **introduction to the blood supply of the digestive tract** is woven throughout.

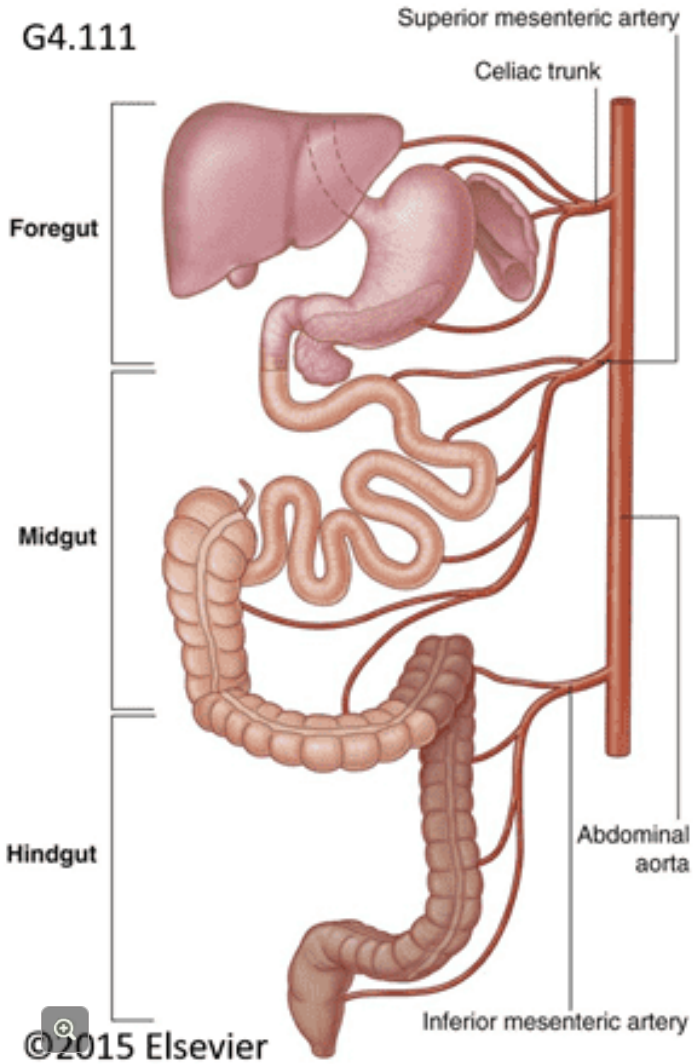
Be warned that exercise **10.2** presumes that you have mastered the material in **SLM 10A**, as indicated by your successful completion of the 10A end-of-module quiz.

When you have successfully completed this exercise, you will be able to:

1. Identify the **abdominal organs** and their features.
2. Identify the various **spaces** within the peritoneal cavity.
3. Identify the **mesenteries** and **ligaments** within the peritoneal cavity.
4. Trace the **blood supply** of the digestive / gastrointestinal (GI) tract from its origin in the **posterior body wall**, through the **mesenteries and ligaments** that carry it to the **target organ**, and thereby begin to understand the **distribution of blood vessels, nerves and lymphatics to the GI tract.**



G4.103



The digestive tract is a single (albeit convoluted) tube that has three subdivisions, based on its embryological development: **the foregut, midgut and hindgut**. Each subdivision receives its blood supply from one of **three, unpaired, visceral branches of the abdominal aorta:**

- The **foregut** receives blood from the **celiac trunk**, and includes the **stomach, spleen, liver, gallbladder** and **proximal duodenum and pancreas**.
- The **midgut** receives blood from the **superior mesenteric artery**, and includes the **distal pancreas** and **duodenum**, the remainder of the **small intestine**, and the **ascending** and initial portion of the **transverse colon**.
- The **hindgut** receives blood from the **inferior mesenteric artery**, and includes the remainder of the **transverse colon**, the **descending** and **sigmoid colon**, and the **rectum**.

These three vessels arise from the aorta in the posterior body wall, i.e. retroperitoneally. In order for their branches to gain access to **intraperitoneal organs**, they must pass through **mesenteries** or **ligaments** .

Uncover as much of the cadaver as necessary to study the abdominal cavity.

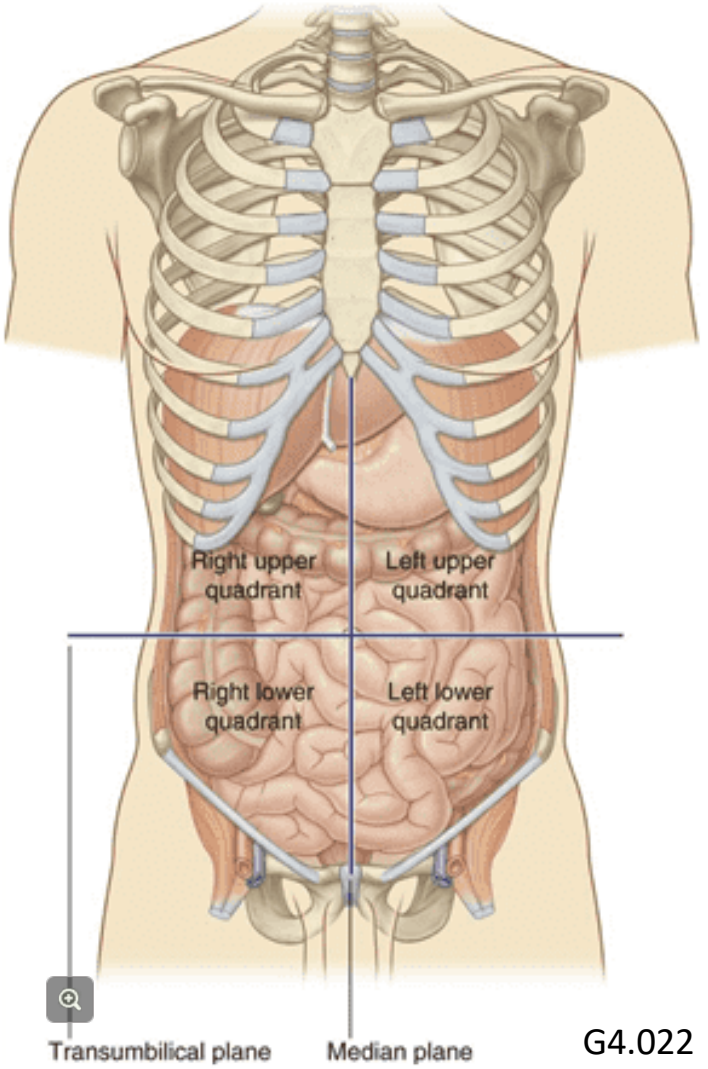
TASK

REFLECT the right, left and inguinal flaps, leaving the falciform flap in place. Identify parietal peritoneum and look through it to see the adipose of the extraperitoneal (subserous) fascia.

If you encounter adhesions while reflecting the skin flaps, gently work them apart with your fingers.

You will locate structures within the peritoneal cavity using the **four quadrant system**, as illustrated in the accompanying figure.

For instance, you will start by studying the **liver**, which is, as illustrated, largely in the **right upper quadrant** of the abdomen.



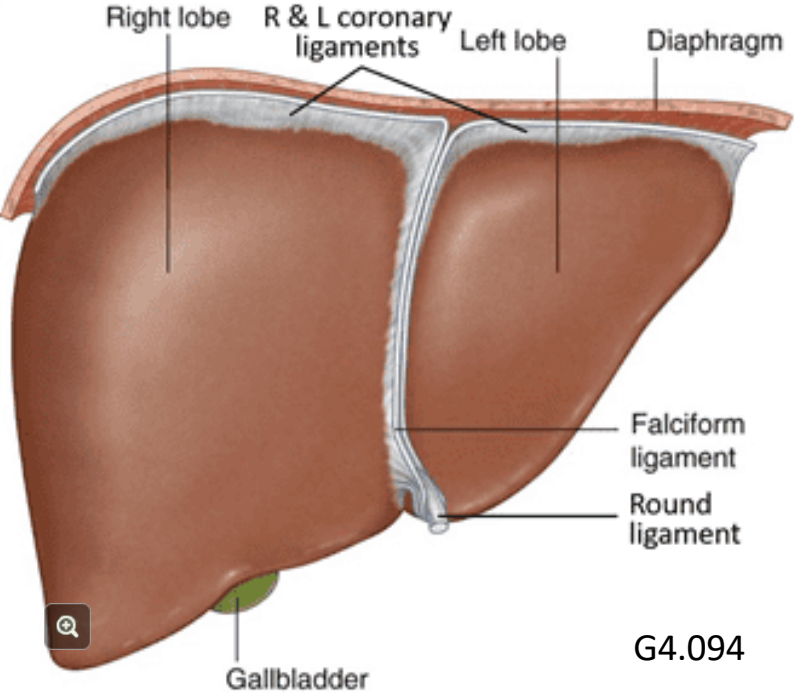
G4.022

TASK

IDENTIFY the liver, in your cadaver.

Confirm that it is largely located in the right upper quadrant of the abdominal cavity. Touch the diaphragmatic surface of the liver and realize that your fingers are on its visceral peritoneum.

GENTLY pull the falciform flap away from the liver and identify the falciform ligament. Remember, the liver develops in the ventral mesentery, so the falciform ligament is a remnant of the ventral mesentery that attaches the liver to the underside of the diaphragm and to the anterior abdominal wall as far inferiorly as the umbilicus.



G4.094

TASK

OBSERVE that the falciform ligament

is composed of two layers of peritoneum that join the parietal peritoneum of the body wall to the visceral peritoneum of the liver.

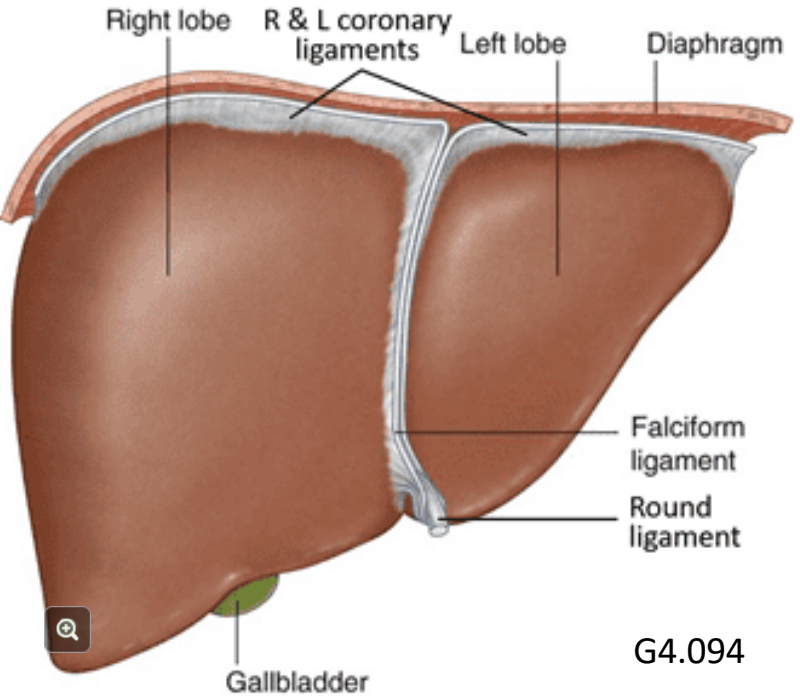
In the inferior free edge of the falciform ligament, identify the round ligament of the liver, and observe that it extends to the umbilicus.

the round ligament is a remnant of the **umbilical vein**, which brought oxygenated blood from the umbilical cord to the fetal liver.

TASK

IDENTIFY the right and left lobes of the liver, separated by the falciform ligament.

Slide your hand into the right subphrenic space. Notice that the subphrenic space is a dead end; i.e. you can't reach over to the posterior aspect of the liver. Your fingers have come up against the right coronary ligament, a peritoneal reflection that attaches the liver to the underside of the diaphragm.



G4.094

TASK

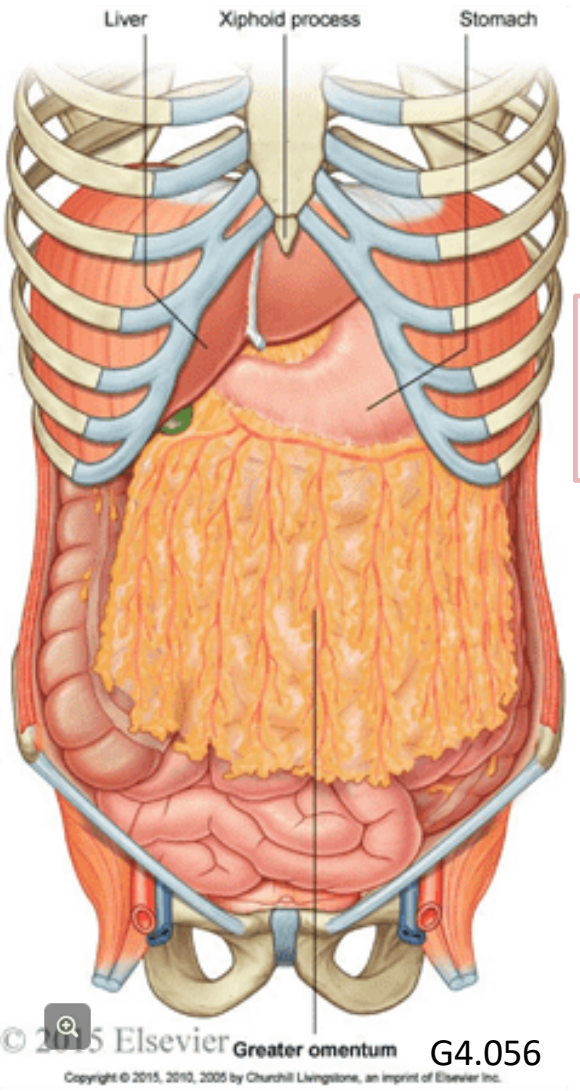
SLIDE your hand into the left subphrenic space. It, too, is a dead end, limited by the left coronary ligament.

Identify the gall bladder, also located in the right upper quadrant, extending out from under the inferior border of the liver.

Confirm its relationship adjacent to the 9th costal cartilage in the right midclavicular line.

Remember: the liver and gallbladder are foregut derivatives which develop in its ventral mesentery. **From which branch of the abdominal aorta does their blood supply originate?**

Think first, and then click here for the answer:



G4.056

TASK

SLIDE your hand into the left subhepatic space.

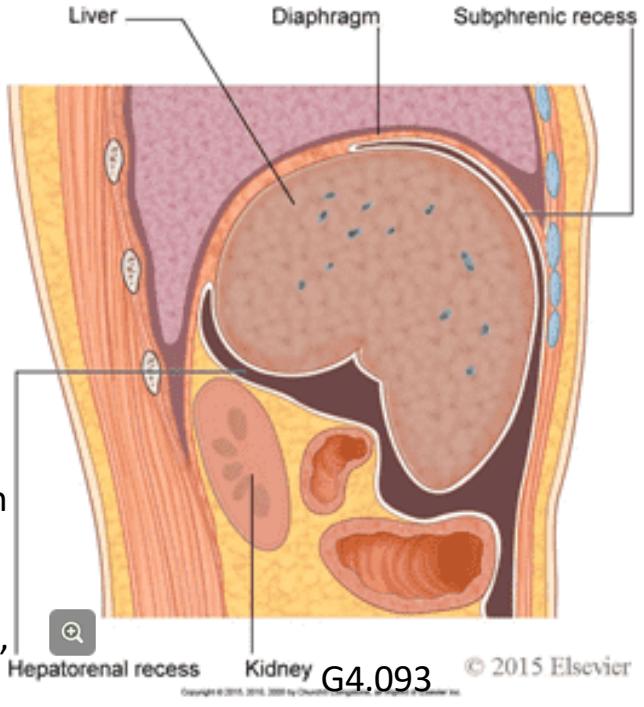
Now, slide your hand into the right subhepatic space. The right sub-hepatic space is the larger of the two, and is also known as the **hepatorenal recess** or the **Pouch of Morrison**.

TASK

OBSERVE in your cadaver

which structures are in contact with the visceral surface of the liver: the gall bladder (if present), the stomach, the first part of the duodenum and the right colic flexure.

As illustrated on the right, through the parietal peritoneum lining the posterior wall of the hepatorenal recess, the liver is in contact with **secondarily retroperitoneal portions of the digestive tract**, the **right kidney**, and **right suprarenal gland**.



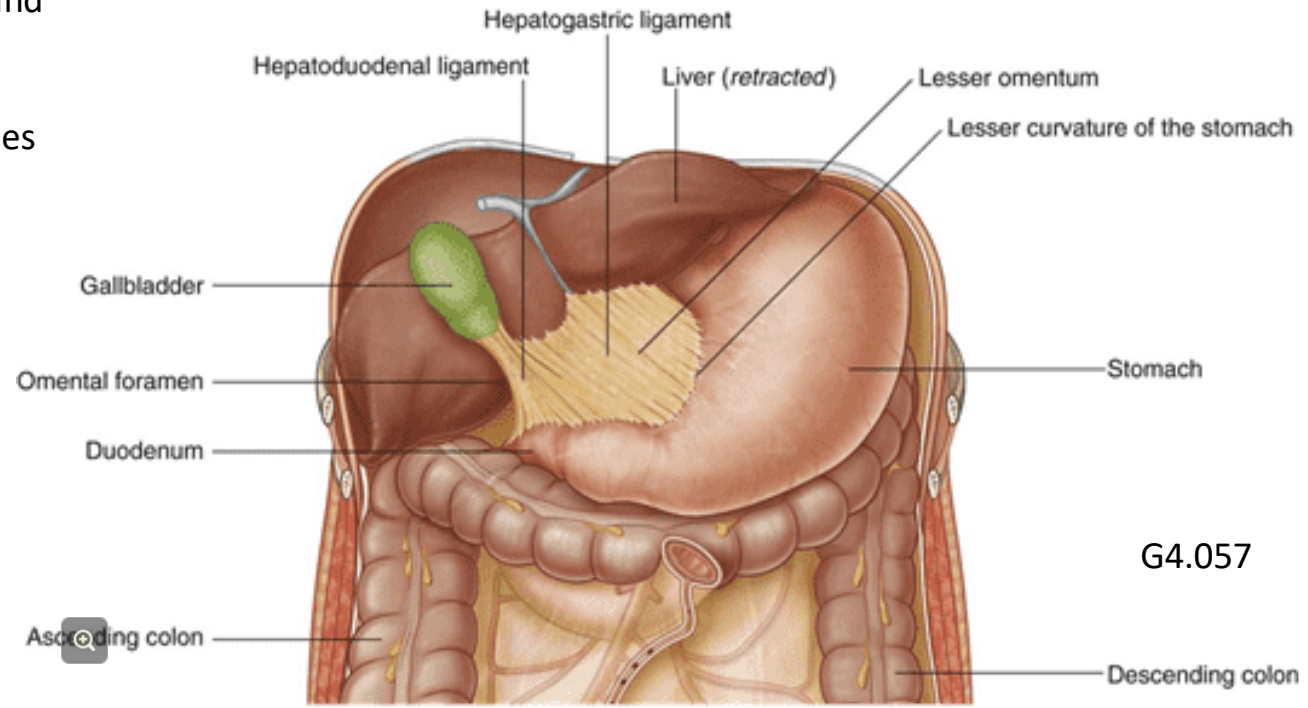
G4.093

TASK

RETRACT the inferior border of the liver to reveal the stomach in the left upper quadrant. The stomach receives food from the esophagus, proximally, and empties into the duodenum of the small intestine, distally.

Identify the duodenum, and note that while its first part is mobile, it quickly becomes fixed to the posterior body wall. This is because except for its initial 2 cm, the duodenum is secondarily retroperitoneal.

Remember: the stomach and proximal duodenum are foregut derivatives. They receive blood from branches of the celiac trunk.



