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Fetal pig dissection lab with detailed images

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This lab is designed to provide students with detailed dissection instructions of the fetal pig, including the digestive, respiratory, cardiac, urinary, and reproductive systems. Color pictures are provided for each step to help students ensure that they are removing the correct material and making the correct cuts. Information is provided throughout the lab about the function of each organ students observe. This lab may be used for majors, and can also be adapted for use in a non-majors, general education course

Keywords: Anatomy, organ systems, fetal pig dissection

Introduction

The fetal pig is used frequently during anatomy units in both major and non-major courses because the pig has a similar anatomy to humans, is reasonably priced, and readily available from multiple sources. In our non-majors biology course, Biology in Society, we use the fetal pig to introduce our students to basic anatomy and the function of the major biological systems within humans. We wrote this lab because I have struggled to find a fetal pig dissection lab that contained sufficient information for my course. I wanted a lab that had enough details for students to make cuts and observe each major organ with minimal assistance from me. When managing a lab with up to twenty students I am not always available to answer basic questions as they occur. Detailed instructions reduce the questions and allow me to circulate around the lab room more quickly. I also needed a lab that included information about each system as students are completing the dissection because I discuss the function of digestive, cardiac, respiratory, and reproductive systems in the lab instead of the lecture portion of the course.

This lab provides detailed, step by step instructions for how to dissect the fetal pig thoracic and abdominal cavities, starting with diagrams of the first cuts. High quality, color images are provided throughout so that students can easily determine how to access each organ. After students have revealed each major organ or organ systems, text is provided to explain what they are looking at and the function of each visible organ. Basic differences between human and pig anatomy are also included when relevant. The main portion of the lab is designed to be completed within a two-hour lab period for non-Biology major students. Some details, such as the dissection of organs themselves, are not included for the non-Biology students. We have provided instructions for these dissections in the appendix in case you wish to include them for a biology majors course. However, if you wish to include these additional experiences, we recommend using a three-hour lab period or splitting the lab across two lab periods.

The two main goals of this lab are to show students the physical relationship between different organs and to introduce them to the basic function of the digestive, respiratory, urinary, and reproductive systems.

Student Outline

Lab 5: Fetal Pig Dissection

Authors: Dr. Beth Cantwell and Dr. Laurel Rodgers with assistance from Laurel Nida

LAB OBJECTIVES

- Identify components of the major organ systems within the fetal pig
- Compare and contrast the anatomy of the fetal pig and that of a human
- Describe the function of each major organ system and the components of the system

PRELAB READING

Because human cadavers are expensive and not practical for most undergraduate courses, we cannot use them in our study of anatomy. Instead, this week we will dissect fetal pigs. There are many anatomical similarities between the organ systems of pigs and humans, making it an ideal specimen to study the basics of anatomy. Throughout this lab, we will discuss the function of each major organ system and any differences that may exist between the pig and the human.

Body cavity	**Sub-cavity**	**Further division**	**Contents**
Dorsal	Cranial cavity		Brain
	Vertebral cavity		Spinal cord
Ventral	Thoracic cavity	Mediastinum	Heart, great vessels, thymus, trachea, esophagus
		Pleural cavities (2)	Lungs
	Abdominopelvic cavity	Abdominal cavity	Most digestive organs, spleen, some urinary organs and endocrine glands, umbilical cord
		Pelvic cavity	Reproductive organs, some urinary organs, rectum

Table 1. The division of the cavities within the body and some of their major components. It is important to remember that there are a variety of smaller organs, vessels and nerves also found within these cavities.

While dissecting your fetal pig, it is important to be aware of a few differences between an adult and a fetal pig (and human for that matter). First, the fetal pig has an umbilical cord because it is harvested prior to birth. The umbilical cord is used by mammals to allow oxygen, nutrient, and waste exchange between the mother and the developing fetus. If an umbilical cord does not develop properly, the growth of the fetus may be halted or significantly slower than normal. There are additional anatomical differences, such as heart structure, that we will point out as necessary during the lab itself.

There are two body cavities in the pig and the human (Table 1), the dorsal body cavity and the ventral body cavity. Due to time constraints, we will not dissect the dorsal body cavity, which spans from the head and along the back (like the dorsal fin on a shark!). The ventral body cavity (Fig. 1) is divided into two large sections by the diaphragm, a dome-like skeletal muscle that contracts while breathing to assist with air inhalation. Above the diaphragm, the thoracic cavity is further divided into the mediastinum and pleural cavities, which are separated by thin membranes. Below the diaphragm is the abdominopelvic cavity, which is also further divided. However, the abdominal and pelvic cavities are not defined by membranes.

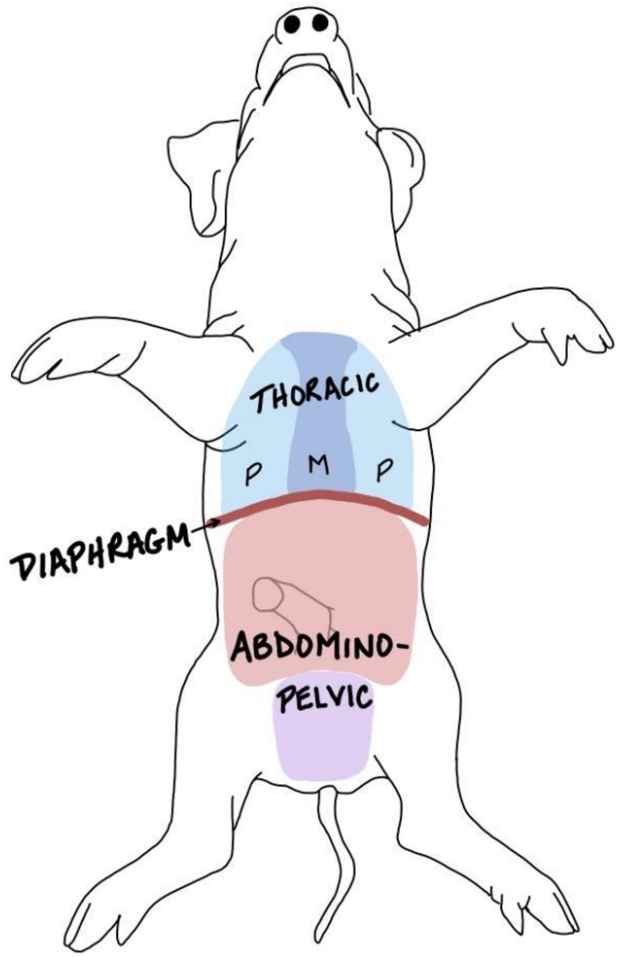


Fig. 1. The ventral body cavity is divided into two large sections. The thoracic cavity contains three smaller cavities that are physically separated by membranes. These are the pleural cavities (P) and the mediastinum (M). The abdominopelvic cavity is open. The division of this cavity into abdominal and pelvic cavities is based on skeletal landmarks.

In this dissection, you will open the ventral body cavity (Fig. 1) and view a variety of organs. Table 2 lists the organ systems you will explore, their general functions within the body, and the organs you will be able to see in lab. Note that these systems have additional structures we are not observing today, and so they are not listed in the table.

Table 2. The systems we will explore, their general functions, and the specific organs that will be dissected within the ventral body cavity.

Organ system	General system function	Organs and structures we will observe
Cardiovascular	Circulates blood throughout the body	Heart, major vessels, arteries, veins, umbilical cord
Respiratory	Site of O_2 entry to and CO_2 exit from the body	Lungs, trachea, bronchi
Digestive	Site of ingestion, mechanical and chemical breakdown of food, absorption of nutrients, and defecation of waste	Mouth, esophagus, stomach, large intestine, small intestine, pancreas, liver
Immune	Finds and destroys pathogens and abnormal or infected cells	Spleen, thymus
Urinary	Filters the blood and removes water-soluble waste, which is excreted as urine	Bladder, kidney
Reproductive	Produces gametes and develops offspring	Testis, ovaries, uterus
Endocrine	Produces and secretes hormones to regulate body function	Pancreas, thyroid

Information about each organ can be found throughout the lab itself. So, without further ado, let's dissect something!

DISSECTION INSTRUCTIONS

First: Know your dissection tools!
There are a variety of tools that you will use while dissecting in lab. Getting a feel for which tools are suited to their own specific applications and which can multitask will help you more easily isolate and identify organs. You may notice that scalpels are not listed among these tools. They are easy to misuse, resulting in dissecting errors and personal injury, so we will not use them!

Figure 2 shows the dissecting tray and the tools that you will find most useful. Note that the blue pad is chemical-resistant, but not sharps-resistant. Please do not stab it with your dissecting tools!

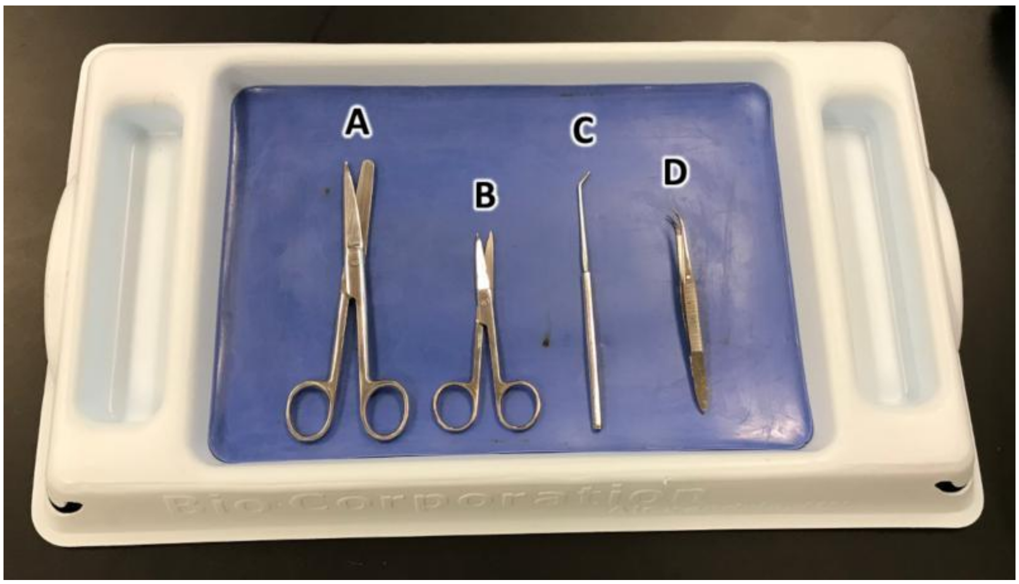


Fig. 2. A dissecting tray containing the tools you will find most useful in this dissection.