G4.057

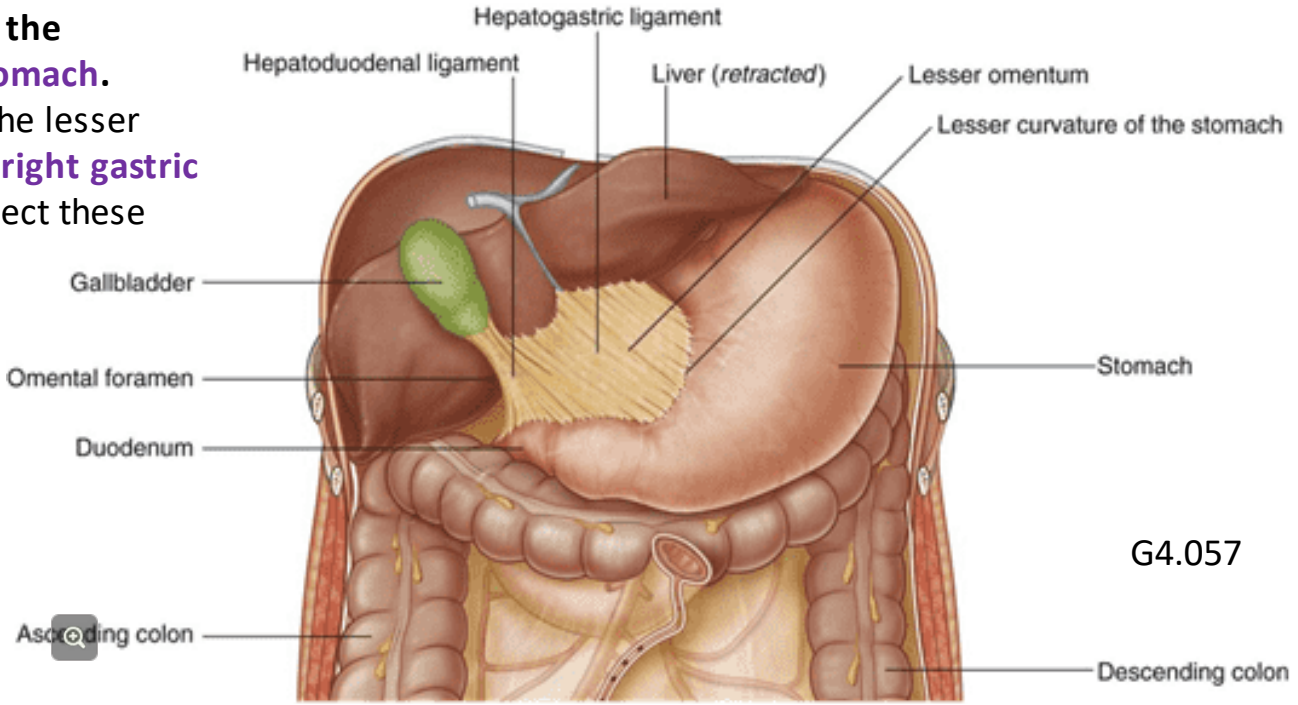
TASK

With the inferior border of the liver retracted superiorly, identify the lesser omentum. It extends from the lesser curvature of the stomach to the visceral surface of the liver. Identify its subdivisions, the hepatogastric and hepatoduodenal ligaments.

The lesser omentum is a derivative of the ventral mesentery that connects the visceral peritoneum of the stomach with that of the liver. It contains within its layers **blood vessels that supply the stomach and liver**, as well as **ducts which convey the exocrine secretions of the liver to the duodenum**.

Using your finger, trace the attachment of the lesser omentum to the lesser curvature of the stomach. Here, within the layers of the lesser omentum, are the **left and right gastric arteries**. You will soon dissect these arteries of the foregut.

From what you know about the blood supply to the foregut, what branch of the abdominal aorta supplies blood to the right and left gastric arteries?



G4.057

All of the spaces within the peritoneal cavity that you have been exploring so far are parts of the **greater sac**. The **lesser sac**, as described in SLM 10A, **is posterior to the stomach**, and therefore hidden from view. The continuity between these two subdivisions of the peritoneal sac is the **epiploic (omental) foramen**, which is located **behind the hepatoduodenal ligament** of the lesser omentum.

TASK

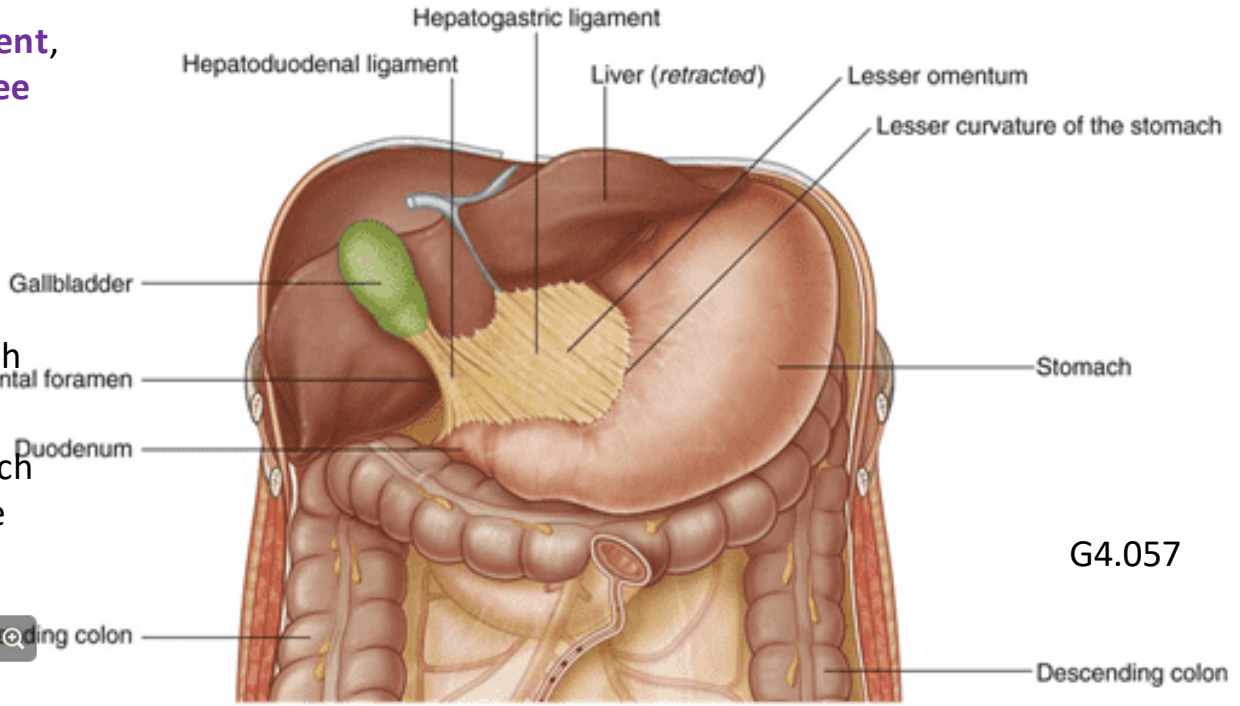
Gently INSERT your index finger through the epiploic foramen, into the lesser sac.

Observe the following relationships: the hepatoduodenal ligament is anterior to your finger, the duodenum is inferior to your finger, the liver is superior to your finger, and the IVC is posterior to your finger.

In the **hepatoduodenal ligament**, anterior to your finger, are **three structures**:

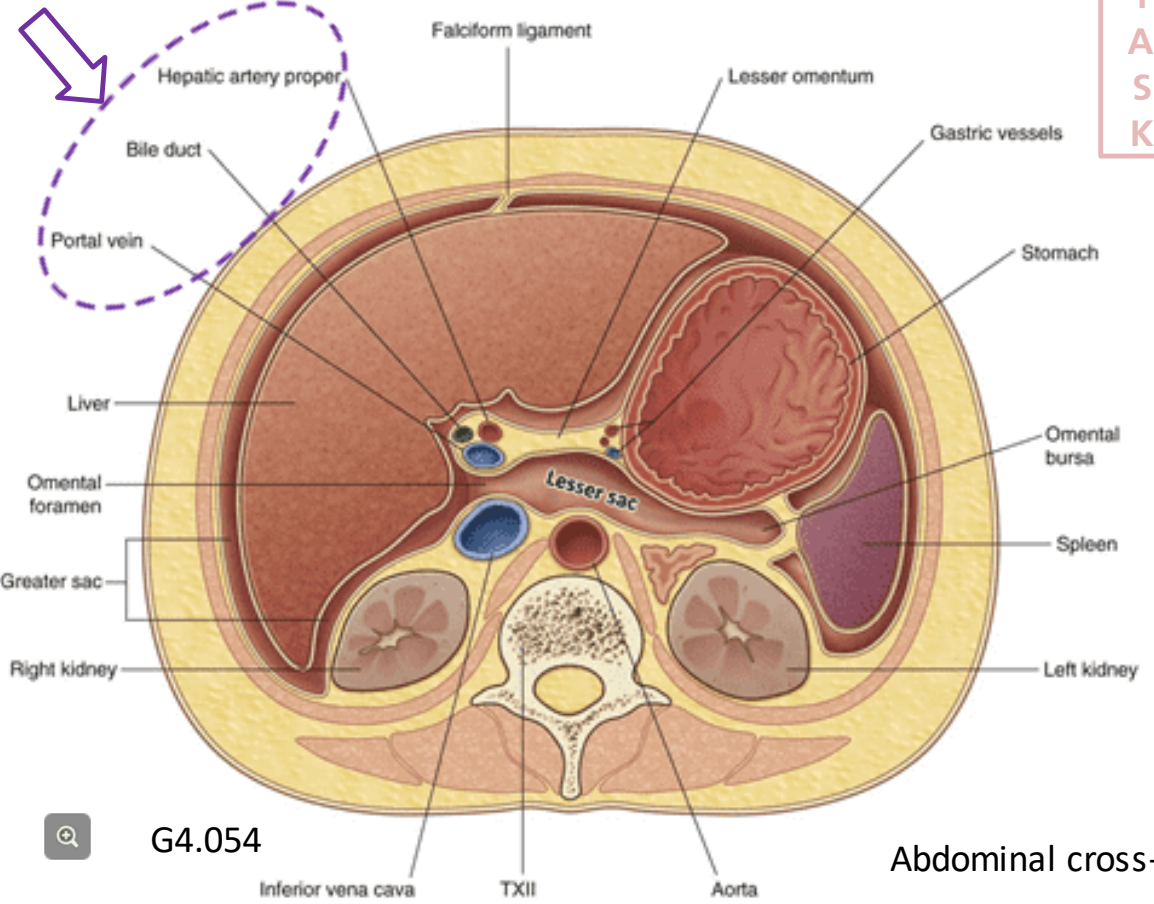
- the **hepatic artery proper**, which arises from a branch of the **celiac trunk**.
- the **common bile duct**, which carries bile to the duodenum
- the **hepatic portal vein**, which drains venous blood from the digestive tract to the liver.

This is **important**, and clearly illustrated in the next slide!



G4.057

The **hepatic artery proper**, **common bile duct** and **hepatic portal vein** in the **hepatoduodenal ligament** of the **lesser omentum**!



G4.054

The spleen is located in the upper left quadrant, and, as illustrated in the accompanying cross section, it is posterior to the stomach.

TASK

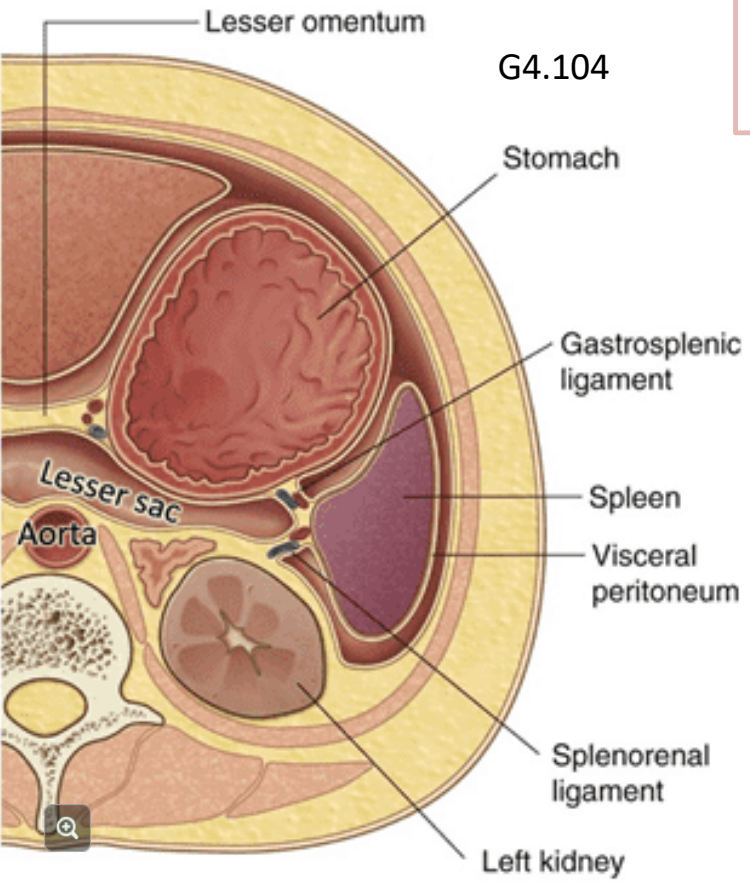
REACH behind the stomach

with your right hand and feel for the spleen. It is an intraperitoneal organ with a smooth surface and should fit in your hand, unless it is enlarged.

Gently reflect the stomach to the right side and try to see the spleen.

It will be deep red to purple in colour because of its rich blood supply.

Abdominal cross-section **from below**.



Abdominal cross-section **from below**.

TASK

Hold the spleen in the palm of your right hand, such that your thumb is between the stomach and spleen and your fingers are around to the back, between the spleen and kidney.

The tip of your fingers are touching the **splenorenal ligament** and the tip of your thumb is touching the **gastrosplenic ligament**.

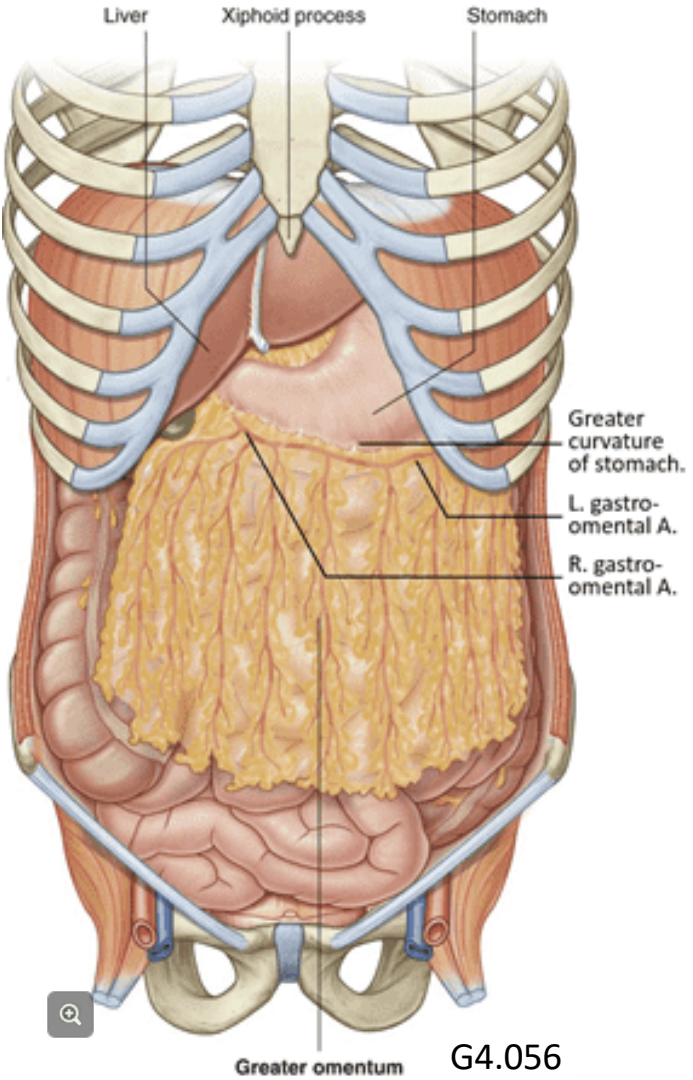
The spleen is a foregut structure. It receives blood from the splenic artery, a branch of the celiac trunk.

Find the **aorta** in the picture. The **celiac trunk** arises from the aorta and gives rise to the **splenic artery**. The splenic artery runs to the left, retroperitoneally, anterior to the left kidney. It then **passes through the splenorenal ligament** to enter the hilus of the spleen.

At the hilus of the spleen, the splenic artery gives off **branches that supply the stomach**, the **short gastric arteries** and the **left gastro-omental artery**. These arteries access the stomach via the **gastrosplenic ligament**.

Trace the route of these vessels on the diagram.

Notice that the spleen and its ligaments form the left lateral border of the lesser sac.



G4.056

TASK

IDENTIFY the greater omentum and its attachment to the greater curvature of the stomach.

The greater omentum is an expanded derivative of the dorsal mesentery that extends from the greater curvature of the stomach to the posterior body wall.

TASK

TRACE the attachment of the greater omentum along the greater curvature of the stomach.

Here, within the layers of the greater omentum, are the **left** and **right gastro-omental (gastroepiploic) arteries**. You will dissect these arteries soon.

The **left gastro-omental artery** is a branch of the **splenic artery** that passes through the **gastrosplenic ligament**.

The **right gastro-omental artery** arises from a branch of the **celiac trunk**.

These arteries anastomose within the layers of the greater omentum along the greater curvature of the stomach.

This figure includes the branches of the celiac trunk that you've learned about so far. There are more that you will learn about as you dissect.

Don't panic! You will learn and remember this vascular tree because **you will discover it for yourself when you dissect it**!

Recap: Try to answer the following questions before clicking on the buttons to check the answers. **You need to know this information before you start your dissection of the foregut!**

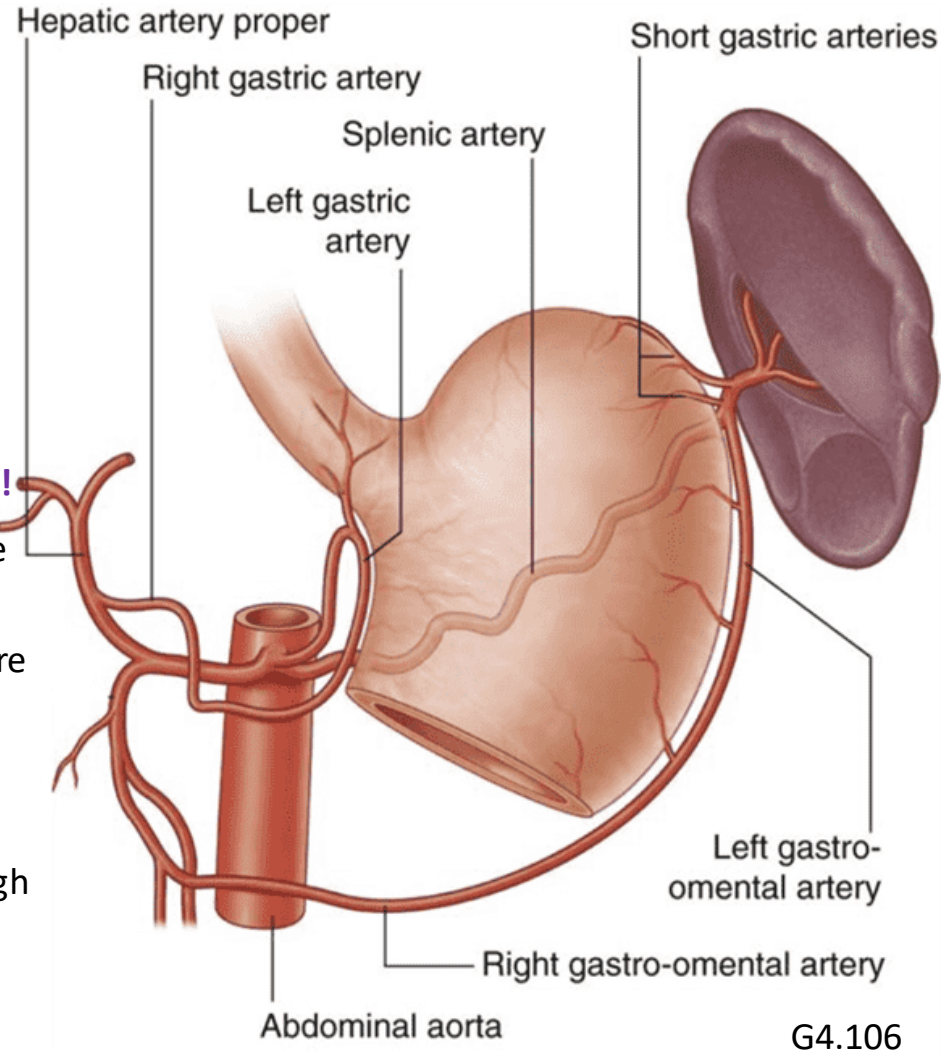
Which two arteries run along the lesser curvature of the stomach in the lesser omentum?

Which two arteries run along the greater curvature of the stomach in the greater omentum?

Which arteries access the stomach by passing through the gastrosplenic ligament?

Which artery accesses the liver by passing through the hepatoduodenal ligament?

Which artery runs through the splenorenal ligament?



G4.106

Since embarking on this exercise, you have **identified** the following structures and learned the **answers to the following questions**:

- What is the dividing line between the foregut and midgut? Between the midgut and the hindgut? Which branch of the abdominal aorta supplies each subdivision of the digestive tract?
- Name and identify four remnants of the ventral mesentery that are associated with the liver. What is contained within the round ligament of the liver and what was its significance during the fetal period?
- What is the surface anatomy landmark for the gall bladder?
- Identify the left and right subphrenic spaces, the left and right subhepatic spaces. Give two alternate names for the right subhepatic space.
- Explain the terms “lesser” omentum and “greater” omentum. Identify and name the two subdivisions of the lesser omentum. Identify the location of the left and right gastric arteries within the lesser omentum.
- What are the greater and lesser sacs subdivisions of? Where is the lesser sac, and through what opening is it continuous with the greater sac?
- Name the structures that border the epiploic foramen anteriorly, posteriorly, superiorly and inferiorly. Name the three structures contained within the hepatoduodenal ligament.
- Identify the splenorenal and gastrosplenic ligaments. What artery is contained within the splenorenal ligament? What arteries that supply the stomach are contained within the gastrosplenic ligament?
- What organ and ligaments form the left lateral border of the lesser sac?
- Identify the location of the left and right gastro-omental arteries within the greater omentum.