A) Large, blunt-tip scissors: When cutting through skin and cartilage, large scissors are a must. Using large scissors with at least one blunt blade will help prevent internal damage to the pig's organs while providing you with enough cutting force to get through dense tissues. Large scissors are not useful for delicate tasks.

B) Small, sharp scissors: This tool is useful for detail trimming, particularly when you have a clear view of what you are cutting. Because the tips are sharp, you can make very small cuts with care.

C) Blunt probe: People frequently think that sharp objects are more appropriate in dissection, but a blunt probe is hands-down one of the most useful tools available. The blunt probe allows you to separate structures from each other and surrounding tissues without the risk of puncturing and possibly tearing them in the process. Having a blunt probe around also allows you to point things out to your lab partners without risk of damage.

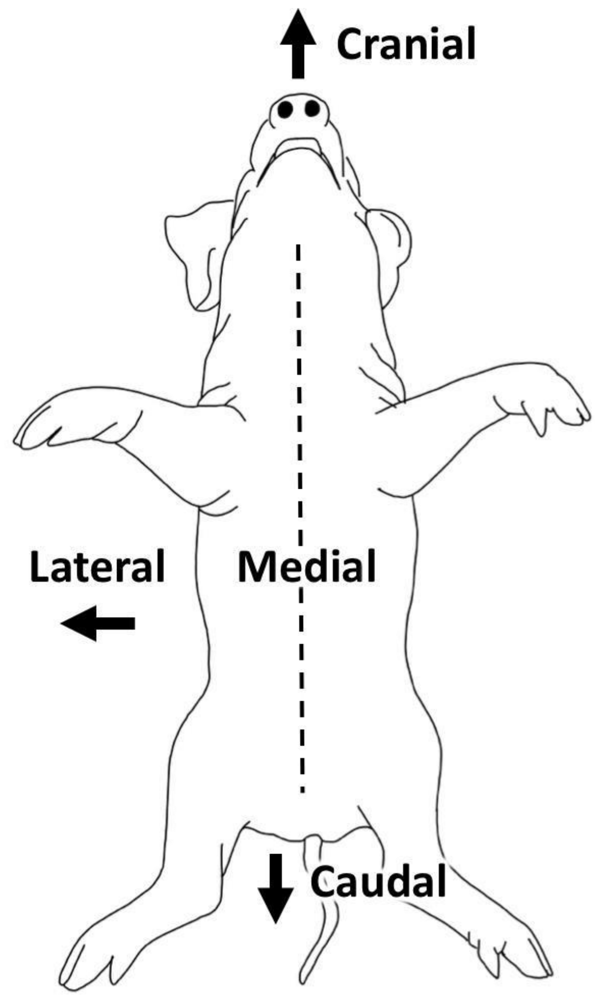
D) Small, curved forceps: Because we are dissecting a fairly small specimen and focusing on internal organs, there is not a large amount of excess tissue to be removed. Therefore, small forceps are the best choice in this particular dissection. The curvature in the forceps is useful because it allows you to either focus on a particular area with the tips, or on a broader area by clasping tissue at the curve.

Second: Know your directional terms!

Figure 3 demonstrates some common directional terms that make describing organ position more straightforward. These terms will be used throughout your dissection instructions.

- **Cranial** – toward the head
- **Caudal** – toward the tail
- **Dorsal** – toward the upper side
- **Ventral** – toward the underside
- **Medial** – toward the midline
- **Lateral** – toward the side

***Pro tip**: Two other terms that get used frequently are superficial and deep. **Superficial** structures are closer to the surface, and **deep** structures are, well, deep.*



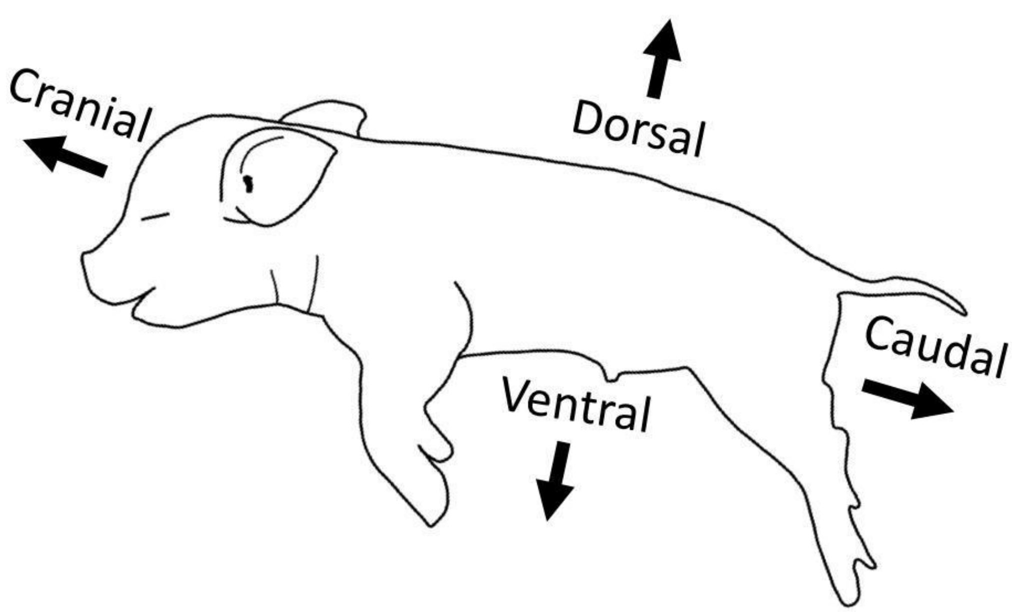


Fig. 3. Directional terms demonstrated on the fetal pig from a ventral view (top) and a lateral view (bottom).

Making the Initial Incisions

The initial incisions that you will make are represented in Figure 4. The initial incision, shown in red, crosses the upper abdominal region and should be made first. The thoracic incision (blue) will allow you to access the thoracic cavity and the abdominal incision (green) will open the abdominopelvic cavity. A condensed set of step-by-step instructions begin on the next page and are followed by more detailed instructions with helpful images.

***Protip**: Not sure whether your pig is a male or female? The male has a urogenital opening just under the umbilical cord (Fig. 4). Males also have an enlarged scrotum between the legs and ventral to the tail. Female pigs have a visible vaginal opening located ventral to the anus (Fig. 4).*

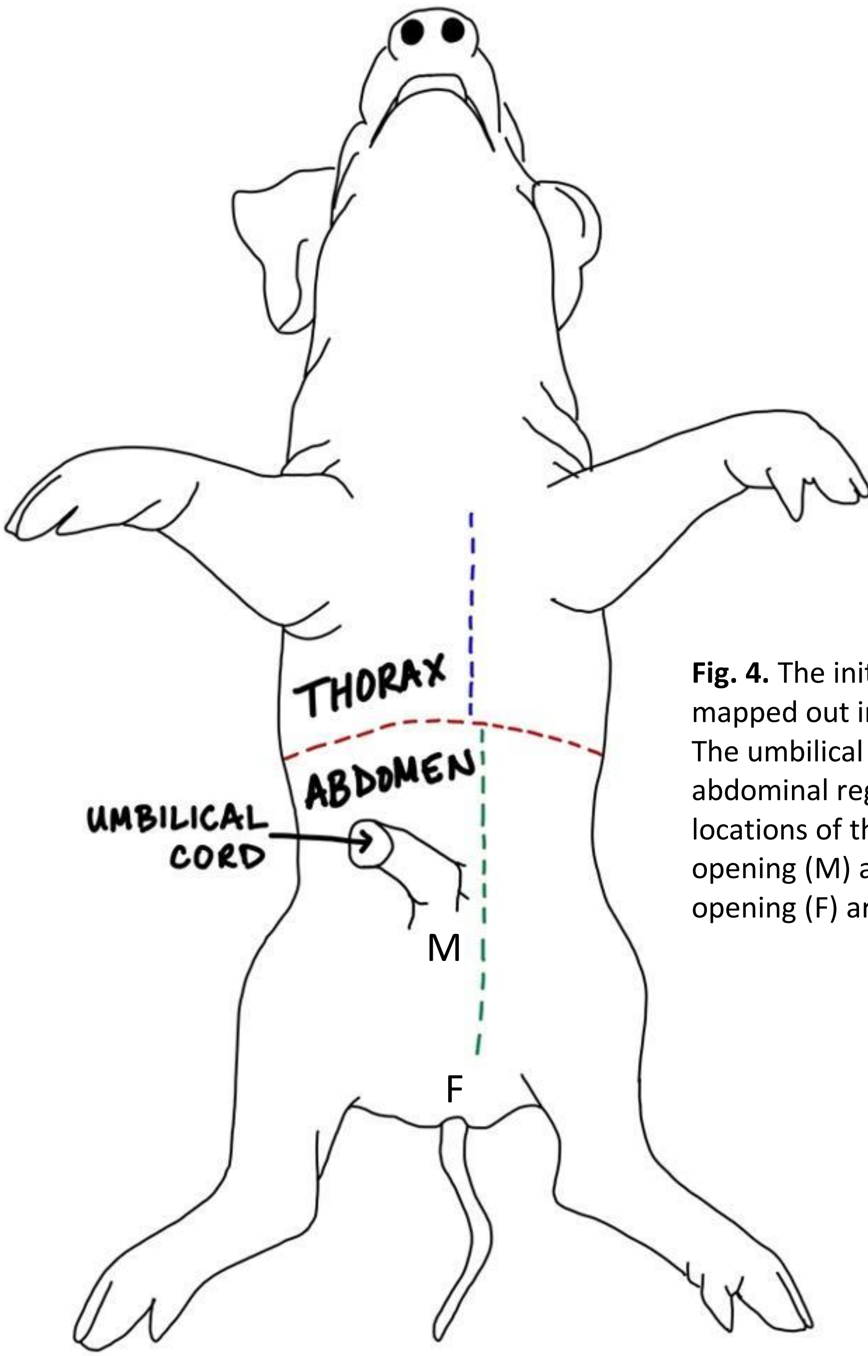


Fig. 4. The initial incisions are mapped out in red, blue and green. The umbilical cord is located in the abdominal region. The differing locations of the male urogenital opening (M) and the female vaginal opening (F) are demonstrated.