Pause here to assess your learning. Quiz each other thoroughly. If you are satisfied with your ability to **identify these structures** and **answer these questions**, move on to the next phase of the exercise.

TASK

FOLD the greater omentum upward

over the costal margin to reveal the intestines.

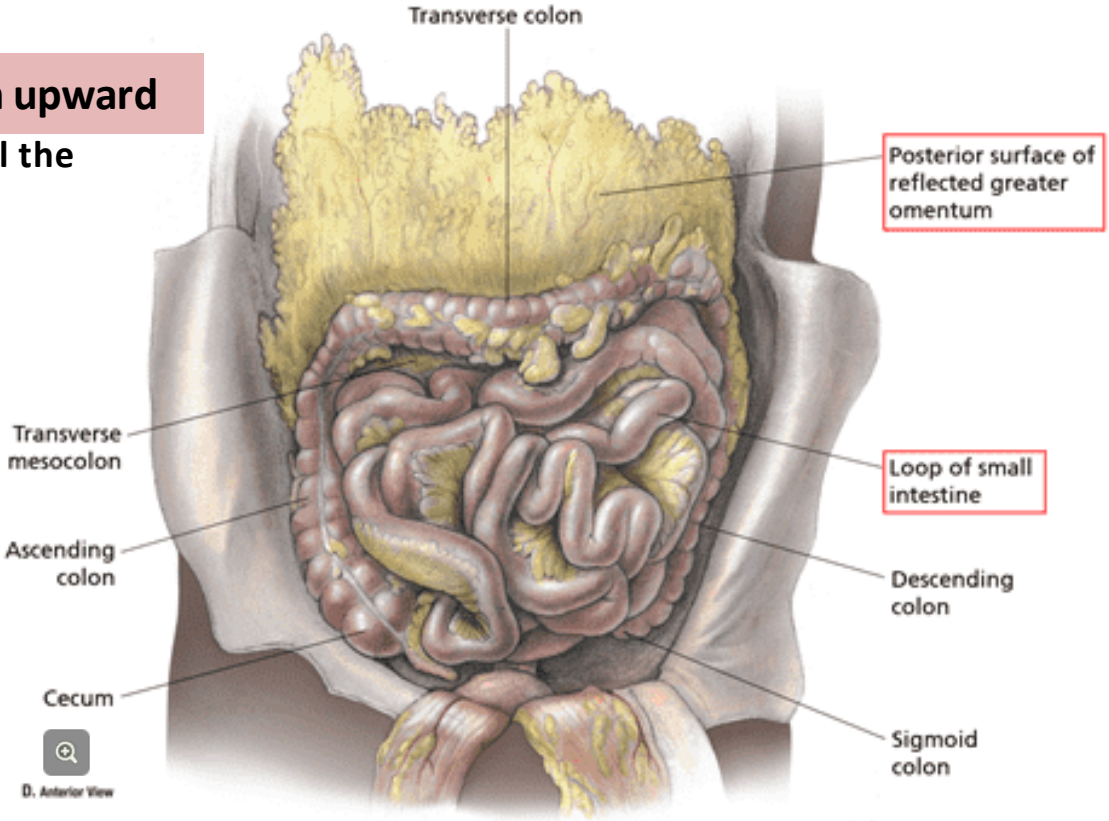
TASK

IDENTIFY

the loops of small intestine.

You will not see the duodenum because, as noted previously, it is **secondarily retroperitoneal**.

However, the remainder of the small intestine, the **jejunum** and **ileum**, are **intraperitoneal** and clearly visible.



Grant's Atlas fig 2.42

Although there is no sharp border between these two subdivisions, the **jejunum** largely occupies the **left upper quadrant**, while the **ileum** largely occupies the **right lower quadrant**.

TASK

Gently REFLECT the small intestine

first toward the right side of the peritoneal cavity and identify its mesentery.

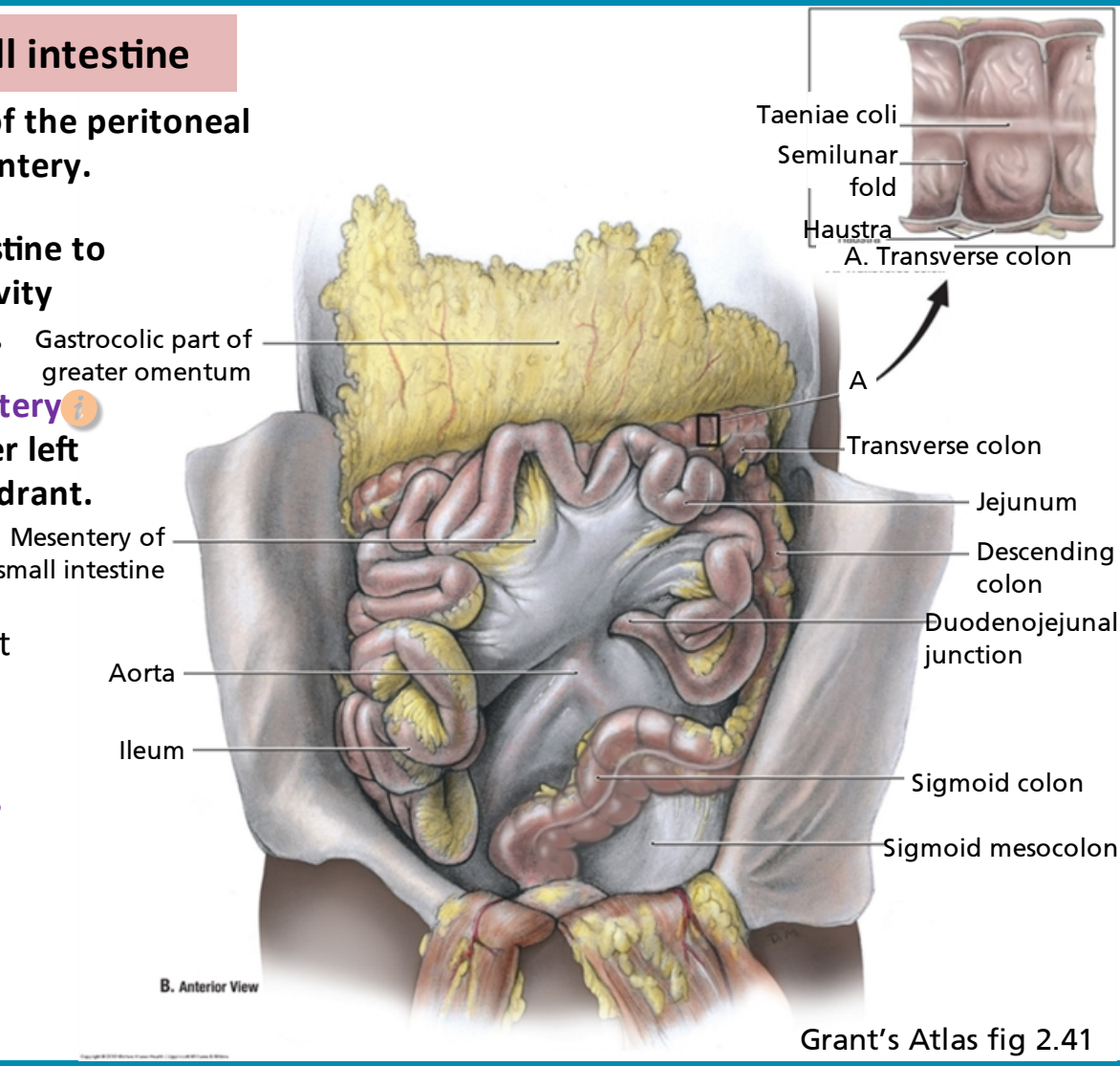
Next, gently push the small intestine to the left side of the peritoneal cavity and again identify its mesentery.

Note that the root of the mesentery extends obliquely from the upper left quadrant to the lower right quadrant.

This mesentery contains the blood vessels, nerves and lymphatics that supply the jejunum and ileum.

Remember: the jejunum and ileum are midgut derivatives. **What does this tell you about the origin of their blood supply?**

Think first, and then click here for the answer:



Grant's Atlas fig 2.41

TASK

With the greater omentum

reflected superiorly, identify the large intestine and its components:

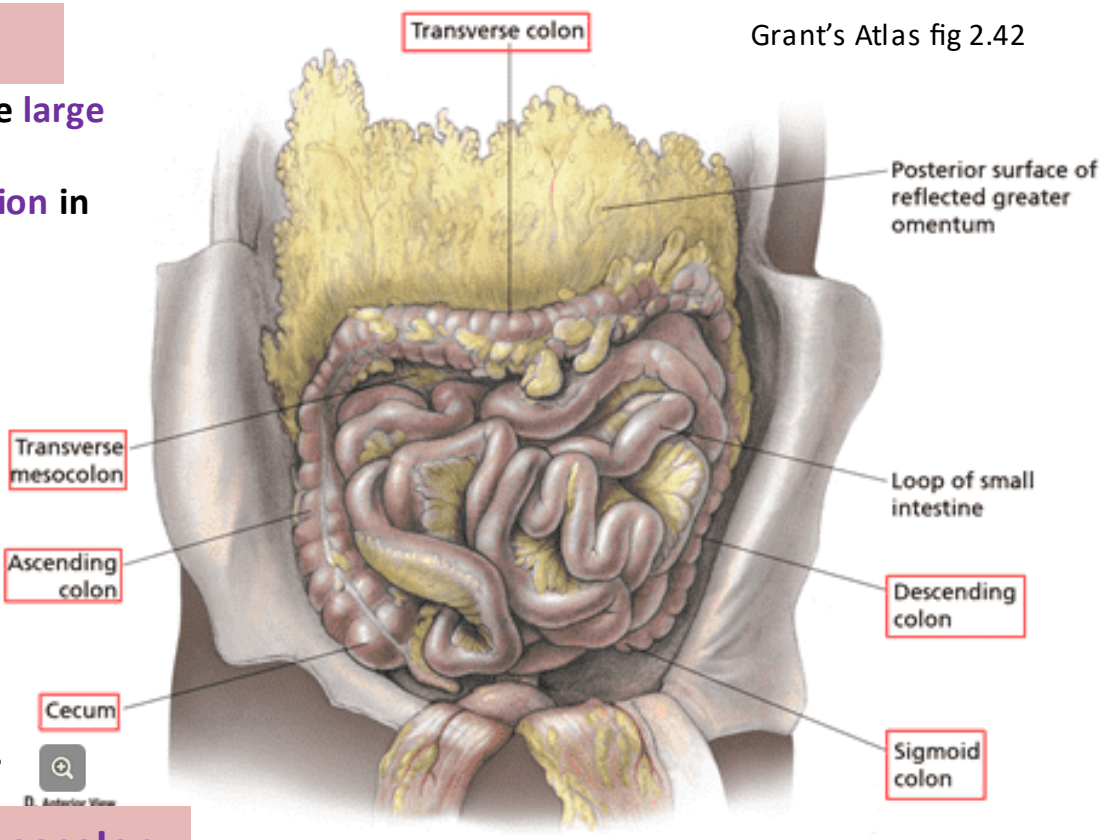
- the cecum and ileocecal junction in the lower right quadrant
- the ascending colon
- the transverse colon
- the descending colon
- the sigmoid colon

TASK

OBSERVE that both

the ascending and descending colons are fixed in place to the posterior abdominal wall, as these portions of the GI tract are secondarily retroperitoneal.

Grant's Atlas fig 2.42



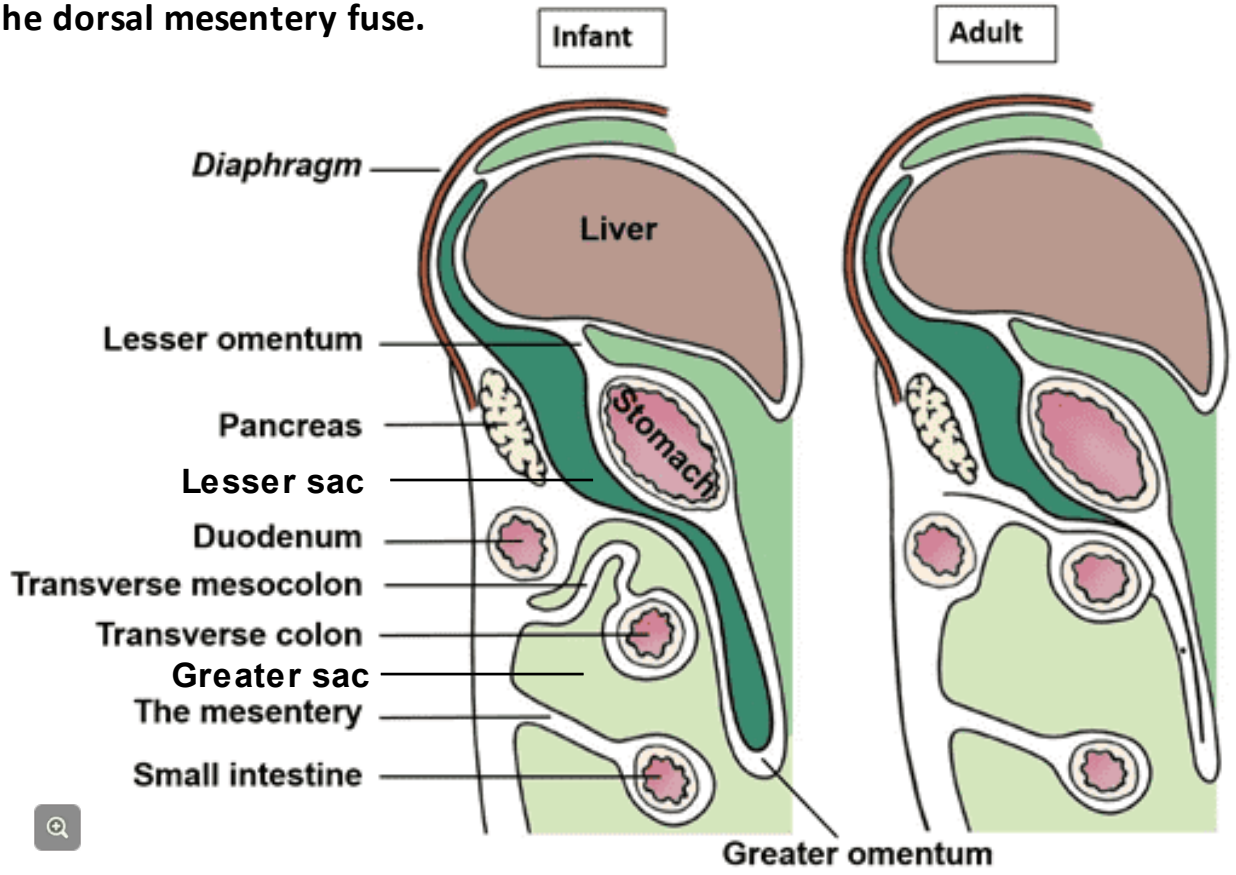
TASK

IDENTIFY the transverse mesocolon

and the sigmoid mesocolon, which are the mesenteries of the transverse and sigmoid colons, respectively, and contain the blood vessels, nerves and lymphatics that supply these portions of the GI tract. Because they have a mesentery, these portions of the large intestine are intraperitoneal.

TASK

OBSERVE that the transverse mesocolon and its mesentery are fixed to the underside of the greater omentum. This occurs in the early postnatal period, as illustrated in this figure from Grant's Atlas of Anatomy, when these two derivatives of the dorsal mesentery fuse.



Grant's Atlas fig 2.24

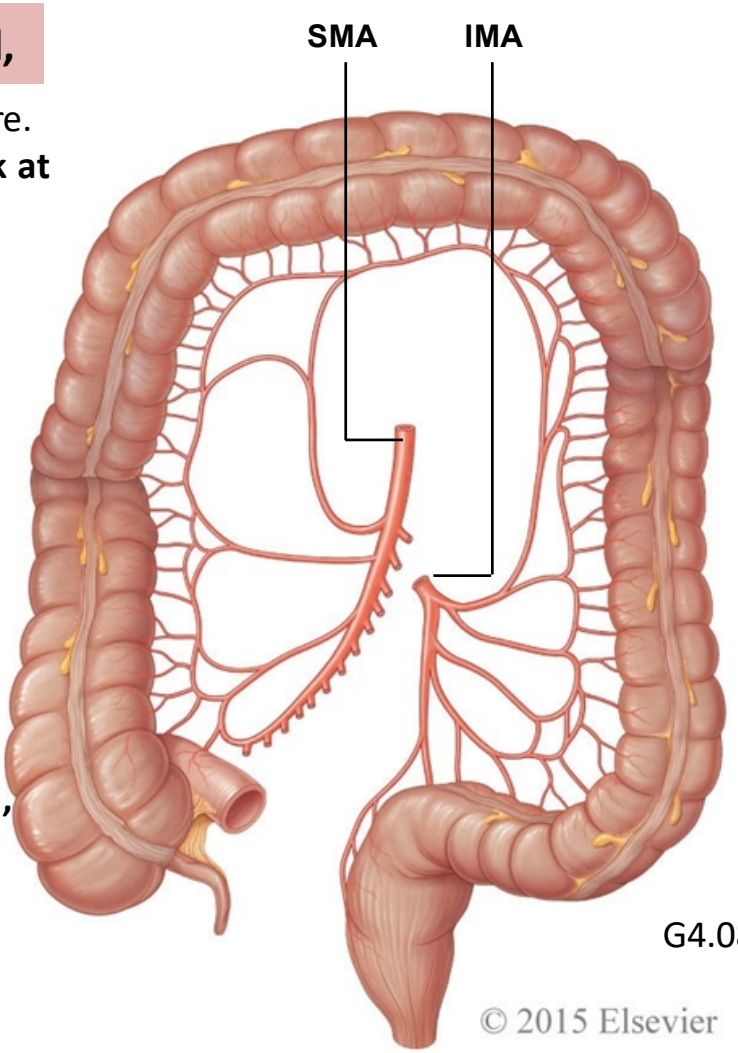
TASK

With the greater omentum reflected upward,

the large intestine will be laid out as it is in this picture. **Gently push the small intestines to the left and look at the cecum, ascending and transverse colon, again. These are midgut derivatives**, and so their blood supply comes from branches of the **superior mesenteric artery (SMA)**.

Because the **ascending colon is secondarily retroperitoneal**, the **branches of the SMA that supply it are secondarily retroperitoneal**. **Run your hand over the parietal peritoneum lining the posterior abdominal wall, from the root of the mesentery of the small intestine laterally to the ascending colon. Feel for the right colic artery, the secondarily retroperitoneal branch of the SMA that supplies the ascending colon.**

The branches of the SMA to the transverse colon run in the transverse mesocolon. Feel the transverse mesocolon, and try to identify, by feel, the middle colic artery contained within it that supplies the transverse colon.



G4.084

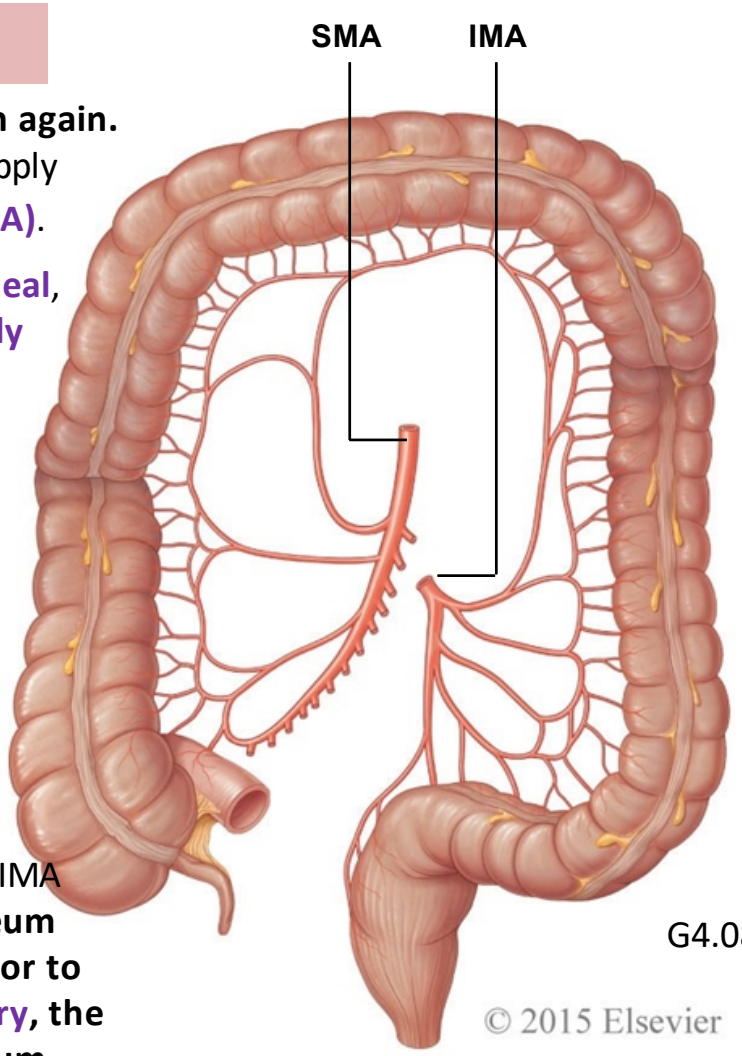
TASK

Now, gently push the small intestine to the right and look at the descending and sigmoid colon again. These are hindgut derivatives, and so their blood supply comes from branches of the inferior mesenteric artery (IMA).

Because the descending colon is secondarily retroperitoneal, the branches of the IMA that supply it are also secondarily retroperitoneal. **Run your fingers over the parietal peritoneum lining the posterior abdominal wall, from the root of the mesentery of the small intestine laterally to the descending colon. Feel for the left colic artery, the secondarily retroperitoneal branch of the IMA that supplies the descending colon.**

The branches of the IMA to the sigmoid colon run in the sigmoid mesocolon. **Feel the sigmoid mesocolon, and try to identify, by feel, the sigmoid arteries contained within it that supply the sigmoid colon.**

The rectum is retroperitoneal, and so is the branch of the IMA that supplies it. **Run your hand over the parietal peritoneum lining the posterior abdominal wall, in the midline, inferior to the bifurcation of the aorta. Feel the superior rectal artery, the retroperitoneal branch of the IMA that supplies the rectum.**



G4.084

Since embarking on this exercise, you have **identified** the following structures and learned the **answers to the following questions**:

- Identify the location of the left and right gastro-omental arteries within the greater omentum.
- Identify and name the subdivision of the small intestine that occupies the left upper quadrant, and that that occupies the right lower quadrant. Identify the mesentery of the small intestine and its root. Branches of what artery enter the mesentery at its root?
- Which portions of the large intestine are intraperitoneal and which portions are secondarily retroperitoneal? Identify and name the mesenteries associated with the large intestine.
- Explain how the transverse colon comes to be attached to the underside of the greater omentum.
- Which portions of the large intestine are supplied by branches of the superior mesenteric artery and which are supplied by branches of the inferior mesenteric artery?
- Name, and identify the location of, the main branch of the superior mesenteric artery to the ascending colon, and that to the transverse colon. Name, and identify the location of, the main branch of the inferior mesenteric artery to the descending colon, those to the sigmoid colon, and that to the rectum.

If you are satisfied with your ability to **identify these structures** and **answer these questions**, call you TA over for confirmation and for permission to proceed. Know that your TA will quiz you on the content of both Progress Check 1 and 2.

10.3 Dissection of the Foregut

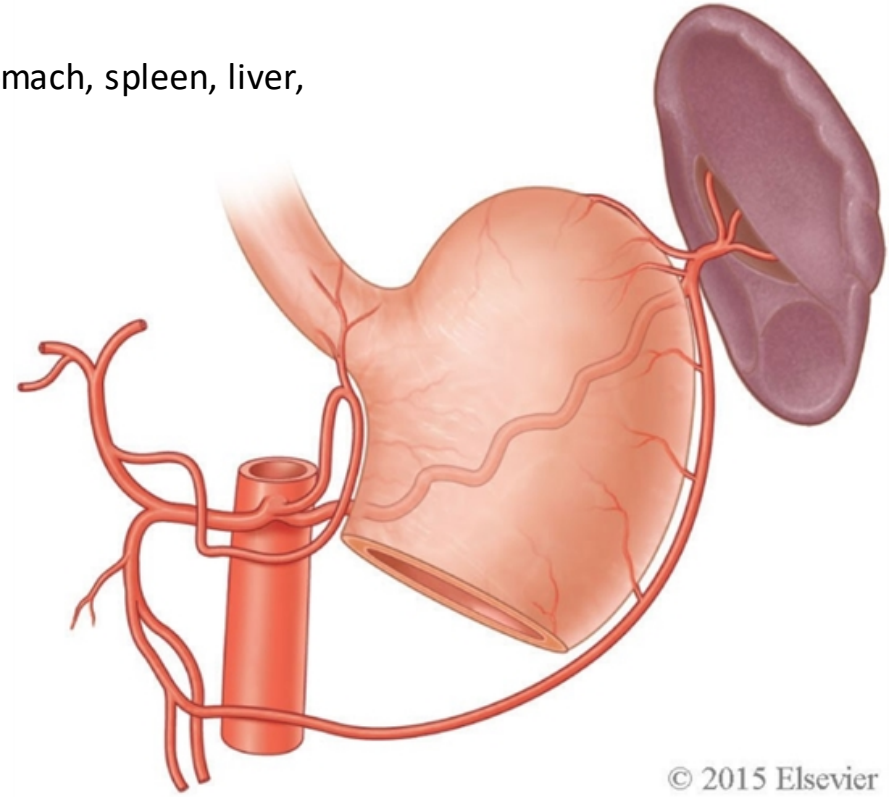
What you'll need:

SPECIMENS

- Cadavers 1 & 2
- Abdominal Organs Teaching Bin

When you have completed this dissection, you will be able to identify and describe the:

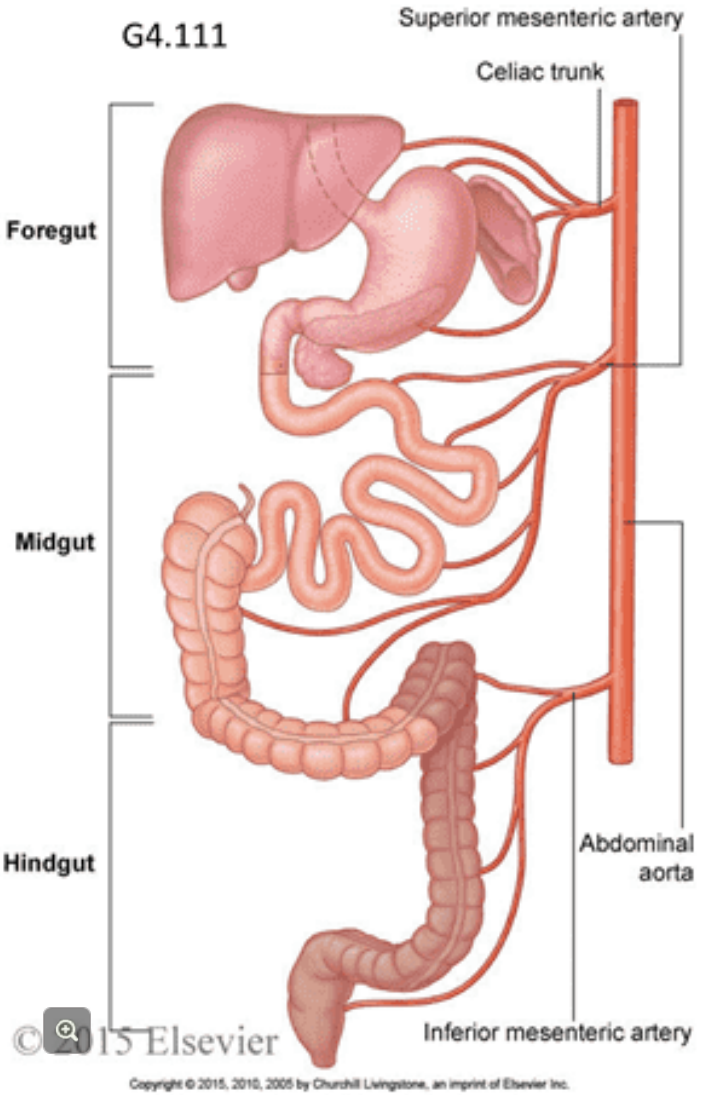
- gross features of the stomach.
- hepatoduodenal and hepatogastric ligaments and the structures contained therein.
- celiac trunk and its branches that supply the stomach, spleen, liver, gallbladder, duodenum and pancreas.
- hepatic portal vein and its tributaries.

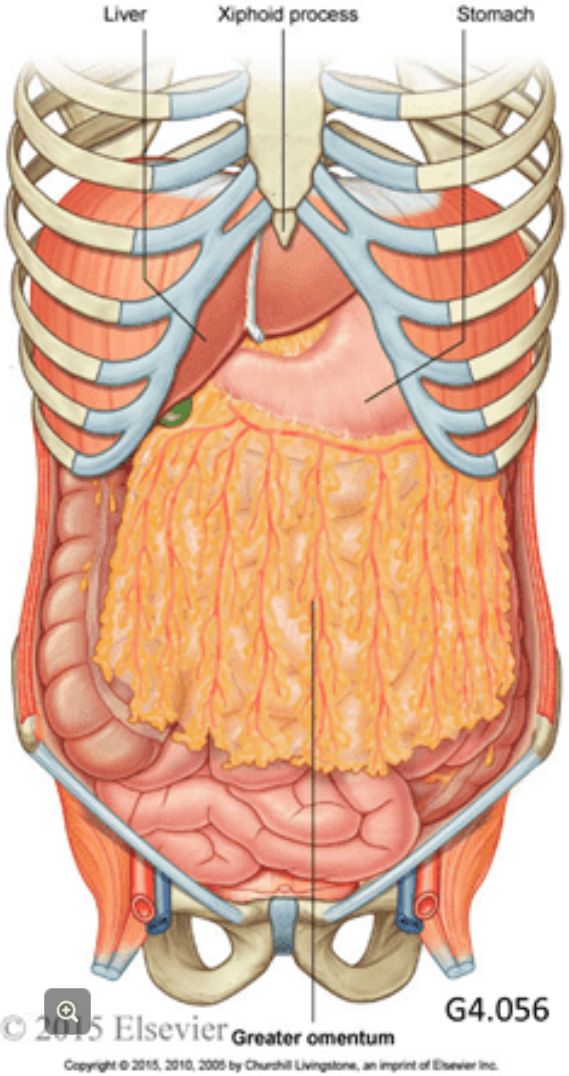


The digestive tract is a single (albeit convoluted) tube that has **three subdivisions: the foregut, midgut and hindgut**. It receives its blood supply from **three, unpaired, visceral branches of the abdominal aorta**. The **foregut** receives its blood supply from the **celiac trunk**, the **midgut** from the **superior mesenteric artery** and the **hindgut** from the **inferior mesenteric artery**.

These vessels arise from the aorta in the posterior body wall. In order for their branches to gain access to intraperitoneal organs, they must pass through **mesenteries** or **ligaments**, structures analogous to mesenteries, but smaller. Like mesenteries, they **consist of two layers of serous membrane with loose CT, adipose, Ns, BVs and Ls sandwiched between them**.

The focus of this dissection is the foregut. You will dissect the branches of the celiac trunk that supply the liver, gallbladder, stomach, spleen, the proximal duodenum and a portion of the pancreas.





TASK

BEFORE DISSECTING,

remove the lungs and heart from your cadaver, wrap them in moist cloths, and set them aside for the duration of the session. Doing so will allow you to retract the costal margin superiorly to improve your access to the foregut. **Replace these organs when you clean up at the end of the session.**

Try retracting the costal margin and liver superiorly. If this proves to be difficult, use bone snippers or a small saw from the tool box to **cut the costal margin in the midaxial line, bilaterally**. This will create a "hinge" that will permit greater elevation of the costal margin and liver.

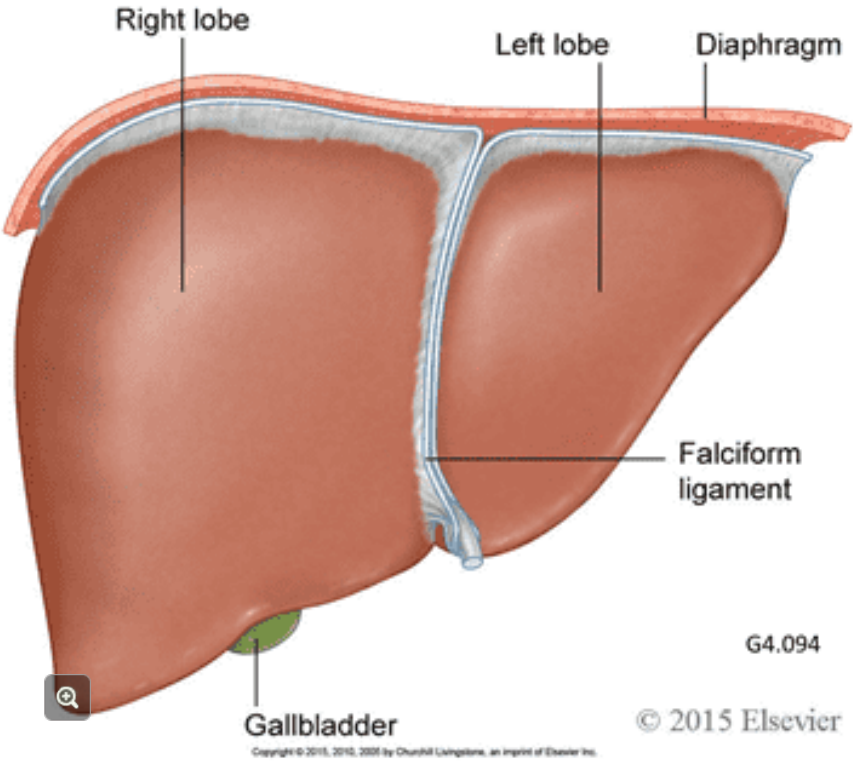
Now, place the greater omentum in its correct anatomical position, and get your bearings by identifying the structures that comprise the foregut.

The liver produces **bile**, which is transported to the duodenum by a series of ducts. **Bile emulsifies dietary fats**, thus **facilitating their enzymatic digestion by pancreatic lipases**. The liver produces bile constantly. The **gall bladder stores and concentrates bile** until the contents of the duodenum necessitates its delivery via the bile duct system.

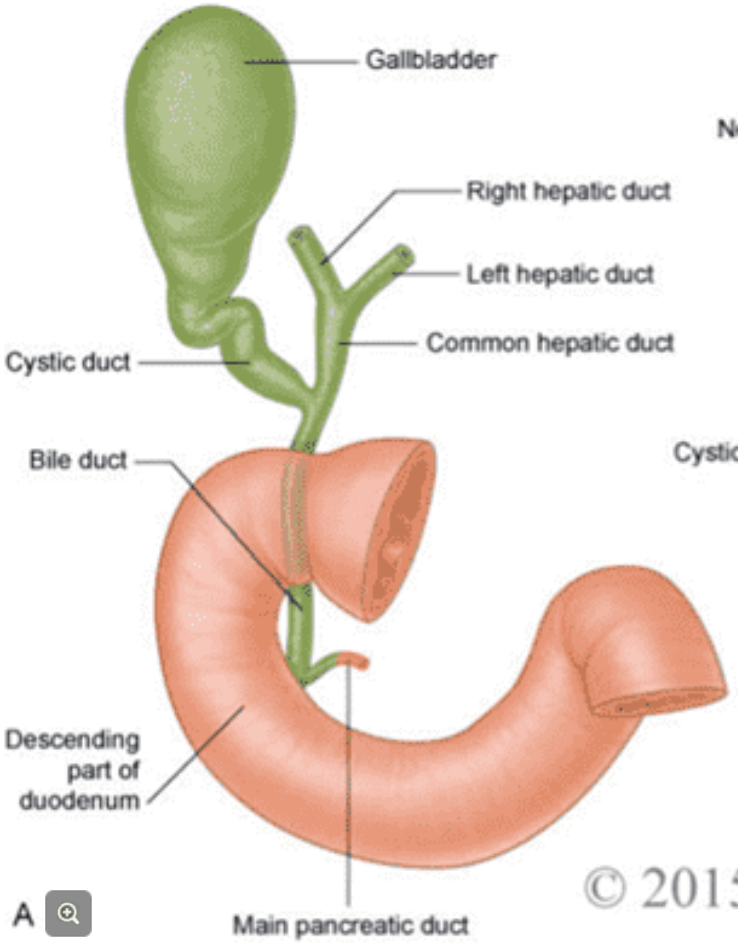
TASK

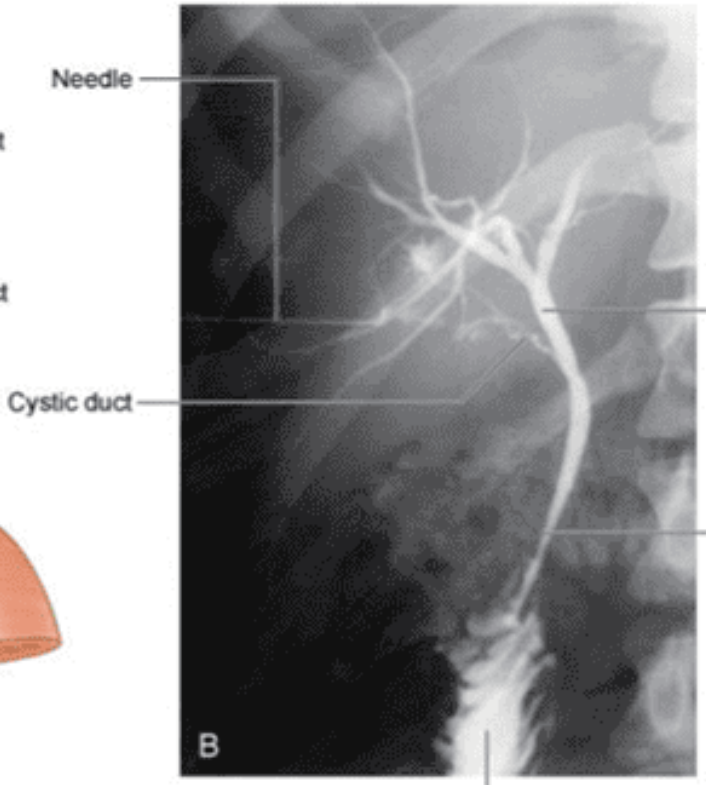
START with the diaphragmatic surface

of the liver. Identify its **right and left lobe**, the **falciform ligament** that separates them, and the **inferior border of the liver**. Notice the **gall bladder** (if it is not present, it was surgically removed via a **cholecystectomy**), which extends beyond the inferior border of the liver at the level of the **ninth costal cartilage**.