Table 3. Quick-view instructions for making the initial incisions. Note that Figure 4 is on the previous page, while the others start on the following page. Detailed instructions begin on the next page.

	Steps involved	Useful Figures
GOAL 1 Cut the horizontal incision (Fig. 4 red line)	● Horizontal cut under the rib cage ● Start carefully to avoid organ damage ● Widen the incision, keeping scissor tips up	5-11, 17
GOAL 2 Clean the pig	● Drain excess fluid ● Rinse with water if needed ● Pat dry	n/a
GOAL 3 Pierce the diaphragm	● Cut just under the sternum *Note: This muscle is thin, so make your cut shallow!*	12-13
GOAL 4 Cut the vertical thoracic incision (Fig. 4 blue line)	● Nudge the heart and lungs aside ● Cut to one side of the sternum, keeping scissor tips up ● End between the two forelimbs ● Cut the diaphragm away from the body wall	13-15, 17
GOAL 5 Cut the vertical abdominal incision (Fig. 4 green line)	● Nudge organs aside ● Cut to one side of the umbilical cord, keeping scissor tips up ● End at the pelvis	16-17

Initial Incisions: Detailed Instructions

First, palpate the rib cage (use your fingers to feel it) until you have found its lower margin. You can start by finding the sternum, a wide, flat bone that sits under the chest wall, and then palpate caudal and lateral to identify the lower margin of the rib cage.

Fig. 5. Palpating the sternum.

Fig. 6. Palpating the rib cage lower margin.

Next, pinch the skin in your fingers and use scissors to cut a small incision into the skin just below the rib cage on one side. Do not try to cut too far all at once, as you may damage internal organs.

Fig. 7. Making the first cut.

Frequently, the first cut will not go completely through the body wall. You may need to make additional small cuts to make it entirely through to the abdominopelvic cavity. Once you have made a small breach through the entire wall, the skin and muscle will easily lift away from the organs within the cavity.

To continue the initial incision, pull up on the skin to lift it away from the internal organs. Inserting the blunt end of the scissors into the abdominal cavity, hold the skin up and cut from one side of the abdomen to the other, following along the underside of the rib cage. That makes this incision a bit curved.

***Protip**: Orient the scissors parallel to the lab bench to keep the tips up and avoid damaging the abdominal organs!*

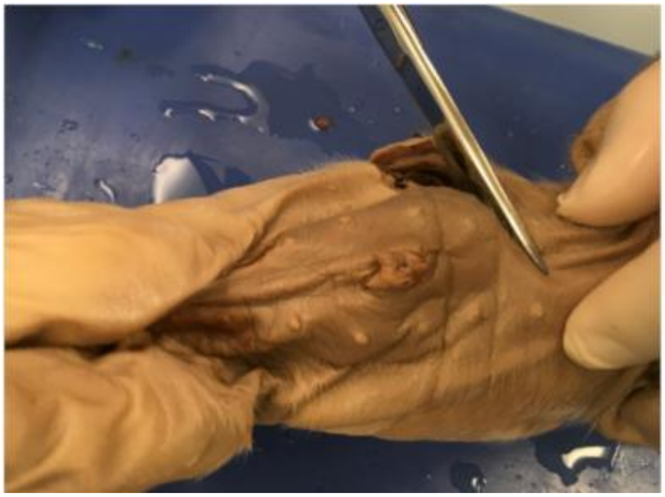


Fig. 10. Keep scissor tips up when cutting.

Fig. 11. The completed initial incision.

Following the initial incision, it is normal for congealed blood and fixative to drain from the abdominal cavity. You may choose to turn the pig over to drain excess fluid. If there is a significant amount of fluid leakage, use paper towels to blot it.

In preparation for the thoracic incision, it is necessary to pierce the diaphragm. The diaphragm separates the thoracic and abdominal cavities, and is visible above the liver (Fig. 12). Perforating the diaphragm also allows air to enter the cavity, which introduces additional space between the thoracic wall and the internal organs.

Fig. 12. The diaphragm is visible through the initial incision.

Piercing the diaphragm below the sternum also allows you to see and avoid damage to the heart (Fig. 13).

***Protip**: Keep your scissor tips up to avoid damage to the thoracic organs as you make the thoracic incision!*

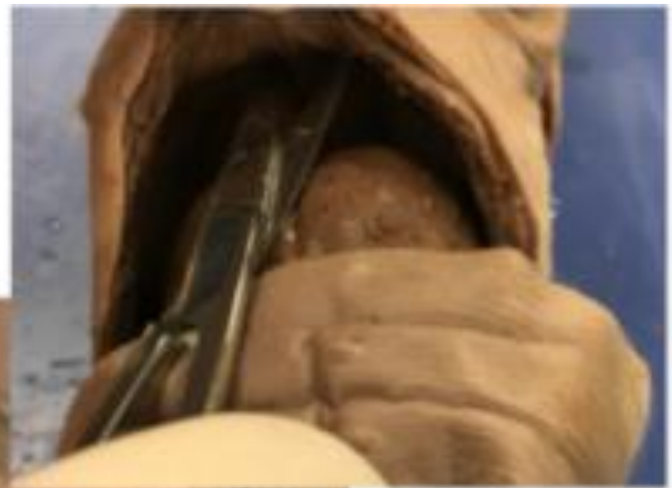


Fig. 13.
(top) Perforation of the diaphragm.
(middle) Visualizing the heart.
(bottom) The thoracic incision.

After palpating to find the sternum, you should cut to either its left or right. Do not attempt to cut through the bone itself!

***Protip**: It is easier for right-handed people to cut to their right, and lefties to their left.*

For now, end your incision between the two forelimbs. It is better to cut less rather than more… you can always extend your incision as needed.

Using your fingers, shift away any organs that are nearby and then detach the diaphragm by cutting it away from the body wall (Fig. 14). This step will allow you to observe its position relative to the internal organs without tearing it.

Fig. 14. To complete the thoracic incision, cut the diaphragm away from the body wall as demonstrated by the white dashed lines.

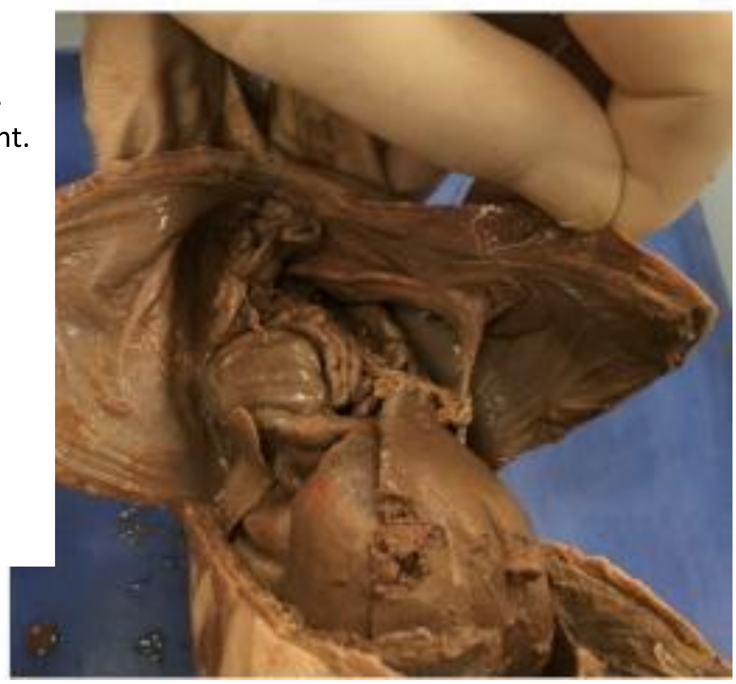
Fig. 15. The completed thoracic incision.

To access the abdominopelvic cavity, start at your initial incision (Fig. 16) and keep your scissor tips up while cutting to one side of the umbilical cord as shown in Figure 4. It is important to be careful here because there are midline vessels associated with the umbilical cord. This incision should be made slowly, with several pauses to check for organs as you continue. Stop when you reach the pelvic region. As with the thoracic incision, you can always elongate the abdominal incision later (Fig. 17).

The initial incisions of your dissection have now been completed.

Fig. 16. It is helpful to lift the skin of the abdominal region and use your finger to ensure the abdominal organs are not clinging to it. Please note that this photo has been taken with the head oriented down and the tail oriented up. You can see there is a great deal of space to work in.

Fig. 17. The completed abdominal incision with the two flaps of skin reflected back. The umbilical vessels are visible on the skin flap to the right.



What Can I see Now? The Umbilical Cord

There is no additional dissection needed to view the umbilical cord (Fig. 18). However, you may choose to cut into the membrane that encloses the two umbilical arteries (Fig. 19).