The Bile Duct System



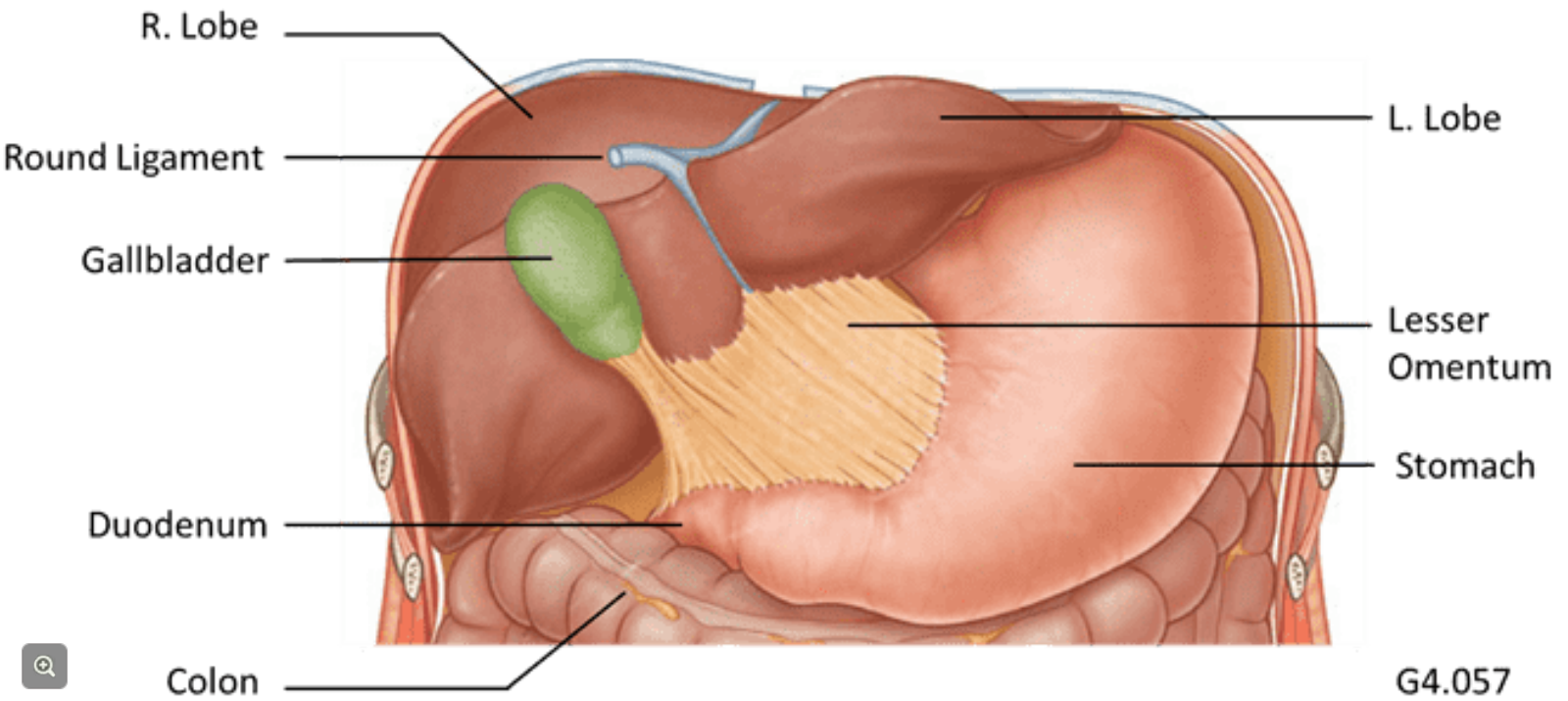


G4.102

TASK

ONE MEMBER of your group should raise the inferior border of the liver,

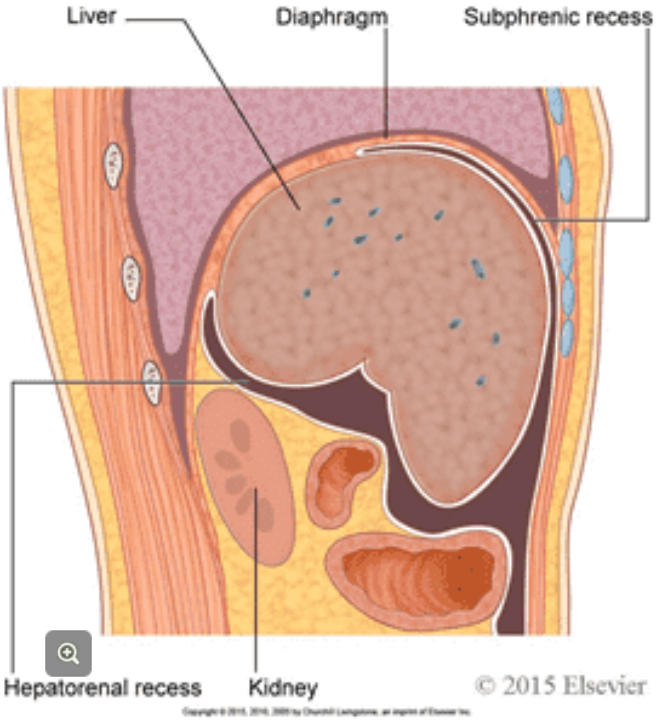
thus exposing its visceral surface. There, identify the hilus of the liver, the **porta hepatis**, through which vessels, ducts, lymphatics, and nerves enter the liver. Take note of the **structures in contact with the visceral surface of the liver**: the **gall bladder** (if present), the **stomach**, the **duodenum**, the **colon**, and through the parietal peritoneum lining the posterior wall of the hepatorenal recess, the **right kidney** and **right suprarenal gland**.



TASK

ONE MEMBER of your group should raise the inferior border of the liver,

thus exposing its visceral surface. There, identify the hilus of the liver, the **porta hepatis**, through which vessels, ducts, lymphatics, and nerves enter the liver. Take note of the **structures in contact with the visceral surface of the liver**: the **gall bladder** (if present), the **stomach**, the **duodenum**, the **colon**, and through the parietal peritoneum lining the posterior wall of the hepatorenal recess, the **right kidney** and **right suprarenal gland**.



G4.093

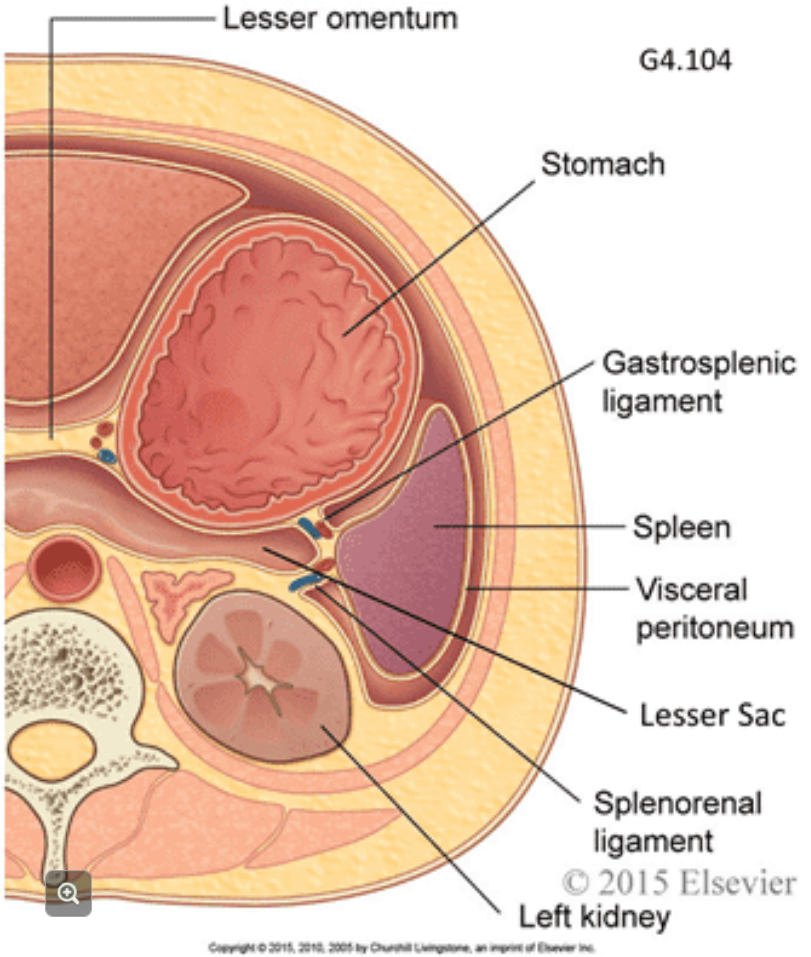
TASK

FROM the cadaver's right side, and with your right hand,

reach around to the left of the stomach and wrap your hand around the spleen. The tip of your thumb will be touching the gastrosplenic ligament and the tips of your fingers will be touching the splenorenal ligament.

These ligaments contain **blood vessels** that arise from the **celiac trunk** to supply the **spleen** and portions of the **stomach**. Remember, the celiac trunk is retroperitoneal. Its branch, the **splenic artery**, accesses the spleen, an intraperitoneal organ, by passing through the **splenorenal ligament**. Look at the illustration and **notice that the name of the ligament is easy to remember because it describes its points of attachment**. Branches of the splenic artery access the greater curvature of the stomach by passing through the **gastrosplenic ligament**. Again, the ligament is named according to its points of attachment.

Notice again, from the illustration that these ligaments form the left border of the lesser sac.



Turn your attention to the stomach and its gross anatomical features.

TASK

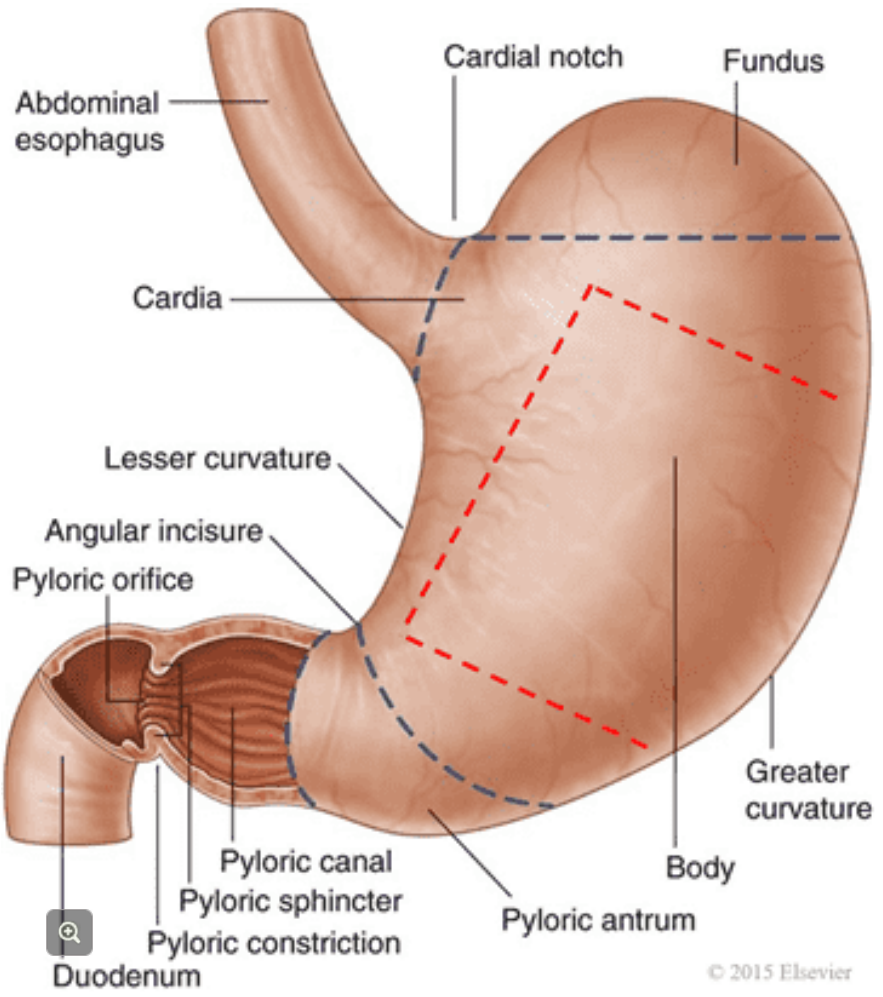
IDENTIFY the

- body
- greater curvature
- lesser curvature
- cardia
- cardial notch
- fundus
- pylorus (inc. pyloric antrum, canal)
- pyloric sphincter

TASK

CUT a flap

in the anterior wall of the stomach, as illustrated by the red dotted lines in the figure. If there is fluid in the stomach lumen, use a rag to absorb it. On the internal surface of the stomach, identify the rugae, longitudinal folds in the stomach wall that flatten out as the stomach fills, increasing its capacity.

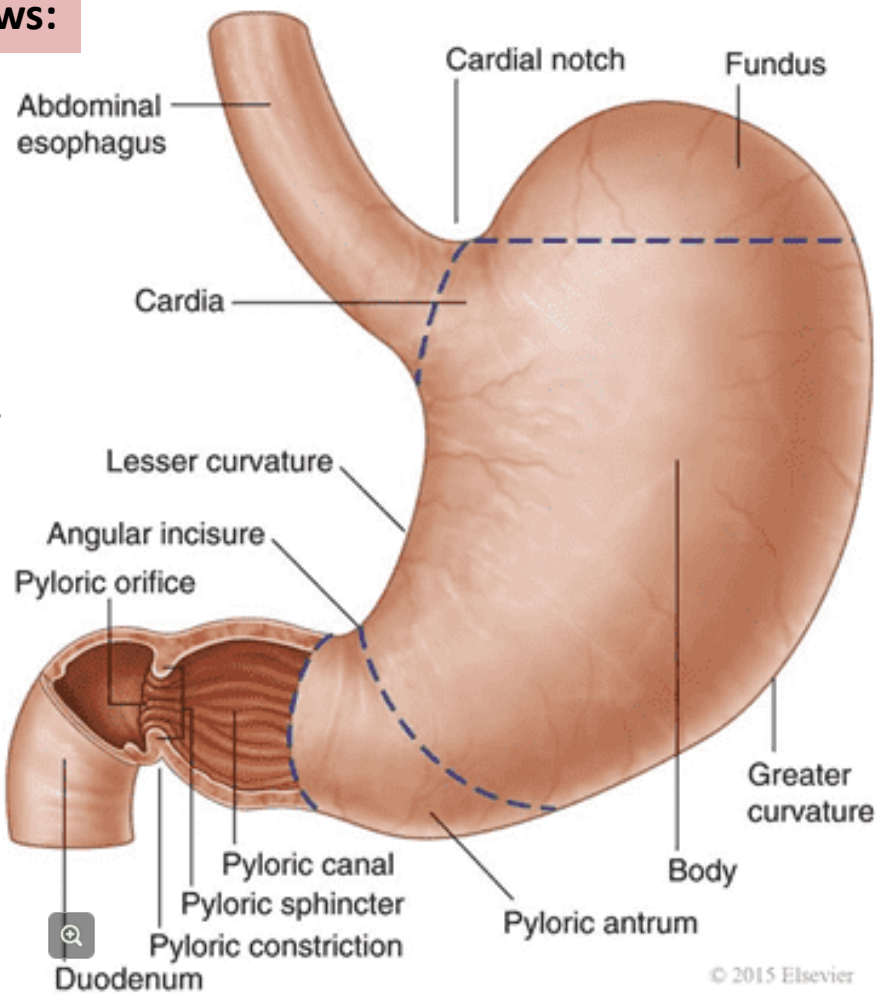


TASK

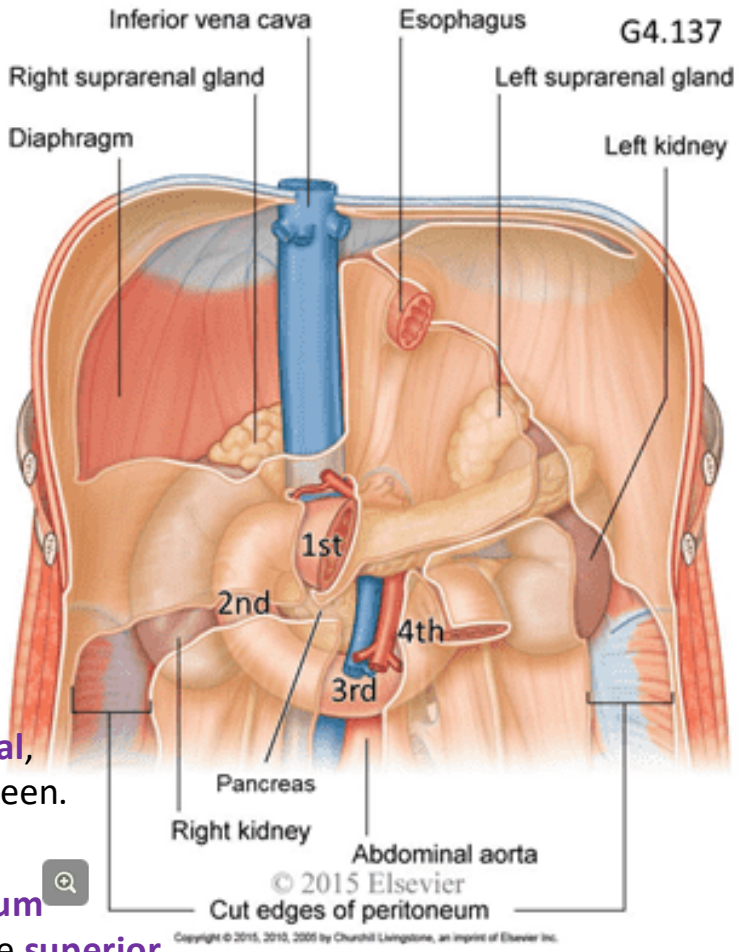
IDENTIFY the pyloric sphincter as follows:

Pinch the thickness of the stomach wall between your index finger and thumb. Note that your thumb and finger are, perhaps 0.5 cm apart, which gives you some idea of the thickness of the wall of this muscular sack. Now feel the thickness of the pyloric sphincter by pinching it between your thumb and finger. You will find that your thumb and finger are now 2.5 - 3 cm apart! This is a very strong sphincter.

The pyloric sphincter controls the passage of chyme (partially digested food) from the stomach into the duodenum. Anatomically, it consists of a thickening of the circular layer of smooth muscle within the wall of the gut at the gastroduodenal junction.



The dividing line between the foregut and midgut passes through the duodenum and pancreas.
The duodenum is subdivided into 1st (superior), 2nd (descending), 3rd (transverse) and 4th (ascending) parts. **The proximal 2 cm of the 1st part is intraperitoneal** and therefore mobile. This is the portion that is attached to the **hepatoduodenal ligament**. **The remainder of the duodenum is secondarily retroperitoneal.**



TASK

EXPLORE the intraperitoneal portion of the duodenum. Insert your index finger though the epiploic foramen and observe that the hepatoduodenal ligament is anterior to your finger and the duodenum is inferior to your finger as it passes into the posterior body wall where it becomes secondarily retroperitoneal and therefore fixed.

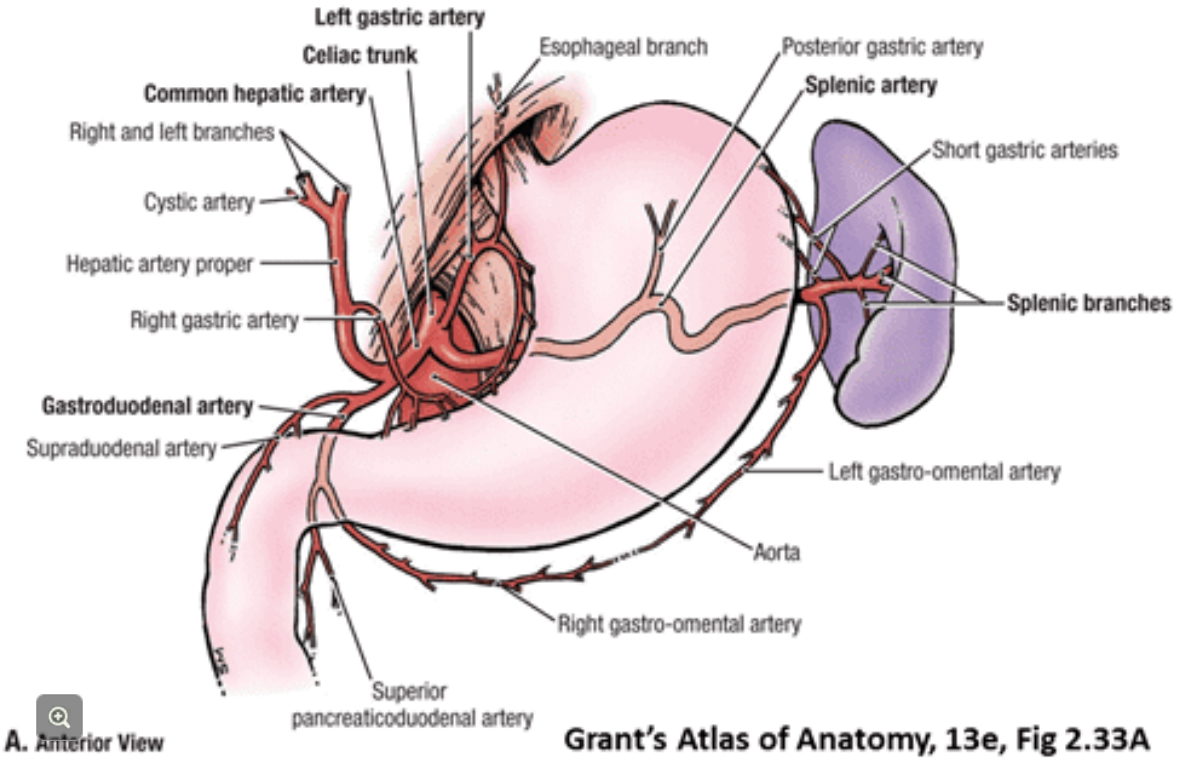
As illustrated, the **pancreas**, also **secondarily retroperitoneal**, lies in the curve of the duodenum and extends toward the spleen.

The **proximal duodenum** and **portions of the pancreas** are supplied by branches of the **celiac trunk**. The **distal duodenum** and **portions of the pancreas** are supplied by branches of the **superior mesenteric artery**. The details will come later in the dissection.

The focus of this dissection is the foregut. You will learn the anatomy of the foregut using its blood supply to guide the progress of your dissection.

Thus, start by learning the major branches of the celiac trunk.

The branches of the celiac trunk are named for their area of distribution, which helps you to remember this important information. The three branches of the celiac trunk are the **common hepatic artery**, **the left gastric artery** and **the splenic artery**.



Grant's Atlas of Anatomy, 13e, Fig 2.33A

The Common Hepatic Artery

The **common hepatic artery** arises from the celiac trunk. It runs to the right, retroperitoneally, toward the duodenum and bifurcates into the **gastroduodenal artery** and the **hepatic artery proper**.