Protip: *When you pull back the skin at the abdominal incision, go slowly. If you open the incision too wide, the umbilical vein detaches easily (Fig. 18). If your vein detaches, don't worry about it. It will happen eventually anyway!*

<u>Umbilical cord structures to identify:</u>

- Umbilical cord
- Umbilical vein
- Umbilical arteries

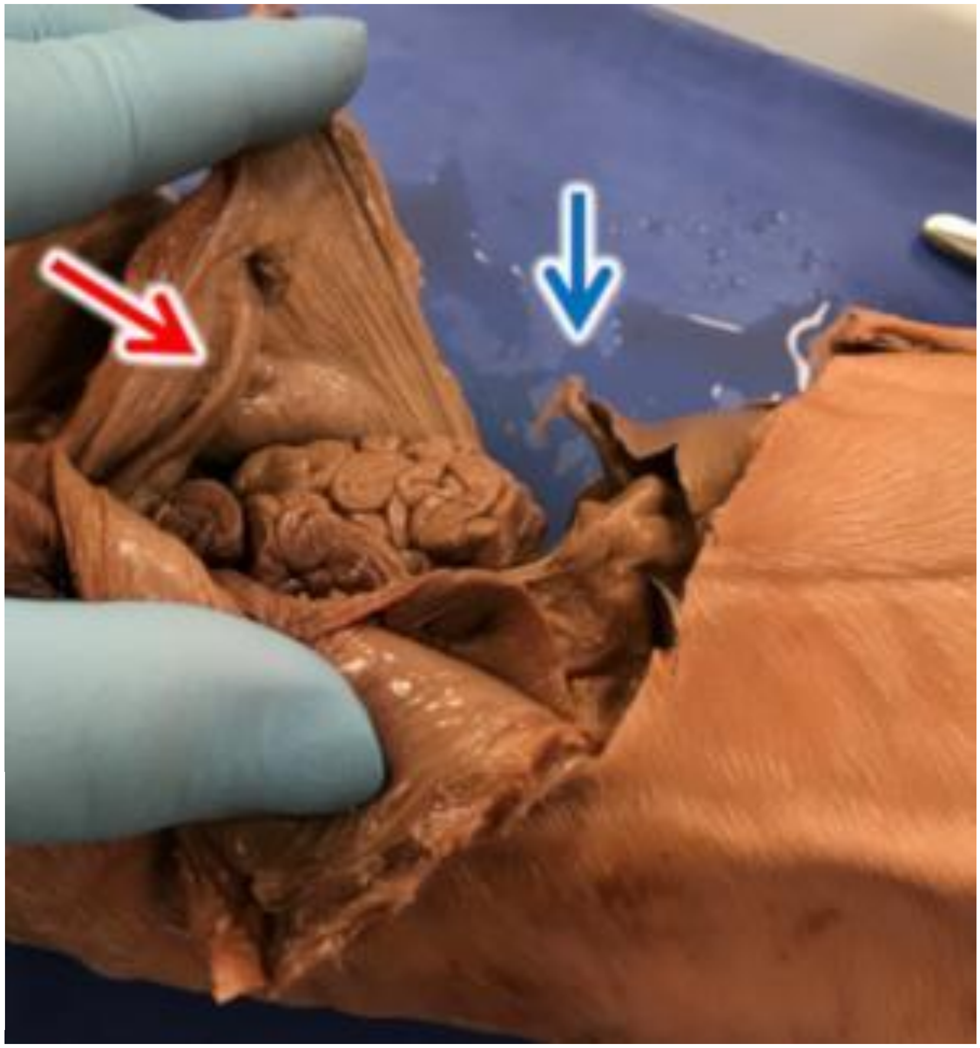


Fig. 18. The umbilical cord contains two umbilical arteries (red arrow) and one umbilical vein (blue arrow).

The **umbilical cord** connects the fetal blood supply to the placenta, which is an organ found only in pregnant females. In the placenta, the maternal blood supply and fetal blood supply circulate close to one another, allowing the fetal blood to pick up oxygen and nutrients from and drop off waste products into the mother's blood. The umbilical cord contains one **umbilical vein** and two **umbilical arteries**.

The umbilical vein collects oxygen- and nutrient-rich blood from the placenta and then travels cranially and dorsally past the liver and other organs to deliver that blood to the inferior vena cava, a large vein that goes directly to the heart. Therefore, this blood is quickly circulated around the body. The umbilical arteries deliver depleted blood to the placenta for exchange with the maternal blood. They branch off of large arteries in the pelvis, which is why their path carries them up the ventral abdominal wall.

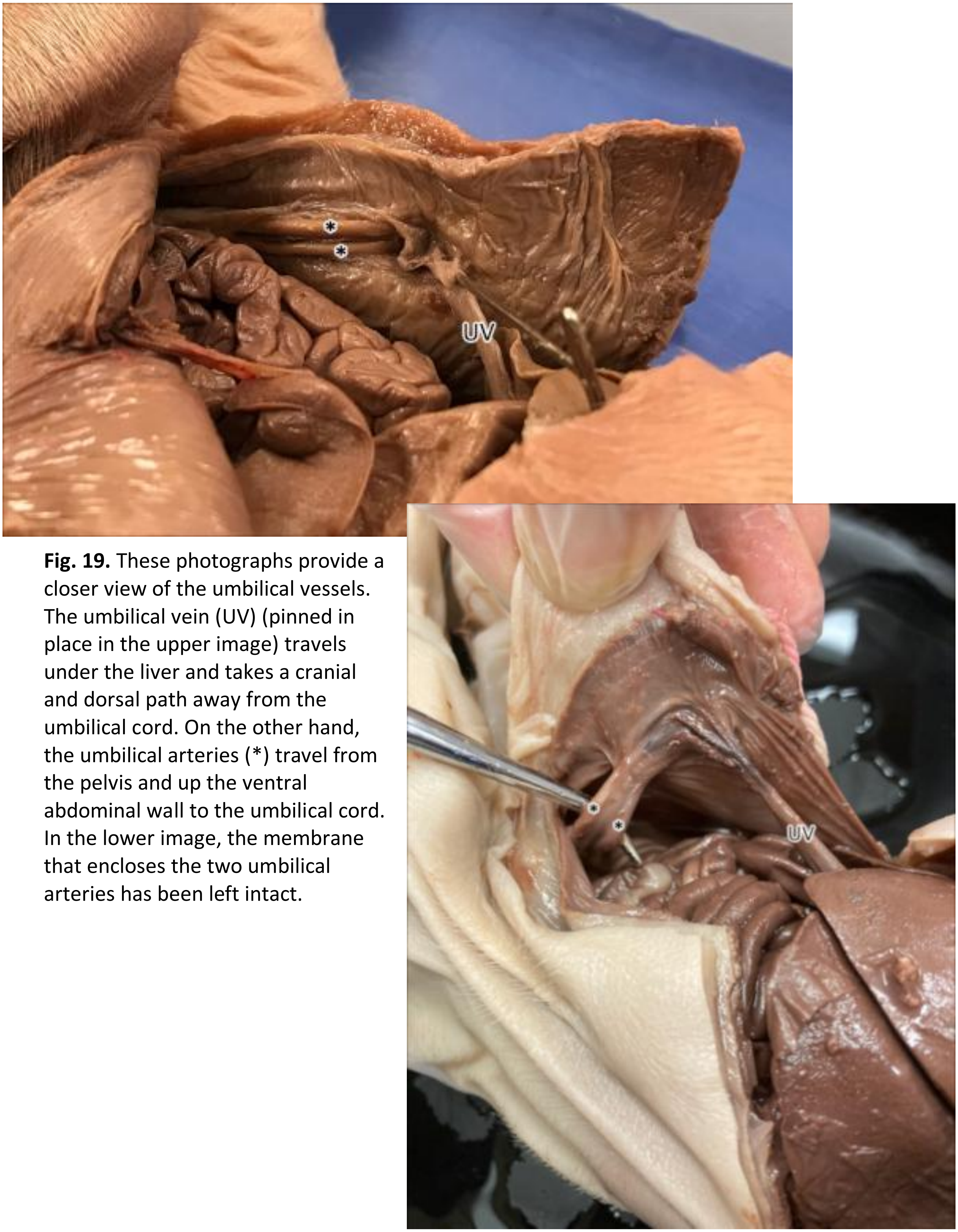


Fig. 19. These photographs provide a closer view of the umbilical vessels. The umbilical vein (UV) (pinned in place in the upper image) travels under the liver and takes a cranial and dorsal path away from the umbilical cord. On the other hand, the umbilical arteries (*) travel from the pelvis and up the ventral abdominal wall to the umbilical cord. In the lower image, the membrane that encloses the two umbilical arteries has been left intact.

Preparing to Dissect the Cavities: Instructions

It is easiest to dissect the cavities when you don't have to hold the fetal pig in one place. Therefore, we use the notches on the corners of the dissection tray to tie down the arms and legs (Fig. 20).

Fig. 20. This pig is ready for dissection of the cavities.

It is important to put them on securely. We recommend the method demonstrated in Figure 21.

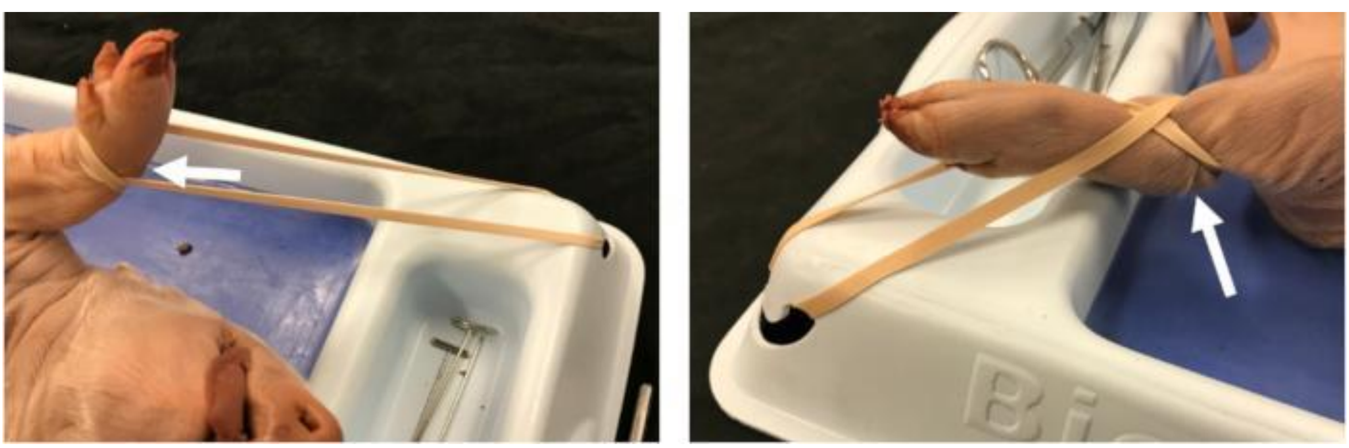


Fig. 21. Properly securing each leg will ensure that your rubber band tie-downs do not snap suddenly. On the forelimbs (left), wrap the over the dorsal side of the wrist first (arrow), then twist it on the underside of the wrist before securing it to the tray. On the hindlimbs (right), loop the rubber band up over the heel (arrow), then twist over the ventral side of the ankle and attach it to the tray.

Dissecting the Thoracic Cavity

There are a variety of structures that we will identify in the thoracic cavity, but you will need to dissect in stages, because these structures are layered on top of each other within this small space. Therefore, you will carefully dissect and observe structures, only to remove them so that you can see what lies beneath. We will accomplish this process in four stages. At the end of each stage, you will learn a bit about the visible structures.