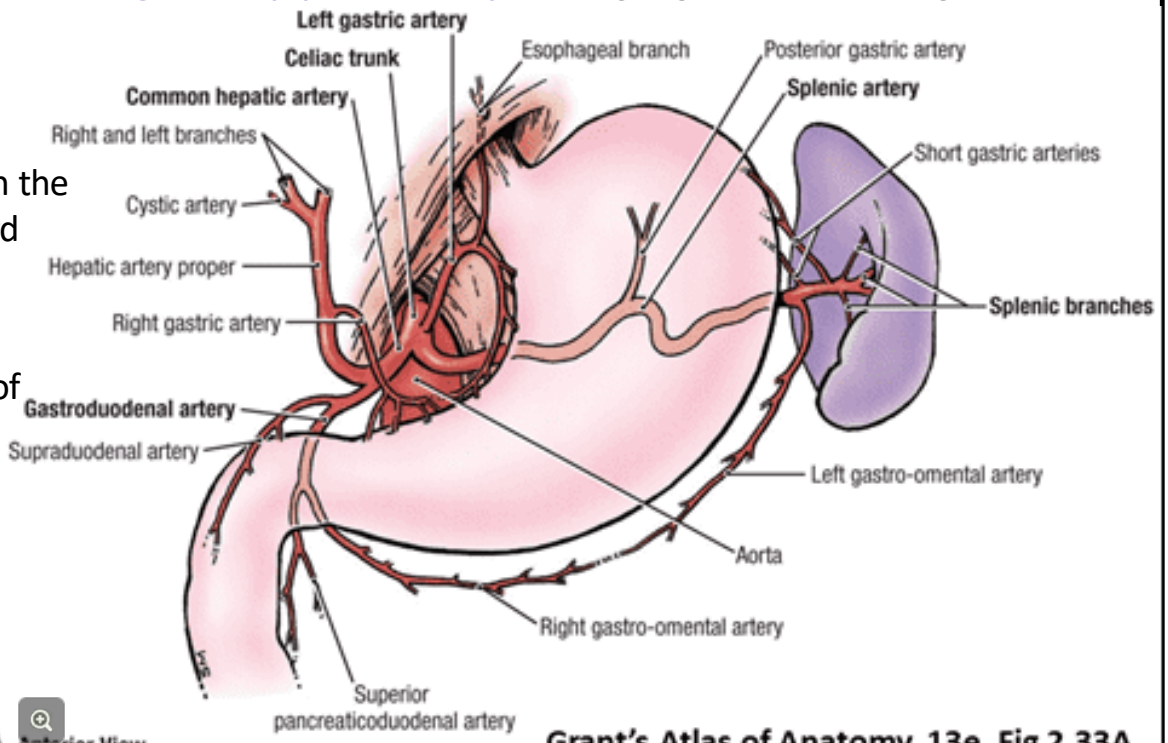
The gastroduodenal artery remains retroperitoneal and **passes posterior to the 1st part of the duodenum**. It continues as the **right gastro-omental (gastro-epiploic) artery**. The right gastro-omental (gastro-epiploic) artery runs along the greater curvature of the stomach within the greater omentum.

The **hepatic artery proper** runs in the **hepatoduodenal ligament** toward the porta hepatis. It gives rise to

i) **the right gastric artery**, which descends to the lesser curvature of the stomach within the lesser omentum, and

ii) the **cystic artery**, which supplies the gall bladder.

The hepatic artery proper ends by bifurcating into the **right and left hepatic arteries**.



Grant's Atlas of Anatomy, 13e, Fig 2.33A

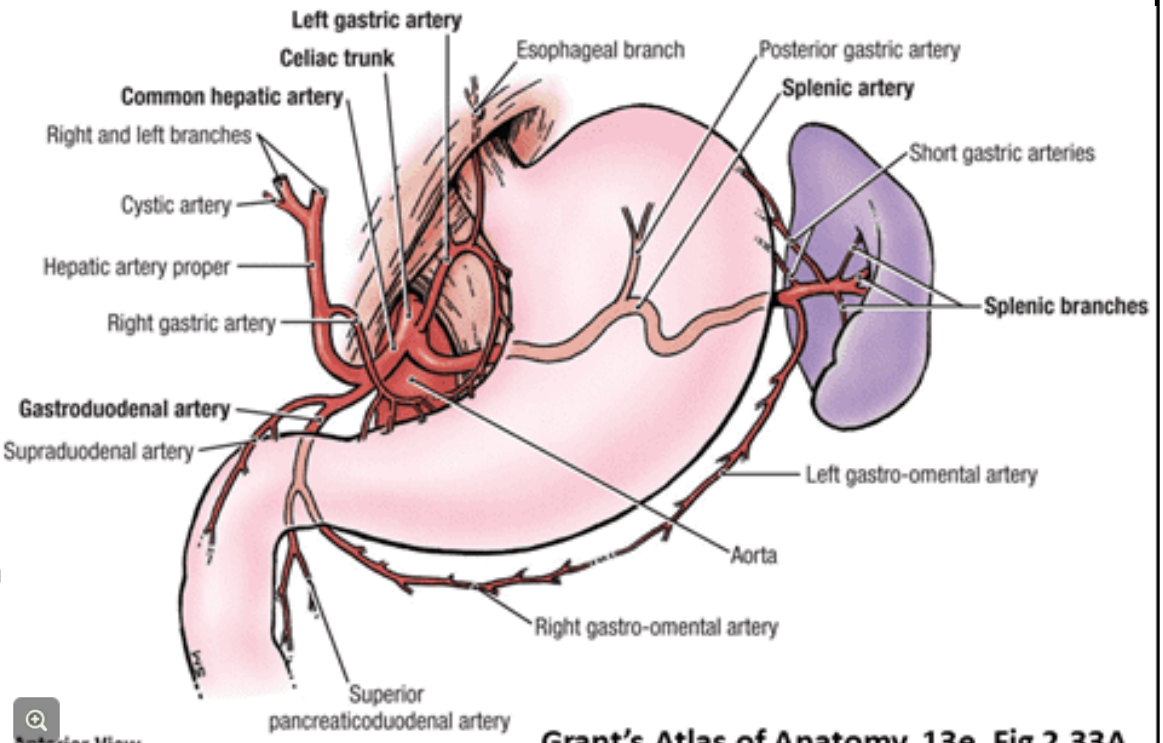
The Left Gastric Artery

The **left gastric ar**tery arises from the celiac trunk, and is therefore, initially, retroperitoneal.

It ascends to the left to the point where the esophagus emerges through the diaphragm to become intraperitoneal. It gives an **esophageal branch** which ascends to supply the retroperitoneal portion of the distal 1/3 of the esophagus.

The **left gastric artery** then accompanies the intraperitoneal terminus of the esophagus to the **lesser curvature of the stomach**.

It runs within the lesser omentum and forms an **arterial anastomosis with the right gastric artery along the lesser curvature of the stomach**.



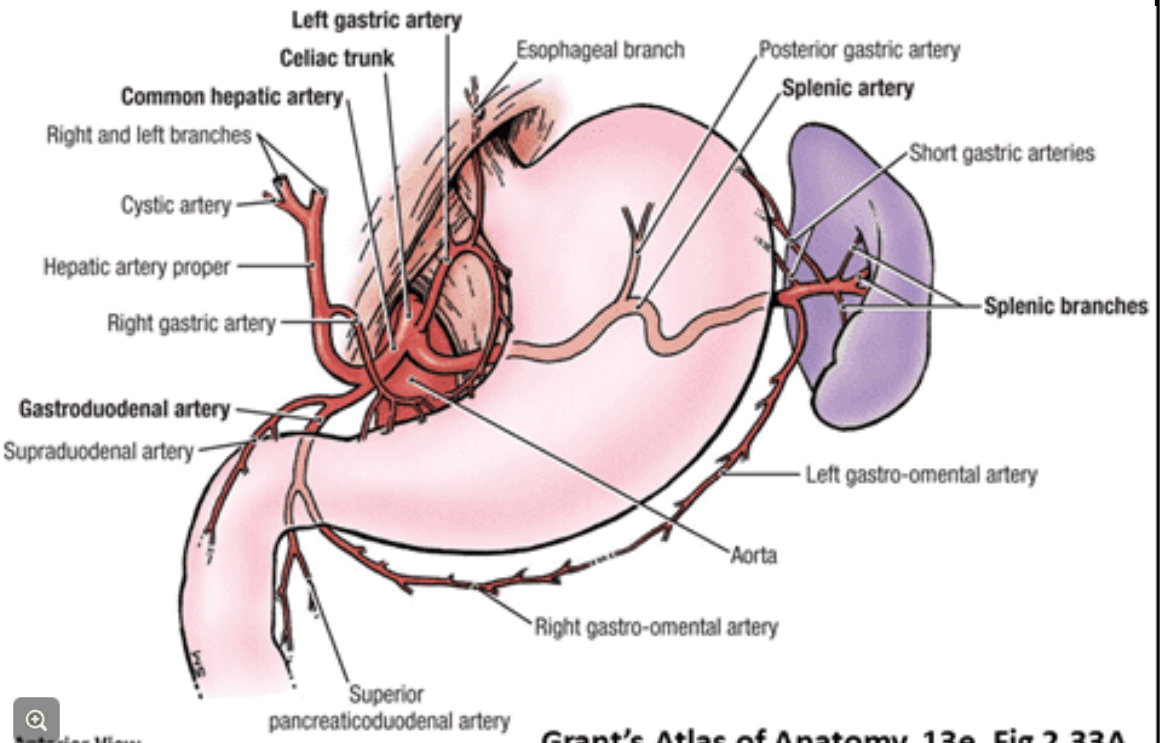
Grant's Atlas of Anatomy, 13e, Fig 2.33A

The Splenic Artery

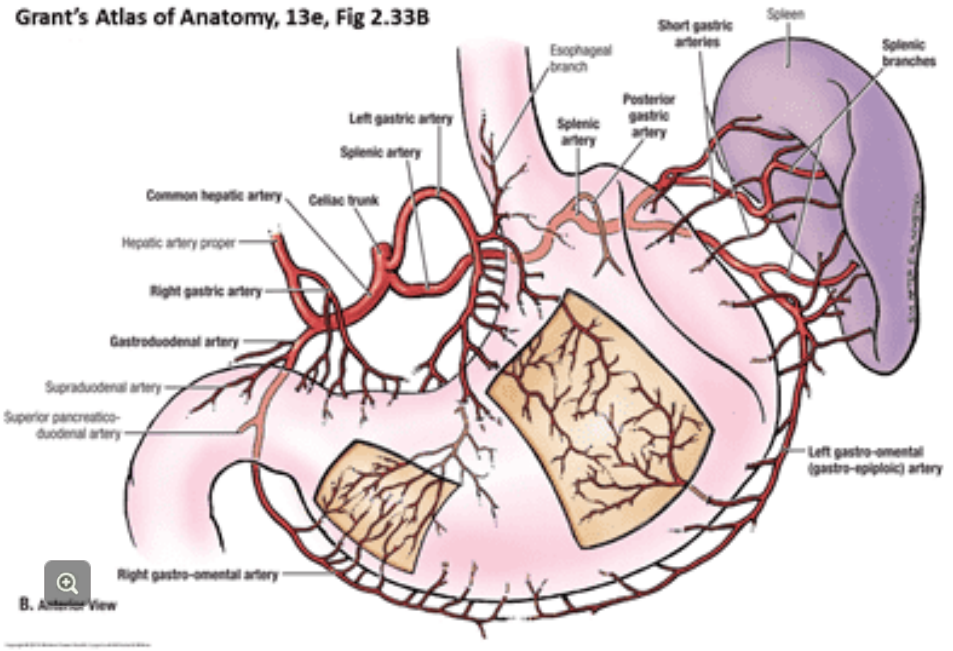
The **splenic artery** arises from the celiac trunk. It runs to the left, retroperitoneally, toward the spleen. It **passes through the splenorenal ligament to access the hilum of the spleen**. Before entering the hilum of the spleen, it gives rise to the following branches that pass through the **gastrosplenic ligament** to access the greater curvature of the stomach.

i) the **short gastric arteries**, which ascend along the greater curvature of the stomach, within the greater omentum, to its fundus, and

ii) the left g**astro-omental (gastro-epiploic) artery**, which descends along the greater curvature of the stomach, in the greater omentum. The latter artery **anastomoses with the right gastro-omental (gastro-epiploic) artery within the greater omentum**.



Grant's Atlas of Anatomy, 13e, Fig 2.33A



The vessels supplying the stomach run along its **lesser** and **greater curvatures**, within the **lesser** and **greater omenta**, respectively.

Within the lesser omentum are the **left** and **right gastric arteries**, the former branching from the celiac trunk and the latter usually arising from the hepatic artery proper.

Within the greater omentum are the **left** and **right gastro-omental (gastro-epiploic) arteries**, the former branching from the splenic artery and the latter arising as the continuation of the gastroduodenal artery. The **short gastric arteries** arise from the splenic artery and ascend in the greater omentum toward the fundus of the stomach.

From these parent arteries running along the margins of the stomach, vessels arise and run within the visceral peritoneum of the stomach to **anastomose on both its anterior and posterior surfaces**, as illustrated in the accompanying figure.

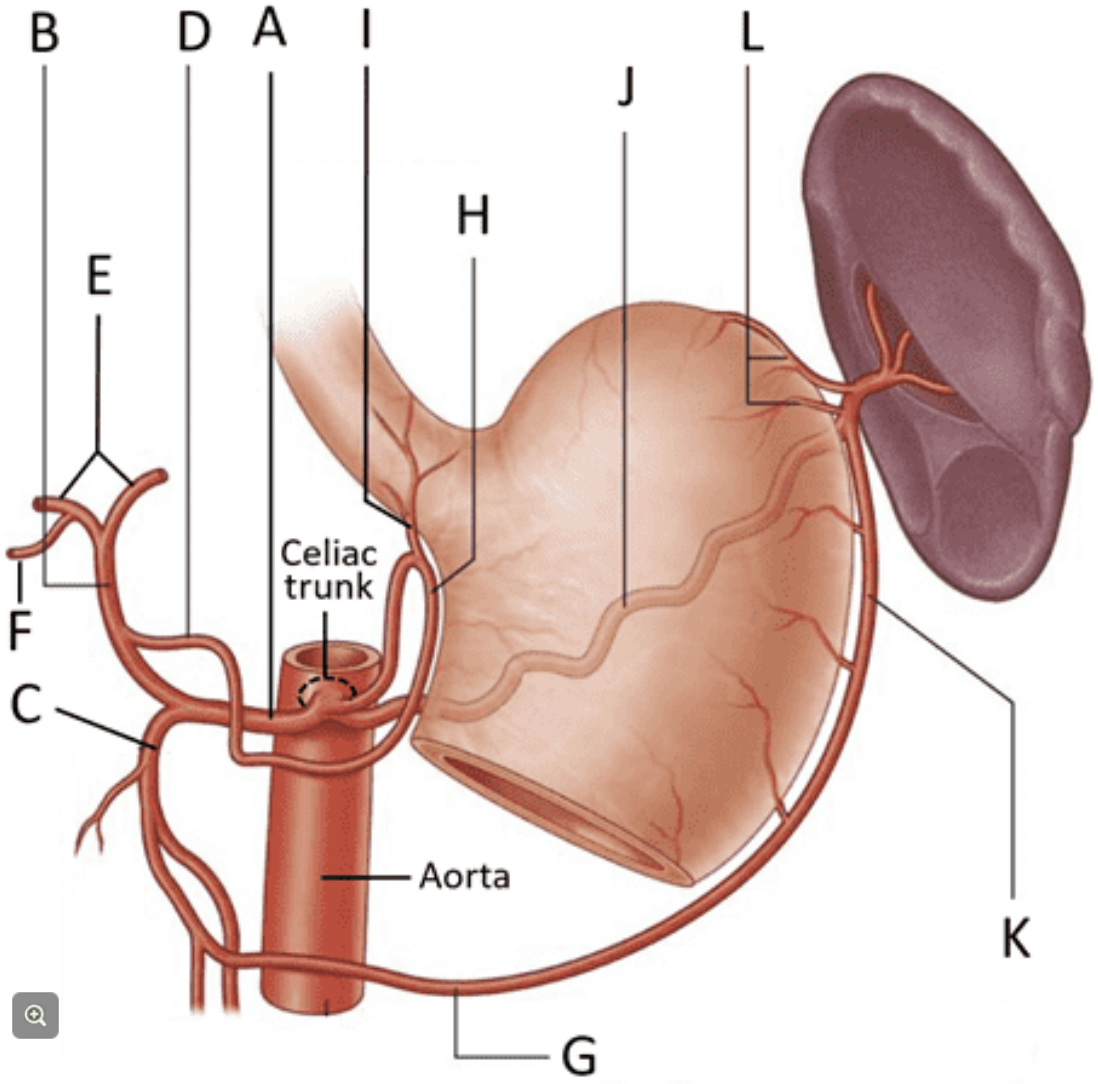
It would be a good idea for one member of your group to draw the vessels described on a white board or chalk board adjacent to your table before embarking on the dissection.

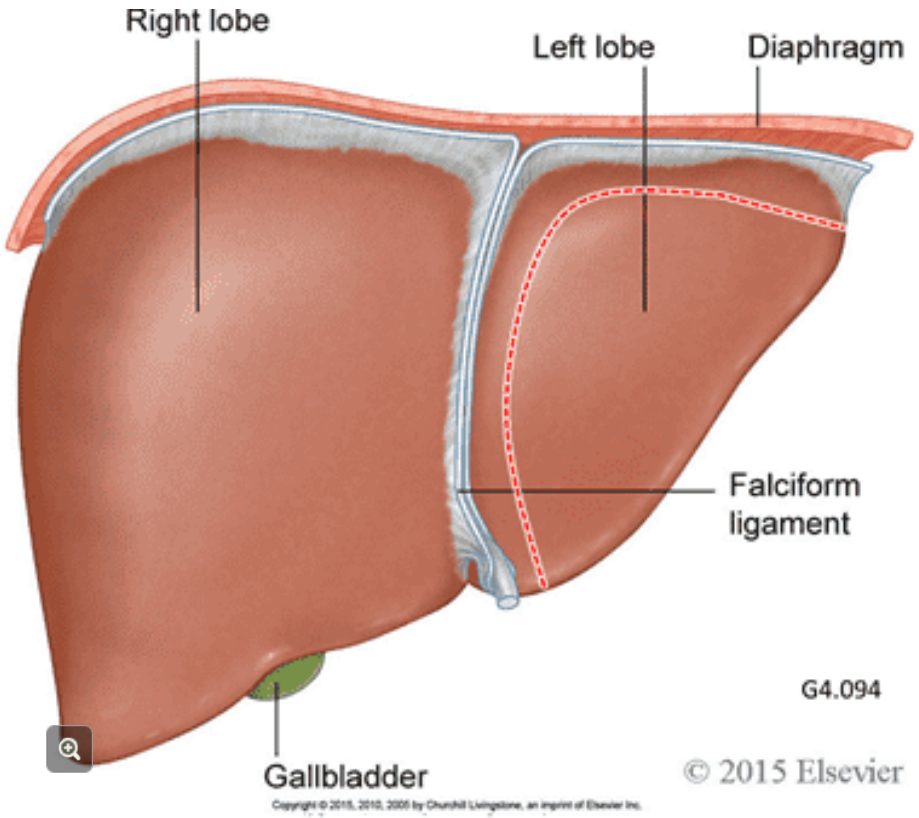
In order to complete a dissection successfully, it is critical to know the anatomy of the region **prior to** taking your instruments to the cadaver. You should identify the following structures and be able to answer the following questions:

- Can you identify the gross anatomical features of the stomach: **the body, greater and lesser curvature, cardia, cardial notch, fundus, pylorus and pyloric sphincter? What are rugae and what is their function? What is chyme?** If any of these structures are difficult to demonstrate in your cadaver, use the prosected stomach in the Abdominal Organs Teaching Bin.
- Your TA will ask you to identify the branches of the celiac trunk, using a diagram, such as this:  . **Be able to state whether each artery is retroperitoneal or intraperitoneal**. If it is intraperitoneal, be able to **name the ligament or mesentery that contains the artery**.
- What structures form the left lateral border of the lesser sac?

If you feel you are ready to proceed, ask your TA to check that you understand the preceding content adequately enough to move on to the next slide and the dissection of the common hepatic artery, its branches, and related structures.