Thoracic Dissection Stage 1: Superficial Structures

Table 4. Quick-view instructions for stage 1 of the thoracic dissection. Detailed instructions follow.

Steps involved		Useful Figures
GOAL 1 View visible superficial structures	• After fastening the pig to your dissecting tray • Before removing excess tissue	22
GOAL 2 Remove the pleural membranes	• Very delicate tissue surrounding the lungs • Use forceps	23
GOAL 3 Extend the thoracic incision to the neck	• Cut through skin, keeping scissor tips up • Small superficial blood vessels may be cut	24
GOAL 4 Open up the rib cage	• Pull back the flaps • Use large scissors to snip the ribs laterally • Fold back the flaps and trim sharp edges	25-26

Thoracic Dissection Stage 1: Detailed Instructions

After completing the thoracic incision, there are several structures that are immediately visible. As described previously, the thoracic cavity is further divided into three smaller cavities. The pleural cavities contain the lungs and are enclosed by the thin pleural membranes (Fig. 22; next page). The remaining space in the medial thoracic cavity is called the mediastinum, which contains the heart and many other structures.

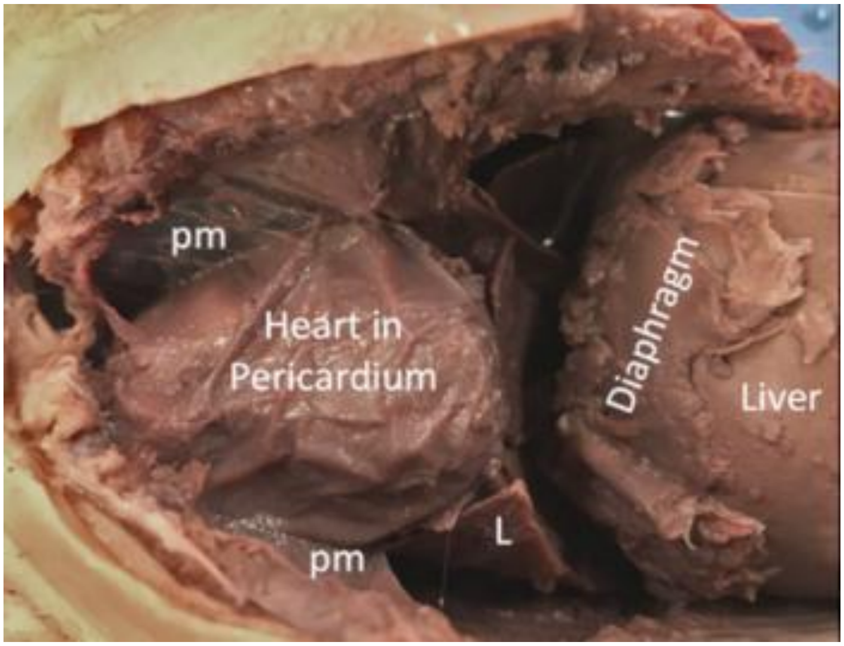


Fig. 22. The pleural membranes (pm) are delicate. You can see a bit of the lung (L) where the right pleural membrane has already torn. Between the pleural membranes is the heart in the pericardium, which sits in the mediastinum. The diaphragm is just above the liver, which is in the abdominal cavity.

Removing the pleural membranes is straightforward since they are so delicate. Prying the two sides of the rib cage apart will cause tears to appear. You can then use forceps to pull them away (Fig. 23).

Protip: The pleural membranes are very thin. Be careful not to damage the lungs as you remove them!

Fig. 23. The thoracic cavity after removal of the pleural membranes. Note that the pericardium is intact.

Fig. 24. Extending the thoracic incision.

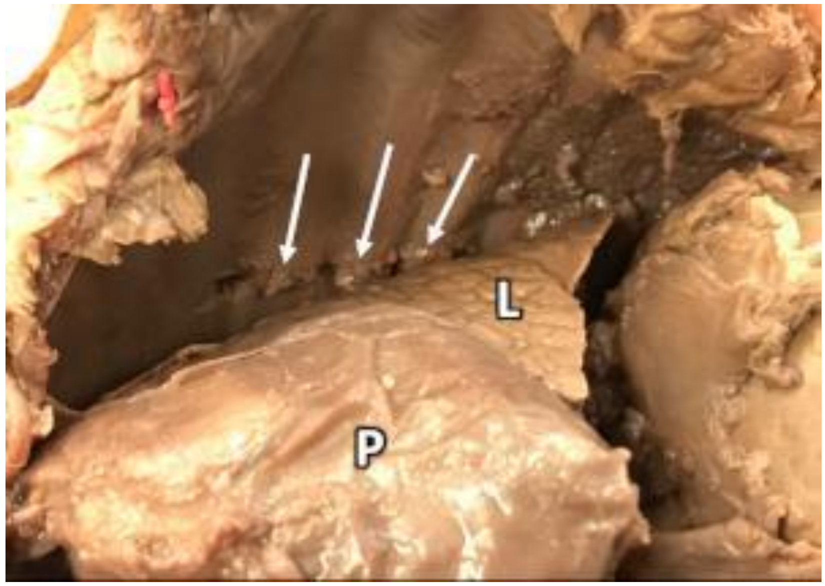
Next, use your large scissors, blunt end down, to extend the thoracic incision into the neck (Fig. 24). To avoid cutting anything important, keep your tips up and stay on the midline. It is normal, and likely, to cut through some smaller vessels.

Protip*: As you dissect, you will notice that the blood vessels are filled with blue and red latex. The blue vessels carry deoxygenated blood, and the red vessels carry oxygenated blood.*

The final step that will open the thoracic cavity for better inspection is to cut the ribs. By cutting the ribs, you will be able to keep the lateral and anterior rib cage from closing in and blocking your access.

To cut the ribs, bend one side of the thoracic body wall back so that you can see the internal face. Using your large scissors, place one blade to each side of the rib and cut. Cut the ribs one-by-one in a straight line (Fig. 25), taking care to avoid damaging surrounding organs.

Fig. 25. Be sure to cut the ribs in a row (arrows) and avoid harming the lungs (L) and the heart in the pericardium (P).



Once you have cut all the ribs, you will be able to lay the thoracic body wall out of the way and get a much clearer view of the superficial structures located there (Fig. 26).

Protip*: Feel the ends of the ribs with your fingers to ensure there are no sharp edges left. You can always trim sharp points with your scissors.*

Fig. 26. The open thoracic cavity.

What Can I See Now? Superficial Thoracic Structures
There is no additional dissection needed to view the superficial structures of the thoracic cavity unless you have not completely removed the cavity membranes found within. You may wish to remove a bit of the connective tissue that holds the thymus down to the pericardium.

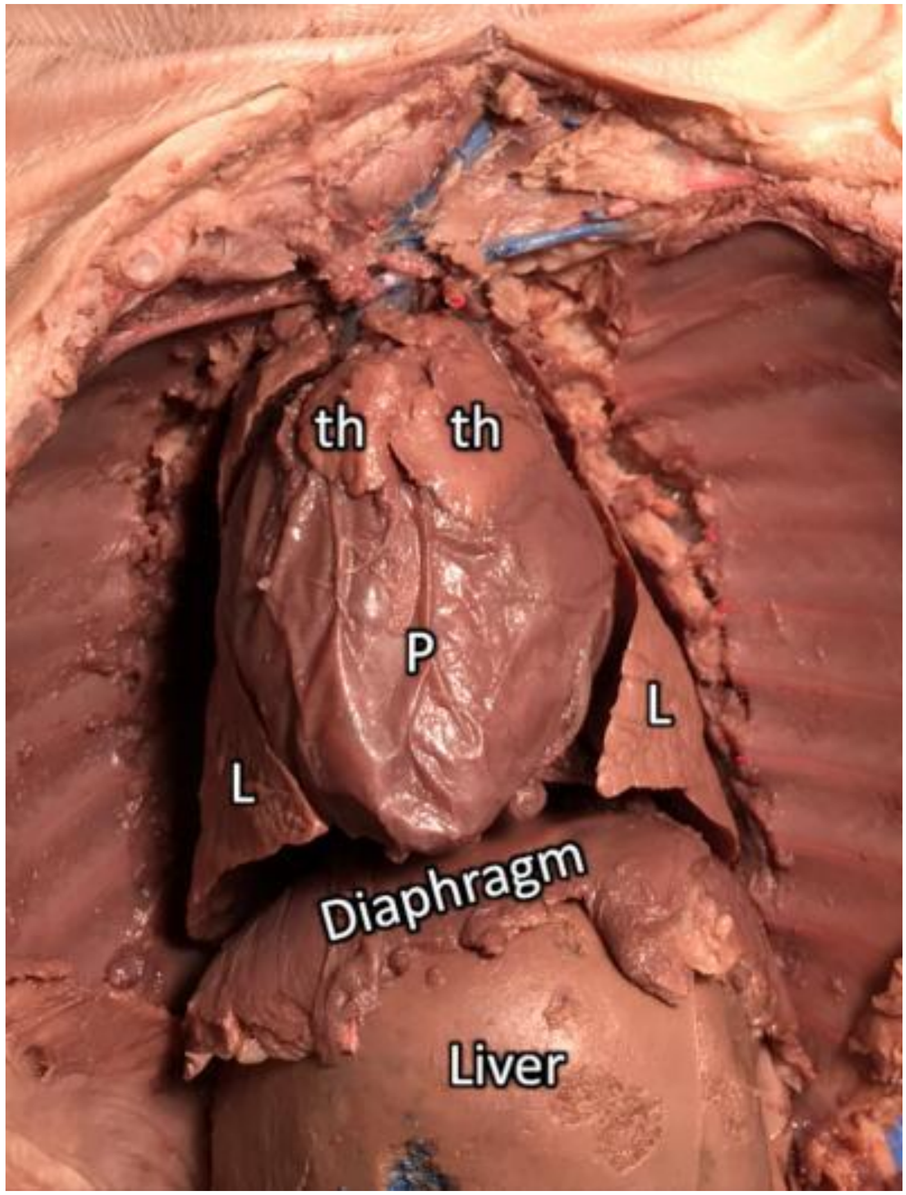


Fig. 27. Superficial structures from the Stage 1 thoracic cavity dissection include: the thymus (T) and pericardium (P). The diaphragm (D) and the liver are provided as reference points. The lungs (L) will be described further in Stage 4.