10.4 Progress Check 1





TASK

CUT a notch

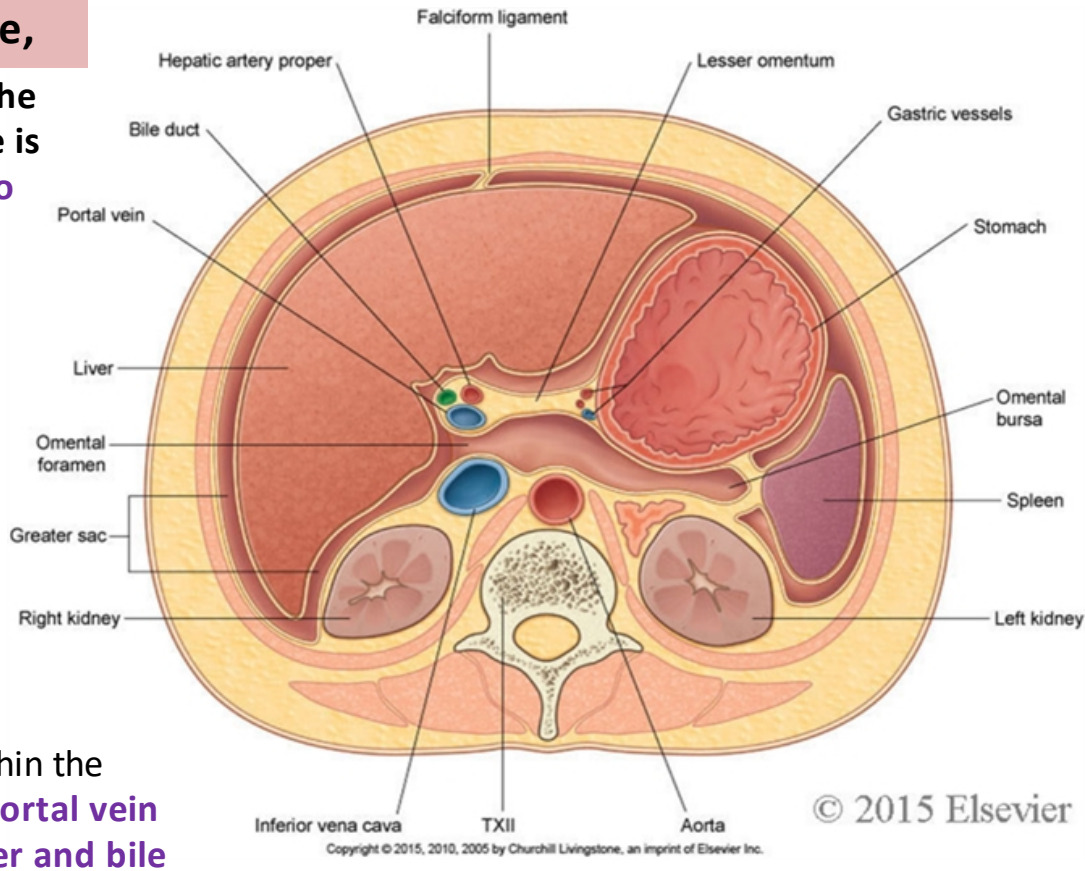
out of the anterior border of the left lobe of the liver. This will allow you to more clearly see the structures of the foregut.

Be careful not to cut into the porta hepatis, but remove enough tissue to more easily see the lesser omentum and the relationship between the stomach and the porta hepatis. This is one of the few times that I will suggest that you use a scalpel on any structure deep to the dermis!

It is best to remove the liver tissue in pieces until you are satisfied with your field of view, although one member of your group will still need to retract the inferior border of the right lobe of the liver.

TASK

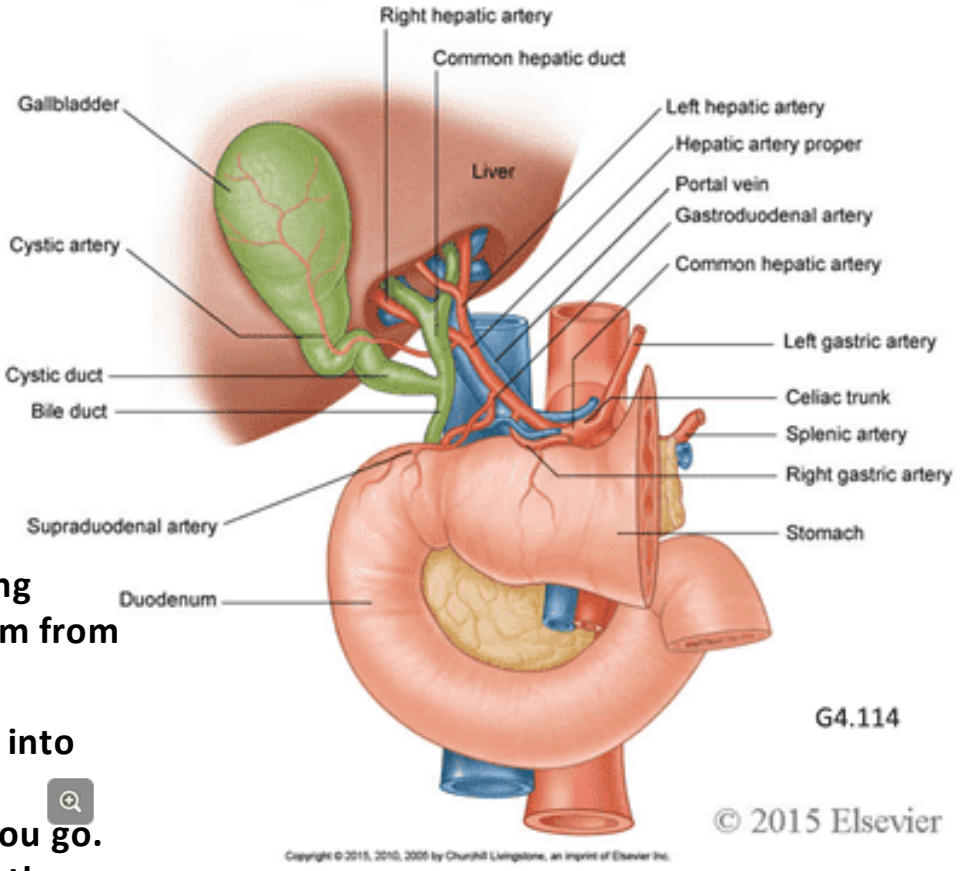
FROM the cadaver's right side, insert your left index finger into the omental foramen. What structure is anterior to your finger? inferior to your finger? superior to your finger?



Realize, with the help of the accompanying figure, that the IVC is posterior to your finger. Also, see from the illustration that the hepatoduodenal ligament contains the common bile duct, hepatic artery proper and the hepatic portal vein.

Note the position of these structures within the hepatoduodenal ligament: **the hepatic portal vein is posterior to the hepatic artery proper and bile duct, and the bile duct is lateral to the artery.** Know that the hepatoduodenal ligament also contains autonomic nerves and lymphatic vessels.

You will start the dissection by exposing the **right gastric artery** located between the serous layers of the lesser omentum, along the right side of the lesser curvature of the stomach. The reason we start with this vessel is because it is small and easily broken. Once identified, you will trace it toward its origin from either the **hepatic artery proper** or the **common hepatic artery**.



TASK

CAREFULLY, using blunt dissection, remove the serous membrane from the anterior surface of the lesser omentum on the right side of the lesser curvature of the stomach. Running parallel to the lesser curvature, and about 1 cm from it, you will encounter the right gastric artery.

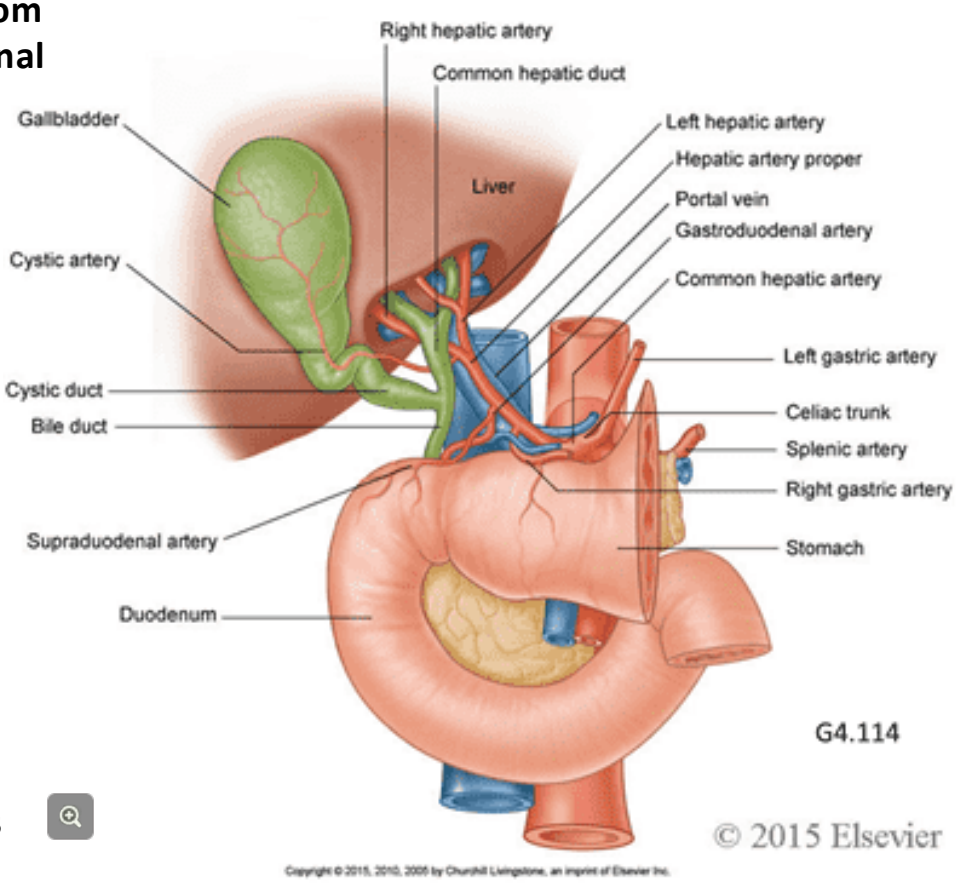
Trace the right gastric artery to the right, and into the hepatogastric ligament, to find its origin, dissecting the serous membrane carefully as you go. The right gastric artery will lead you to either the common hepatic artery or the hepatic artery proper.

TASK

CAREFULLY, using blunt dissection *i* **,**

continue to remove serous membrane from the anterior surface of the hepatoduodenal ligament to expose the hepatic artery proper and the common bile duct. The artery is medial to the duct. Posterior to these two structures, you will encounter the hepatic portal vein. The artery is robust, but the bile duct and portal vein are thin-walled, so exercise particular caution in cleaning these latter two structures.

Trace the bile duct toward the liver and gall bladder, dissecting carefully as you go *i* **. Find the point at which the common bile duct is formed by the union of the cystic duct, which drains the gall bladder, and the common hepatic duct, which drains the liver. Continue to dissect the common hepatic duct toward the porta hepatis until you observe its formation from the union of the right and left hepatic ducts.**



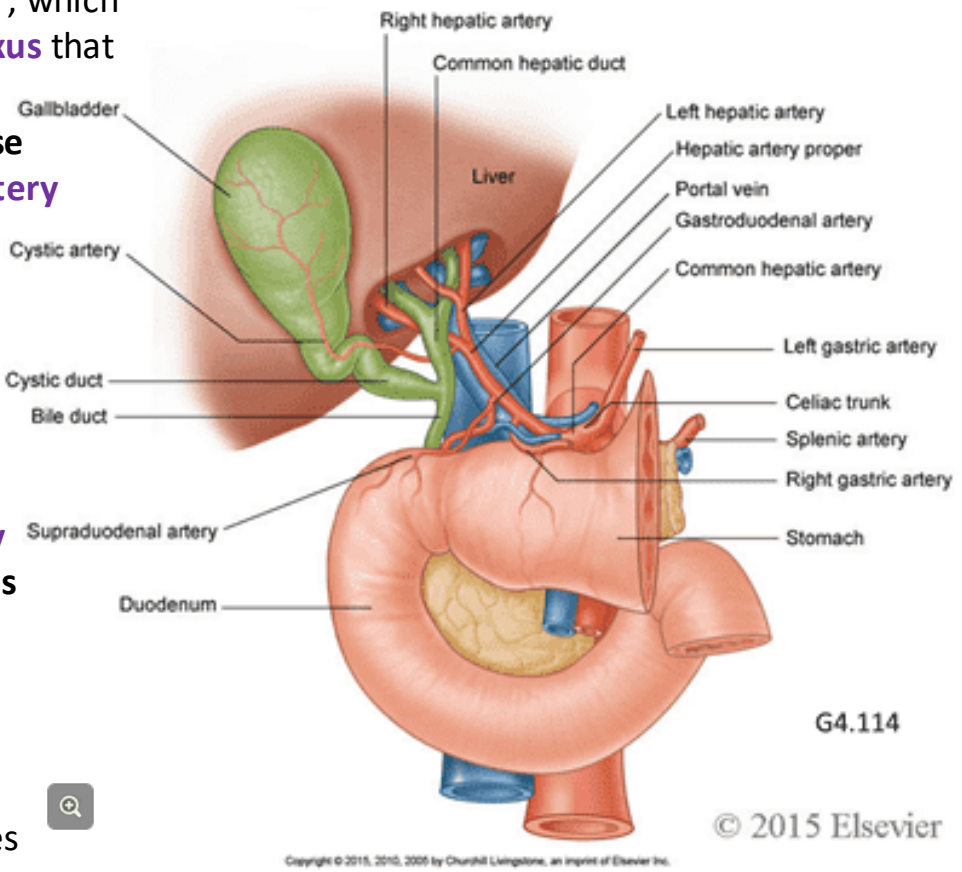
TASK

NOW dissect the hepatic artery proper.

It will appear to be surrounded by tough CT, which is really autonomic fibres of the **celiac plexus** that innervate the liver. **Remove these nerve fibres in order to create a clean dissection. Exercise caution, however, because the right gastric artery often arises from the hepatic artery proper to descend within the hepatogastric ligament to the lesser curvature of the stomach. Maintain the integrity of the right gastric artery.**

Trace the hepatic artery proper toward the porta hepatis, where it bifurcates to form the left and right hepatic arteries. The cystic artery usually arises from the right hepatic artery. It is small and fragile; if possible, identify the cystic artery and clean it as it travels with the cystic duct to the gallbladder.

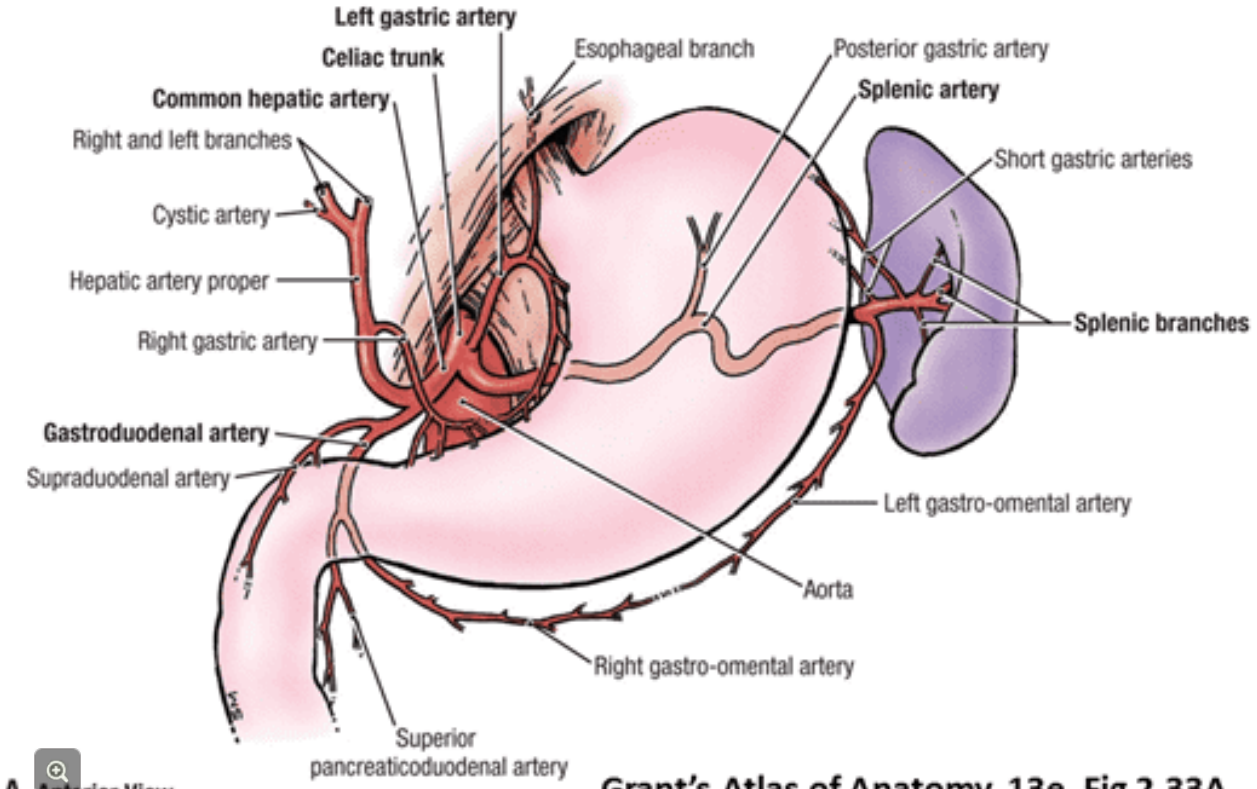
Lymphatic vessels are too small and delicate to dissect, but you might notice hepatic lymph nodes as you work. Remove these lymph nodes in order to create a clean dissection.



TASK

Follow the hepatic artery proper inferiorly until you find its origin

as a branch of the retroperitoneal common hepatic artery. Identify the other branch of the common hepatic artery, the gastroduodenal artery. Continue to clean the gastroduodenal artery as it passes posterior to the first part of the duodenum, and until it bifurcates to form the right gastro- omental (gastroepiploic) artery and the anterior superior pancreaticoduodenal artery.



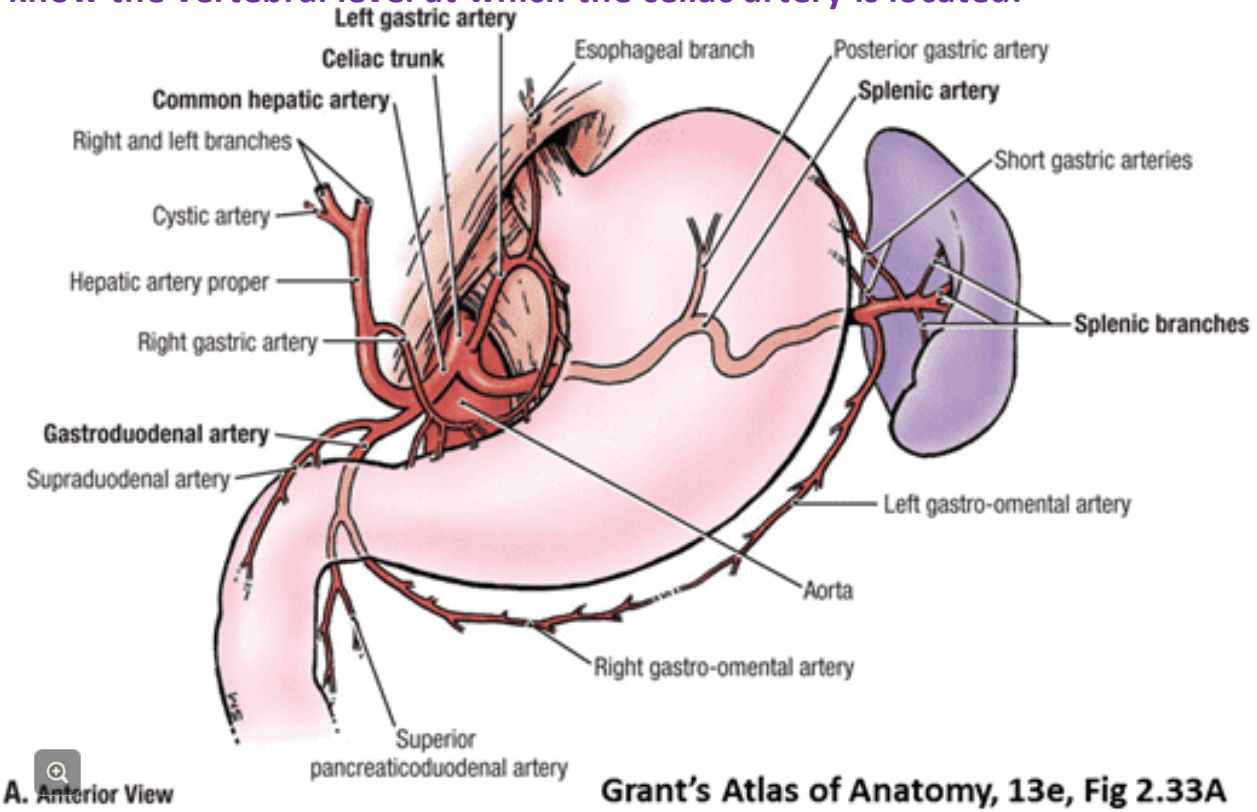
A. Anterior View

Grant's Atlas of Anatomy, 13e, Fig 2.33A

TASK

TURN your attention to the common hepatic artery and clean it toward its origin as a branch of the celiac trunk. Clean the celiac trunk and notice that it is very short, usually less than 2 cm in length. The celiac trunk arises from the anterior surface of the abdominal aorta as it passes through the aortic hiatus of the diaphragm. **Since you know the vertebral level at which the aortic hiatus is located, you know the vertebral level at which the celiac artery is located.**

Identify the other two branches of the celiac trunk, the left gastric artery and the splenic artery. Again, I recommend blunt dissection with large forceps and large scissors.



Grant's Atlas of Anatomy, 13e, Fig 2.33A

Since the last Progress Check, you have **dissected** and **clearly exposed** the following structures:

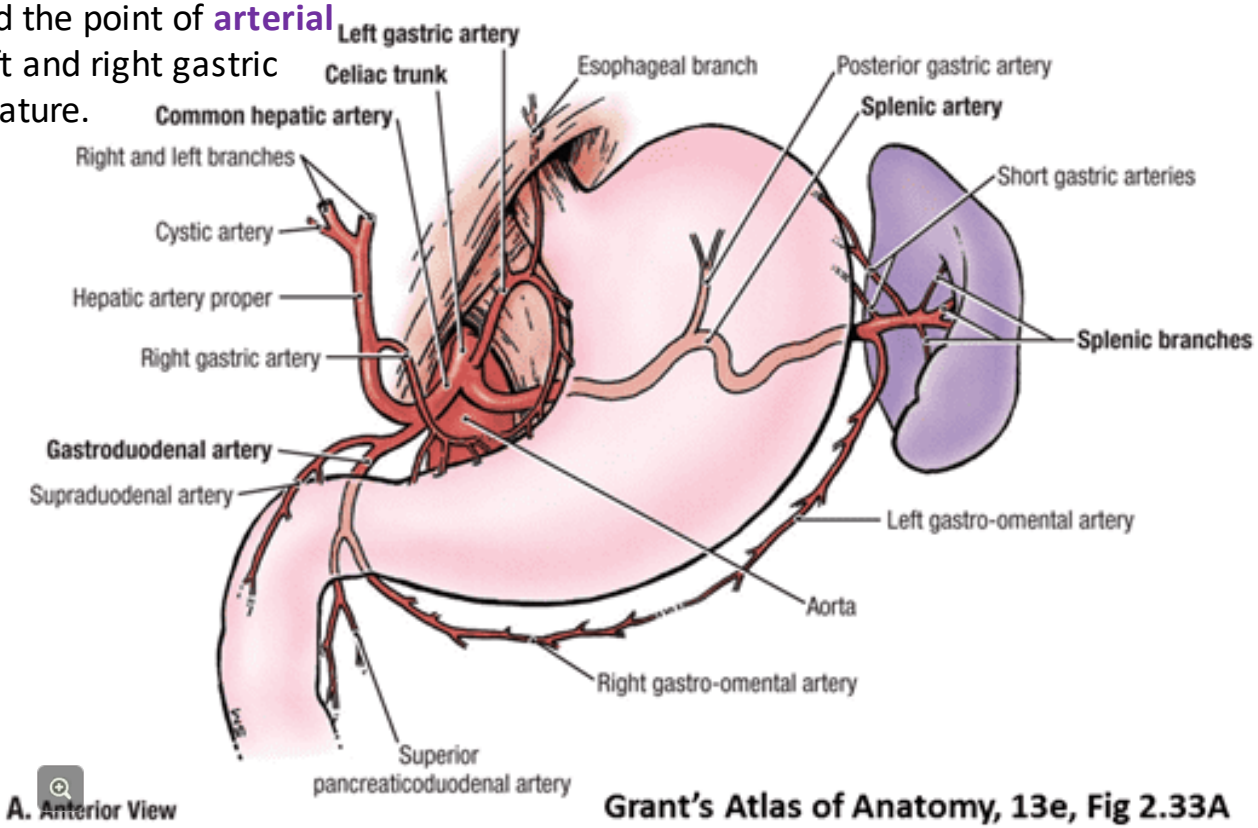
- right gastric artery
- hepatic artery proper, common bile duct, and hepatic portal vein
- cystic artery and cystic duct
- common hepatic duct, right and left hepatic ducts, right and left hepatic arteries
- gastroduodenal artery and the origin of the right gastro-omental artery
- common hepatic artery
- celiac trunk and the origins of the splenic artery and left gastric artery

Pause here to assess your learning. Quiz each other thoroughly. If you are satisfied with your ability to **identify these structures** and **answer these questions**, move on to the next phase of the exercise.

TASK

CLEAN the left gastric artery toward the junction of the esophagus and stomach.

There, identify its esophageal branch ascending through the esophageal hiatus to supply the terminal third of the esophagus. Trace the continuation of the left gastric artery through the lesser omentum, along the lesser curvature of the stomach. Ideally, you will find the point of arterial anastomosis between the left and right gastric arteries along the lesser curvature.

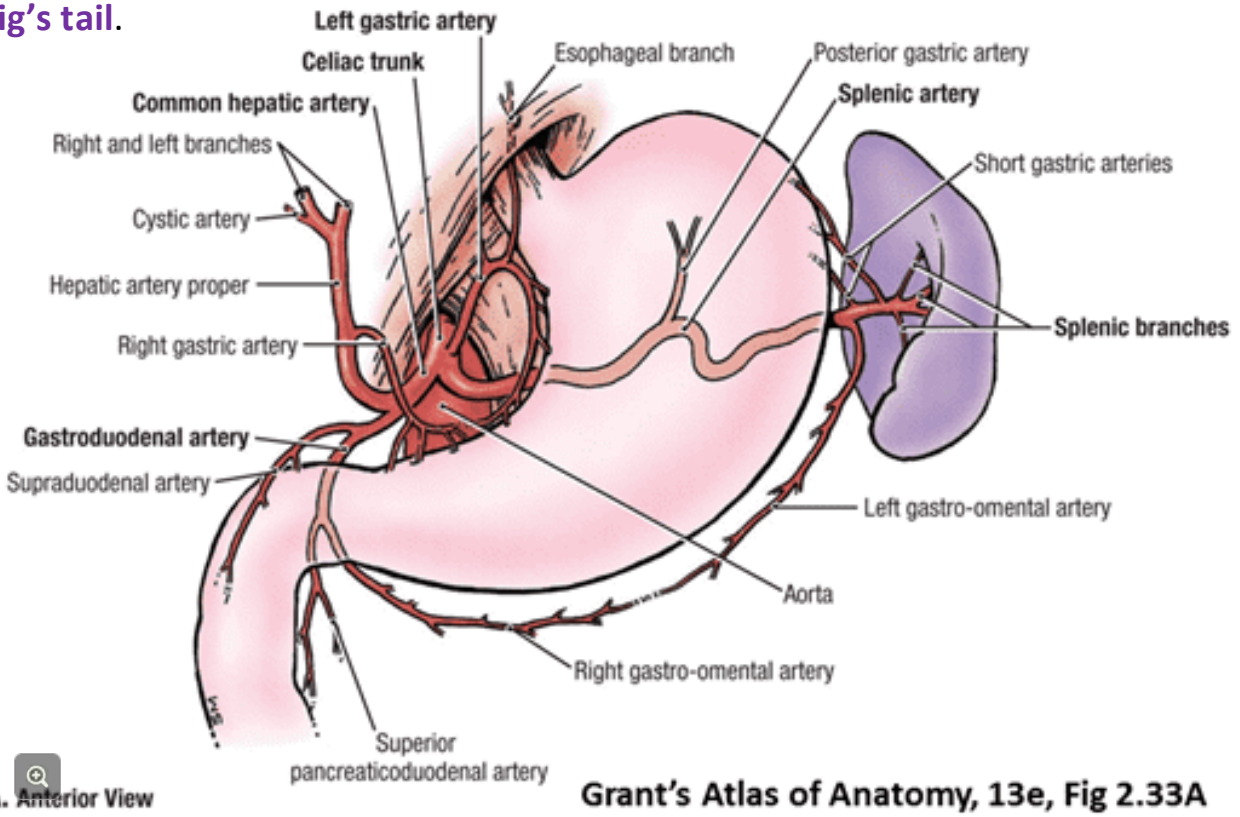


Grant's Atlas of Anatomy, 13e, Fig 2.33A

TASK

RETURN to the celiac trunk and clean the splenic artery

The **splenic artery** runs to the left retroperitoneally, in close association with the superior border of the pancreas. **Clean the splenic artery with blunt dissection and note its relationship to the superior edge of the pancreas.** You will find that the splenic artery is characteristically helical in its course, and is thus **reminiscent of a pig's tail**.



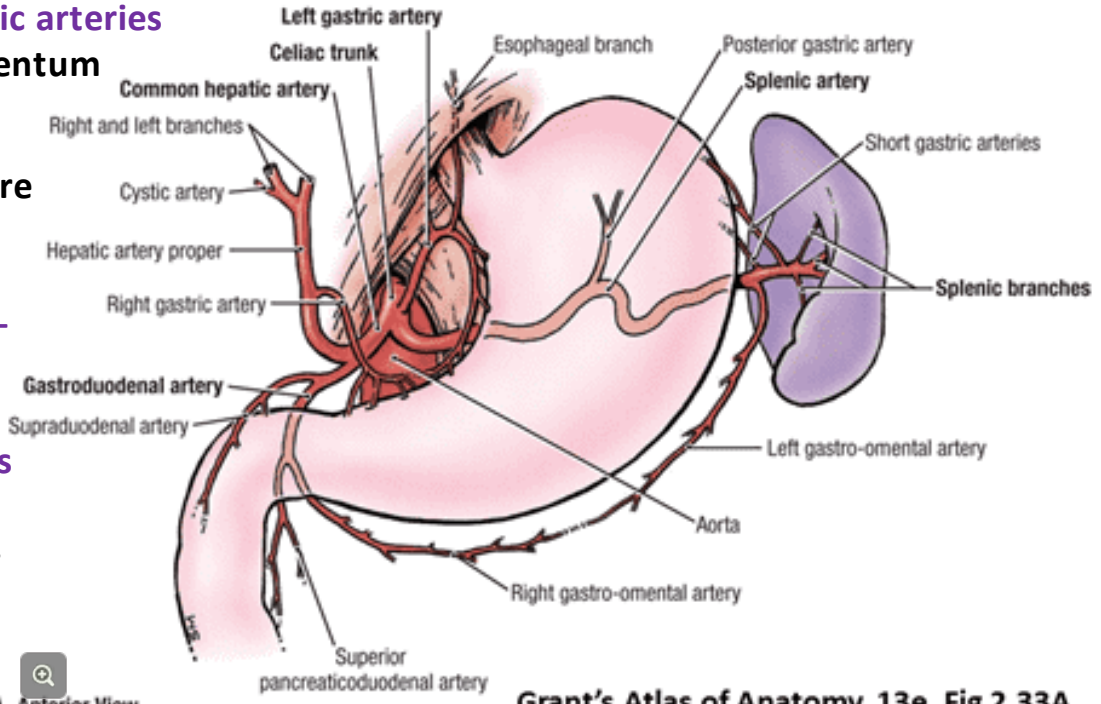
Grant's Atlas of Anatomy, 13e, Fig 2.33A

Turn your attention to the greater omentum. Running within the greater omentum, **about 2 cm from the greater curvature of the stomach**, are the left and right **gastro-omental (gastro-epiploic) arteries**.

TASK

Adjacent to the body of the stomach, break through the greater omentum using blunt dissection and identify the left gastro-omental (gastroepiploic) artery. Trace it back toward the left until you find its origin as a branch of the splenic artery. Clean the splenic artery in the hilum of the spleen as well as back toward the celiac trunk. Look for the short gastric arteries which ascend within the greater omentum to the fundus of the stomach.

About 2 cm from the greater curvature of the stomach, in the region of the pylorus, break through the greater omentum to identify the right gastro-omental artery. Clean it to the left along the greater curvature; ideally you will find the point of anastomosis of the right and left gastro-omental arteries. Now follow the right gastro-omental artery to the right until you find its continuation with the gastroduodenal artery, which you identified earlier.



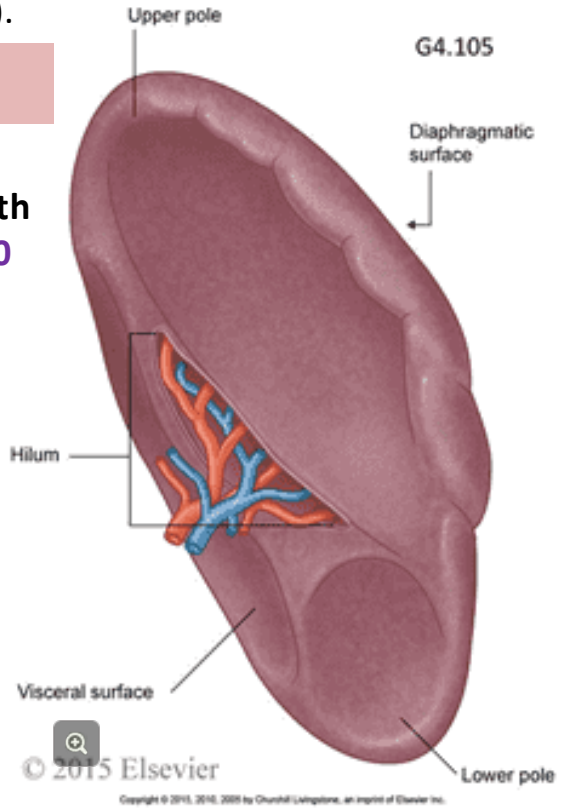
A. Anterior View

Grant's Atlas of Anatomy, 13e, Fig 2.33A

Because of its large blood volume, the spleen, if lacerated, bleeds profusely into the peritoneal cavity, as may occur as a result of a rib fracture or a penetrating wound. Also, it is important to remember that the spleen may be punctured accidentally during a pleural tap (thoracentesis).

TASK

USING your left hand, retract the fundus of the stomach to the right and grasp the spleen with your right hand. Pull the spleen anteriorly in order to identify its features. Note the smooth diaphragmatic surface of the spleen, which lies at the level of ribs 9, 10 and 11. Identify its sharp borders and its visceral surface. You have already observed the four organs adjacent to the visceral surface of the spleen: the stomach, the pancreas, the left kidney and the transverse colon at its left colic flexure.



The spleen, as you know from your understanding of the immune system, processes blood for antigen and for spent formed elements. The spleen is wholly intraperitoneal, except at its hilus.

INFO

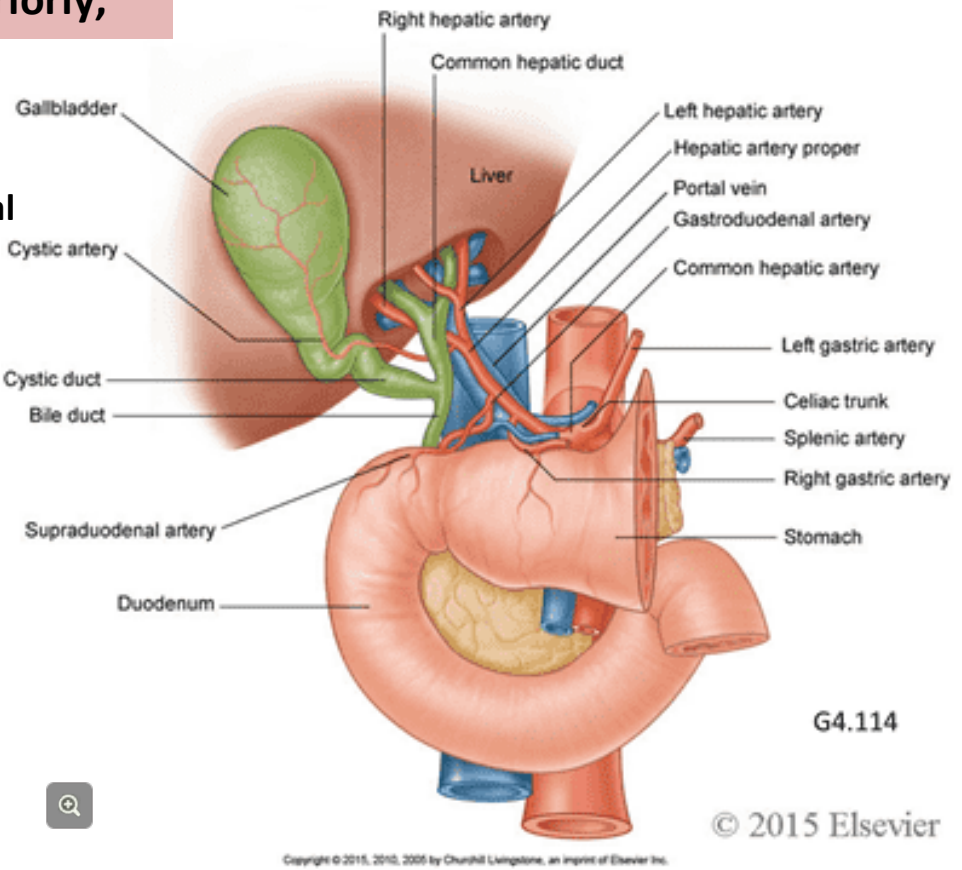
SPLEEN

Thus, the spleen's relationship to **ribs 9, 10, and 11** of clinical importance in **rib fractures** and **thoracentesis**. A variety of infections and disease processes might cause an enlarged spleen (**splenomegaly**). If, during physical examination, the spleen can be palpated inferior to the costal margin, it is considered to be enlarged.

Now revisit the hepatoduodenal ligament and again identify the hepatic portal vein where it lies posterior to both the hepatic artery proper and the bile duct.

TASK

CLEAN the hepatic portal vein superiorly, into the porta hepatis and identify its terminus as the right and left portal veins. Now clean the hepatic portal vein inferiorly until it becomes retroperitoneal and passes posterior to the first part of the duodenum.



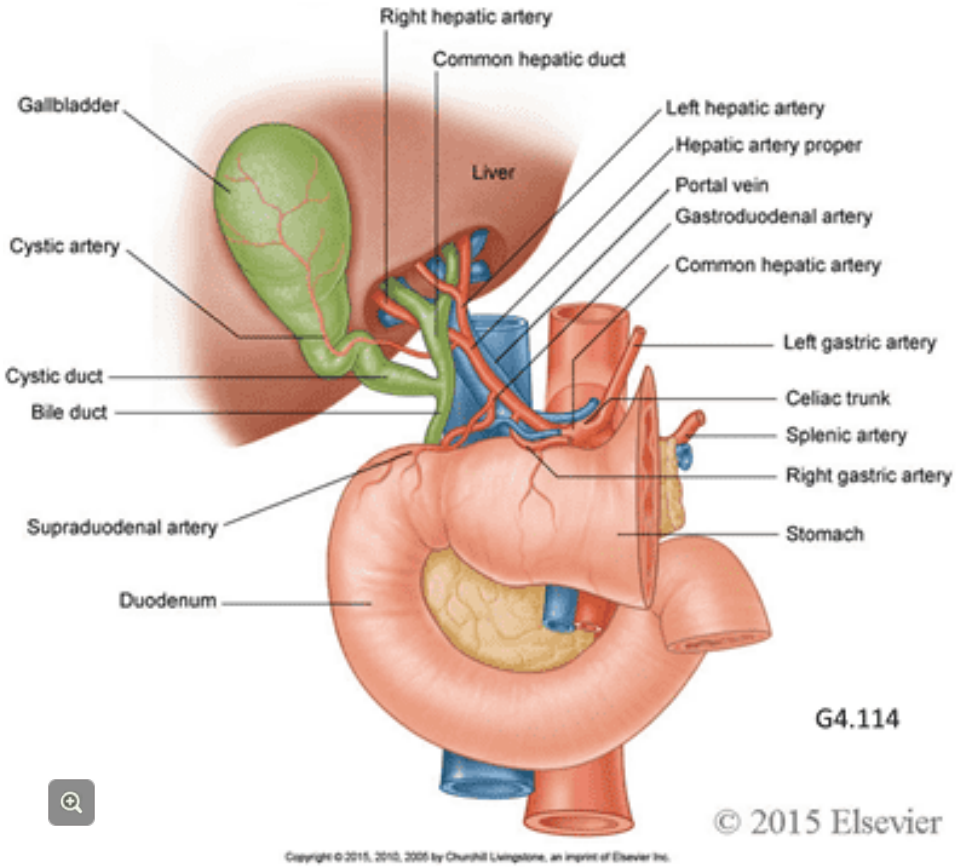
The gallbladder stores and concentrates bile. After death, the active processes that contain bile within the lumen of the gallbladder cease, and bile leaches across the wall of the gall bladder, staining adjacent organs dark green.

TASK

ONE colleague should retract

the inferior border of the right lobe of the liver, and the other can work the gall bladder free using blunt dissection. Identify the fundus, body and neck of the gallbladder.

Using scissors, cut through the wall of the gallbladder, starting at the fundus and continuing through the body and neck, and into the cystic duct. Gallstones might be present; if so, remove them.



Since the last Progress Check, you have **dissected** and **clearly exposed** the following structures:

- the esophageal branch of the left gastric artery passing through the esophageal hiatus
- the full course of left gastric artery and its anastomosis with the right gastric artery
- the splenic artery adjacent to the superior border of the pancreas, and into the hilum of the spleen
- the short gastric arteries ascending to the fundus of the stomach
- the full course of the left gastro-omental artery, from its origin as a branch of the splenic artery to its anastomosis with the right gastro-omental artery
- the full course of the right gastro-omental artery from its origin as a branch of the gastroduodenal artery to its anastomosis with the left gastro-omental artery
- hepatic portal vein and right and left portal veins
- the fundus, body and neck of the gall bladder

If you are satisfied with the **quality of your dissection**, and your **ability to identify these structures** and **answer these questions**, call your TA over for confirmation and for permission to clean up.