Stage 1 thoracic structures to identify:

- Thymus
- Pericardium

The **thymus** is involved in both the immune and endocrine systems. Its immune function is to act as the site of maturation for white blood cells called T-lymphocytes. Its endocrine function is to produce thymosin, a hormone that triggers the production of more T-lymphocytes. T-lymphocytes are crucial in your body's defense against many infections, as well as cancer. The thymus is bilobed and is very large from the fetal stage until around puberty, at which point it gets progressively smaller as one gets older. In the superficial dissection, we only see a small part of the thymus. It extends cranially into the neck, as we will discover in Stage 2.

The **pericardium** is a sac that contains the heart and the great vessels (large blood vessels that are attached directly to the heart) of the cardiovascular system. The pericardium has two layers. The outer layer, which we see here, is fibrous. It helps to hold the great vessels firmly to the heart, and it limits the amount of blood that can enter the heart to prevent overfilling. The inner layer is too fine for us to see with the naked eye. It is responsible for producing lubricant fluid, which prevents friction damage to the heart as it beats.

Thoracic Dissection Stage 2: Glands of the Neck and Ventral Heart, and Anterior Vena Cava

Table 5. Quick-view instructions for stage 2 of the thoracic dissection. Detailed instructions follow on the next page.

	Steps involved	**Useful Figures**
GOAL 1 Remove the pericardium	• Keeping scissor tips up, cut the sheath around the sides and bottom of the heart • Cut away the front half • Cannot be pulled off by forceps • Use small scissors and cut carefully • Avoid damaging large vessels cranial to the heart	28-31
GOAL 2 Remove the superficial, caudal thymus	• Much of the thymus will come off with the pericardium • The rest is loose and easily removed with forceps • Careful with the lungs… they look like thymus!	28-29
GOAL 3 Remove additional connective tissue cranial to the heart	• Most will come off with forceps, but some will require scissors • There is a lot surrounding the blood vessels • Veins are more superficial than arteries • Trim bone edges if more sharp edges are found	30, 32-33
GOAL 4 Expose the glands of the neck	• The deep, cranial parts of the thymus surround the thyroid gland • Remove strap-like neck muscles to reveal the thyroid • Elongate the thoracic incision as needed	33-34

Thoracic Dissection Stage 2: Detailed Instructions

First, you should remove the pericardium. As seen in Figure 28, use your small scissors to cut into the pericardium at the tip of the heart (arrow). Then, carefully cut along the sides of the pericardium, as demonstrated by the dashed blue lines. Be sure to keep your scissor tips up as you complete this process, otherwise, you could harm the upper chambers of the heart. Lift the front half of the pericardium with your forceps and carefully cut it away. To avoid damaging the vessels at the top of the heart, it is better to remove the last of the pericardium separately.

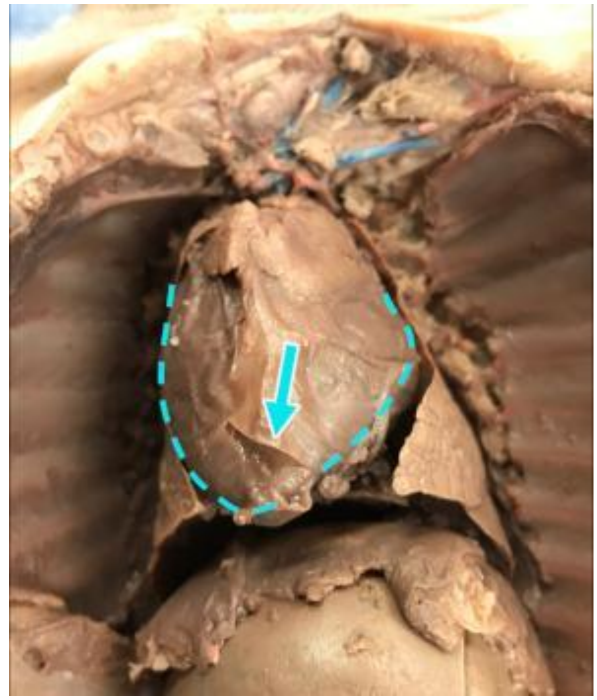


Fig. 28. Cuts needed to remove the pericardium. The arrow indicates your entry point, and the dashed lines indicate where to cut from there.

As you remove the pericardium, a large portion of the thymus will come with it. All superficial parts of the thymus should be removed (Fig. 29). To do this, use your forceps to grasp the remaining glandular tissue and simply pull it away.

***Protip**: The lungs look similar to the thymus gland. To ensure that you are not tearing away lung tissue, start at the caudal end of the lungs and follow it cranially. If it is a part of the lung, do not remove it!*

To remove any remaining pericardium, use forceps and small scissors to lift and make small cuts (Fig. 30). Leave the large veins located just under the remaining pericardium intact (Fig. 31).

Fig. 29. Green scissors indicate more tissue to be removed.

Fig. 30. Removing the remaining pericardium.

Fig. 31. The veins closest to the heart are now visible.

After removal of the pericardium, there is still some connective tissue to remove around the veins above the heart. Any projecting ribs should be cut, but avoid nearby vessels when you do (Fig. 32).

Next, dissect out the glands of the neck: the deep cranial portions of the thymus gland and the thyroid gland, which sits medial and deeper in the neck. While the tissue is delicate, it is enclosed by connective tissue. This physical boundary makes the thymus fairly easy to pick out from the surrounding tissues (Fig. 32). Compare the tissue marked with the white asterisk in Figure 32 and Figure 33 for a visual.

Fig. 32. Tissue to remove includes projecting ribs (green scissors) and any connective tissue obscuring the veins. Tissue to preserve includes the glands in the neck (*).

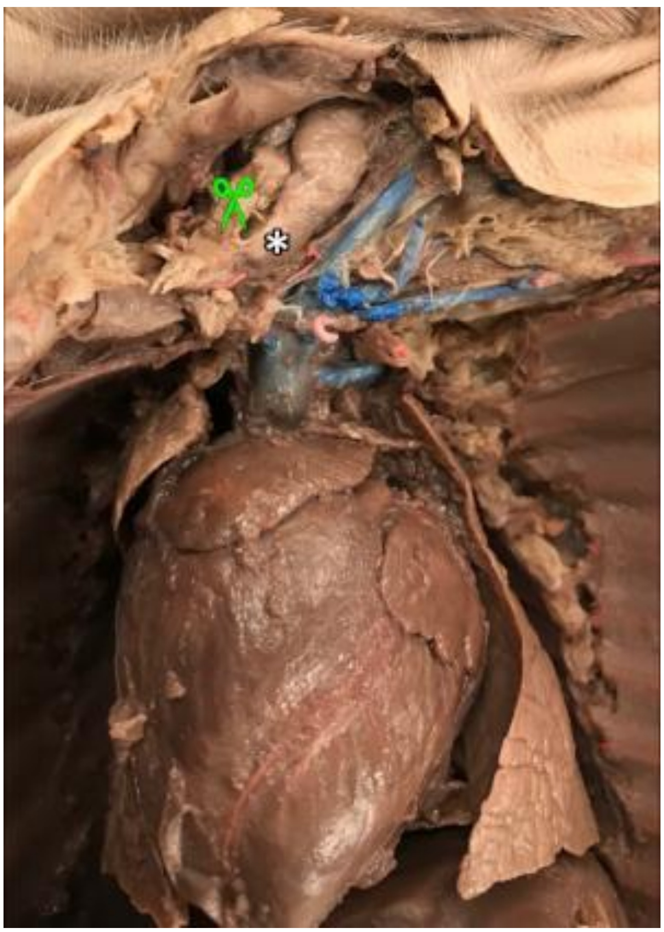


Fig. 33. Tissue to remove includes the thin strap of neck muscle that sits above the thyroid gland (green scissors). The asterisk (*) demonstrates the same tissue and location indicated in Figure 32. It is now apparent this tissue is the left lobe of the thymus gland.

Once you have located the cranial regions of the thymus gland, use a blunt probe to detach it slowly and carefully from the surrounding connective tissue.

The thoracic incision in our photographed pigs was made to the dissector's right of the sternum. Therefore, the left lobe of the pig thymus is visible. Between the left and right thymus, there is a thin strap of muscle, which must be removed (Fig. 33). The thyroid sits under this muscle, so take care not to remove too much tissue.

Fig. 34. The thymus glands and thyroid gland (*) have been dissected. The green scissors indicate a piece of the caudal thymus that will be removed.

It may be necessary to further elongate the thoracic incision. Complete this task with small scissors, which will give you more control over what you cut. Otherwise, the blunt probe and curved forceps are sufficient for dissecting out the other lobe of the thymus and the thyroid, which sits between and just deep to the two lobes (Fig. 34).

You can now appreciate the size of the thymus gland. Sometimes more caudal portions will remain attached to one or both lobes (Fig. 34). For photographic purposes, we have removed that excess tissue (Fig. 35).

Fig. 35. The completed Thoracic Stage 2 dissection.

What Can I See Now? Glands of the Neck and Ventral Heart, and Anterior Vena Cava

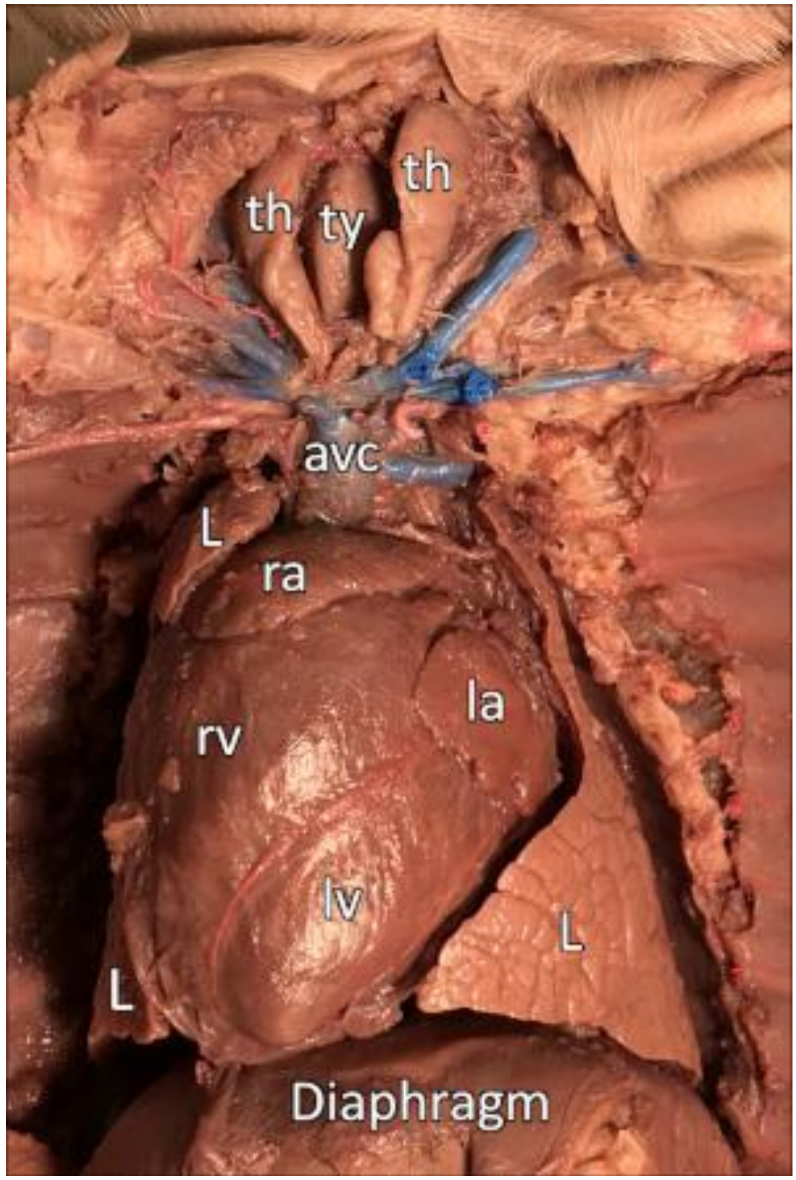


Fig. 36. Structures from the Stage 2 thoracic cavity dissection include: the **right atrium** (ra) and **left atrium** (la) of the heart, the **right ventricle** (rv) and **left ventricle** (lv) of the heart, the **anterior vena cava** (avc), the left and right lobes of the **thymus gland** (th) and the **thyroid gland** (ty). The lungs (L) and diaphragm are labeled for reference.

Stage 2 thoracic structures to identify:
- Heart:
  - Right and left atrium
  - Right and left ventricle
- Anterior vena cava
- Thymus gland
- Thyroid gland

The **heart** is the pump that propels blood through the vessels of the cardiovascular system. All mammals have a four-chambered heart: there are two atria and two ventricles. Each **atrium** receives blood delivered by veins, and each **ventricle** pumps blood out of the heart through arteries. While we will see additional vessels in the next two stages of dissection, the **anterior vena cava** is prominent in this dissection. The anterior vena cava drains deoxygenated blood from the upper body and returns it to the **right atrium**.

***Protip**: In four-legged animals, directional terms are a bit different than in humans. So, while it is the **anterior vena cava** in pigs, in humans it is called the **superior vena cava**.*

While the function of the **thymus gland** was discussed in Stage 1, we were previously not able to appreciate its size. Approximately half of its mass has been removed in dissection, and it previously overlapped onto the heart! This size makes sense given that this is a fetal pig. As we grow older, the thymus is replaced with fat as it degenerates.

The **thyroid gland** of the endocrine system is primarily responsible for producing hormones that regulate basal metabolic rate (BMR). BMR roughly describes how active your cells are and, therefore, how much energy they are using. The normal function of most of your organ systems requires a constant output of these hormones.

Interlude: The Heart and its Great Vessels

You just identified the first of the great vessels we will explore: the anterior vena cava. There are others, all of which are associated with four heart chambers (Fig. 37).

Since the atria are at the cranial end and the ventricles are at the caudal end of the heart, you might assume that the blood enters at one end of the heart and exits at the other. This is not the case. Blood is delivered to the atria: to the right atrium by the anterior and posterior venae cava and to the left atrium by the pulmonary veins. Blood then flows through valves from atrium to ventricle. When the ventricles contract, pressure drives blood anterior and out of the heart through valves into the great arteries. The pulmonary trunk drains the right ventricle and the aorta drains the left ventricle.

Therefore, all of the great vessels are affixed to the cranial end of the heart. Even the posterior vena cava, which is visible on the caudal end, drains into the right atrium, which is at the cranial end.

We will observe these structures in the next few stages of dissection.

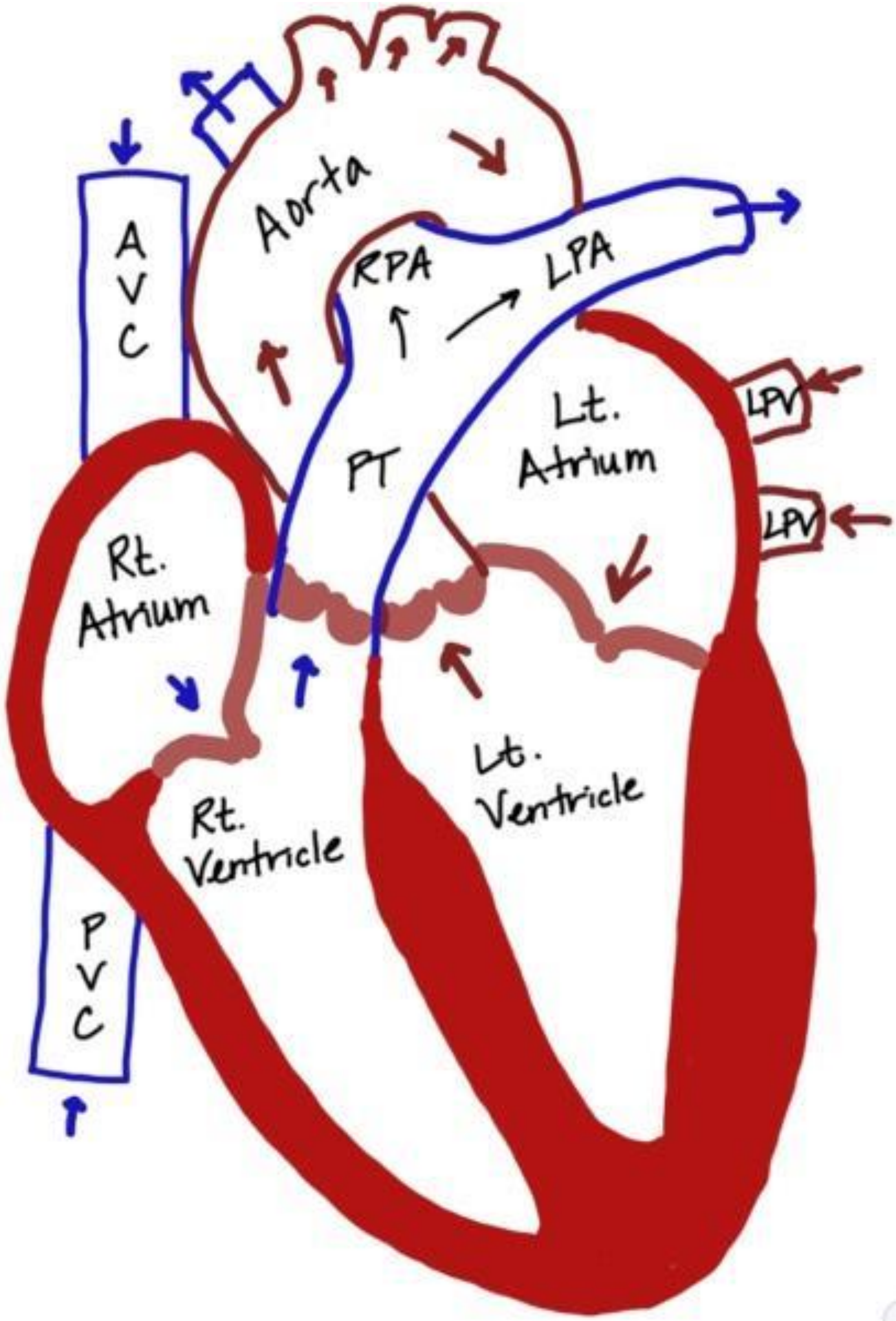


Fig. 37. The heart and its great vessels. The great veins include the anterior vena cava (AVC), posterior vena cava (PVC), left pulmonary veins (LPV) and right pulmonary veins (not visible here). The great arteries include the pulmonary trunk (PT), which branches into the left (LPA) and right (RPA) pulmonary arteries, and the aorta. Arrows demonstrate the direction of blood flow. Blue indicates deoxygenated blood flow and red indicates oxygenated blood flow.

Thoracic Dissection Stage 3: Major Veins

A quick note before getting started

The fetal pigs that we are using are "double-injected", which means they have been injected with blue and red latex. Vessels that carry deoxygenated blood should be blue. Vessels that carry oxygenated blood should be red. This is not a perfect system—sometimes vessels end up the wrong color and sometimes they simply do not fill—but most pigs will be injected correctly.

When dissecting vessels, the walls are sometimes torn, leaving bright blue uncovered latex (Fig. 38). While it is not typically a problem if this occurs here and there, you should avoid stripping off the vessel walls as much as possible.

Fig. 38. The white arrows indicate tears in the vessel walls where bright blue latex is visible. Such damage should be avoided.

Dissecting the Major Veins

Table 6. Quick-view instructions for stage 3 of the thoracic dissection. Detailed instructions follow on the next page.

Steps involved		Useful Figures
GOAL 1 Remove glands of the neck	• Thymus and thyroid can both be removed with forceps • Take care not to pull at any major vessels	39-41
GOAL 2 Remove connective tissue from around the major veins, trachea, and larynx	• Follow along vessels and use curved forceps and a blunt probe to remove tissue • Do not strip vessel walls from latex • Avoid tugging at and tearing vessels	42

Thoracic Dissection Stage 3: Detailed Instructions

The glands of the neck must be removed to view the major veins. Starting with the thymus, simply grasp the underside of each lobe with the curved edge of your forceps and pull. Take care not to pull any large vessels in the process.

Fig. 39. At the end of Stage 2, both lobes of the thymus gland and the thyroid gland were dissected in the neck.

Fig. 40. Once the thymus has been removed, the thyroid gland is fully visible. It sits on top of the trachea.

Carefully remove the thyroid gland. As with the thymus, the thyroid is made of loose glandular tissue that can be easily grasped with the curved edge of the forceps and pulled clear of the neck. However, the thyroid gland is also attached by connective tissue to the trachea just below, so take care to avoid causing damage.

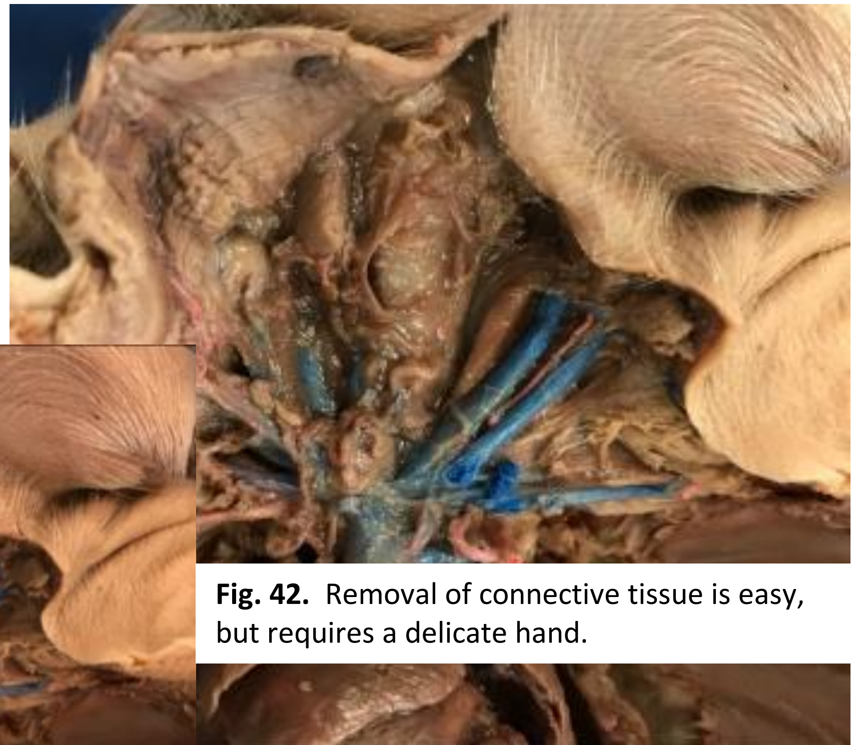


Fig. 42. Removal of connective tissue is easy, but requires a delicate hand.

The most straightforward way to dissect the veins at this point is to use your blunt probe and curved forceps to gently follow the edges of the vessels. Keep an eye out for branch points in the vessels to avoid tearing them. As you clear connective tissue from around the vessels, you can remove it with your forceps. Use Figure 43 as a guide in your dissection. Finally, clear the excess connective tissue from around the trachea and larynx (Fig. 42.)

Fig. 41. The neck with the glands removed.

What can you see now?
Continue to the next page!

What Can I See Now? The Major Thoracic Veins

Stage 3 thoracic structures to identify:

Veins:
- Anterior vena cava
- Brachiocephalic (R&L)
- Internal jugular (R&L)
- External jugular (R&L)

Arteries:
- Common carotid (R&L)
- Pulmonary trunk

Right atrium

Most **veins** in the body carry deoxygenated blood to the right side of the heart. The exceptions to this rule are the pulmonary veins, which carry oxygenated blood from the lungs to the left side of the heart. The **anterior vena cava** is responsible for draining blood from the upper body into the **right atrium**. It is formed by a fusion of the **left and right brachiocephalic veins**. The head is drained by the jugular veins. Specifically, the **internal jugular veins** drain the cranial cavity and the **external jugular veins** drain the face and scalp. There are a variety of smaller veins visible lateral and caudal to the assigned veins that serve the shoulder and upper extremity. They do not tend to inject as well during the preservation process and have a branching pattern that is significantly different than humans.

The **common carotid arteries** and **pulmonary trunk** are prominent in this dissection; however, their functions will be discussed in the next section.

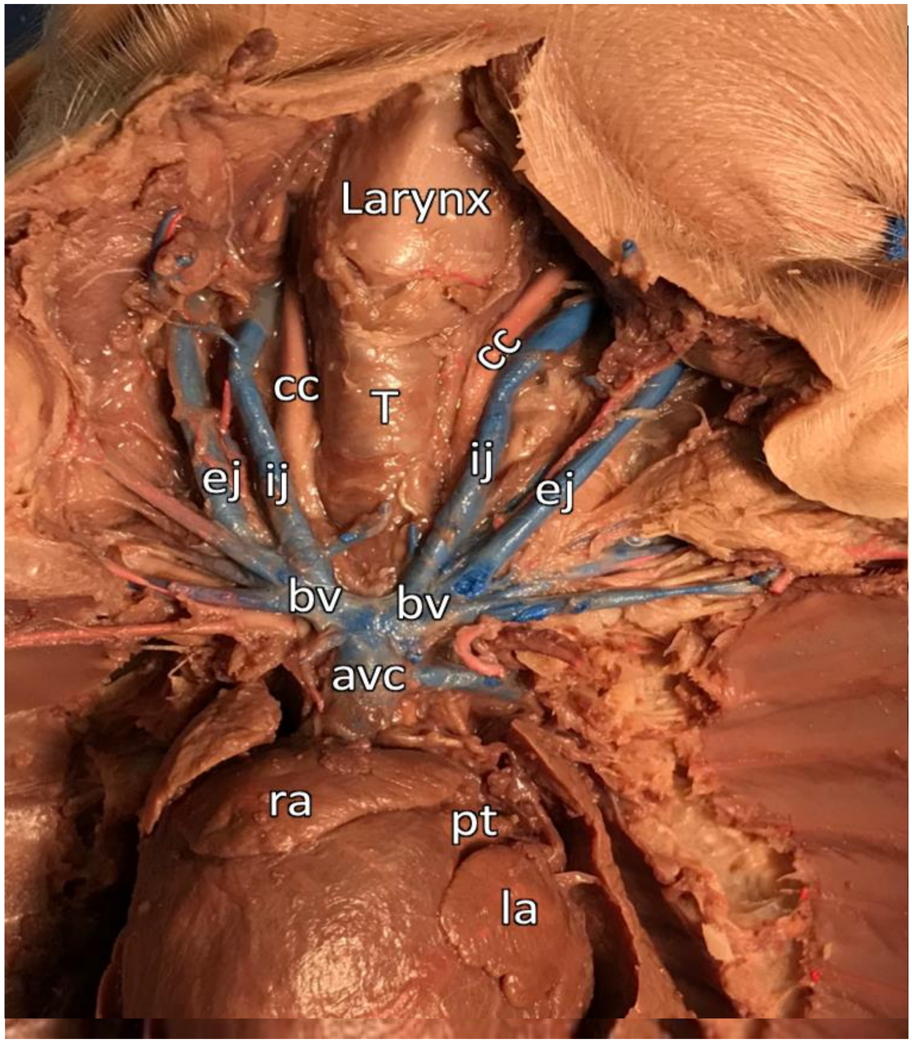


Fig. 43. Structures from the Stage 3 thoracic dissection include: the right atrium (ra), left atrium (la), anterior vena cava (avc), left and right brachiocephalic veins (bv), left and right internal jugular veins (ij), left and right external jugular veins (ej), pulmonary trunk (pt), and left and right common carotid arteries (cc). The trachea (T) and larynx are labeled for reference.

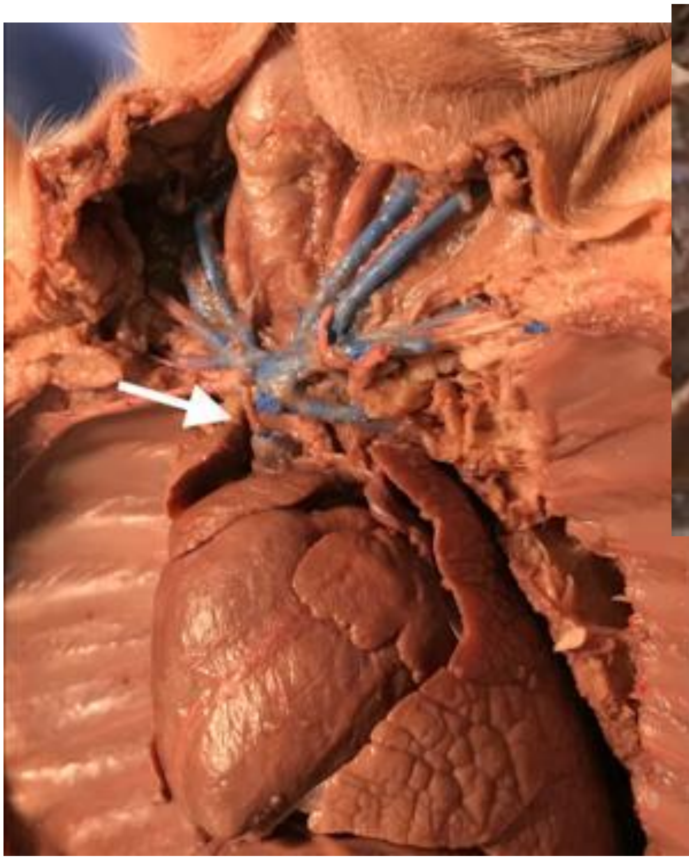
Thoracic Dissection Stage 4: Major Arteries

The arterial system in the thoracic cavity is almost entirely hidden under the venous system. Therefore, the best way to visualize these arteries is to remove the veins.

Table 7. Quick-view instructions for stage 4 of the thoracic dissection. Detailed instructions follow.

	Steps involved	**Useful Figures**
GOAL 1 Remove the veins	• Cut anterior vena cava (avc) about 0.5 cm above heart • Pull up carefully, cutting veins as needed to avoid damaging arteries	44-46
GOAL 2 Remove connective tissue around the arteries	• Follow along vessels and use curved forceps and a blunt probe to remove tissue • Do not strip vessel walls from latex • Avoid tugging at and tearing vessels	47-48

After removing the connective tissue that binds the anterior vena cava in place, cut it, leaving enough that it can be seen projecting from the top of the heart (Fig. 44).



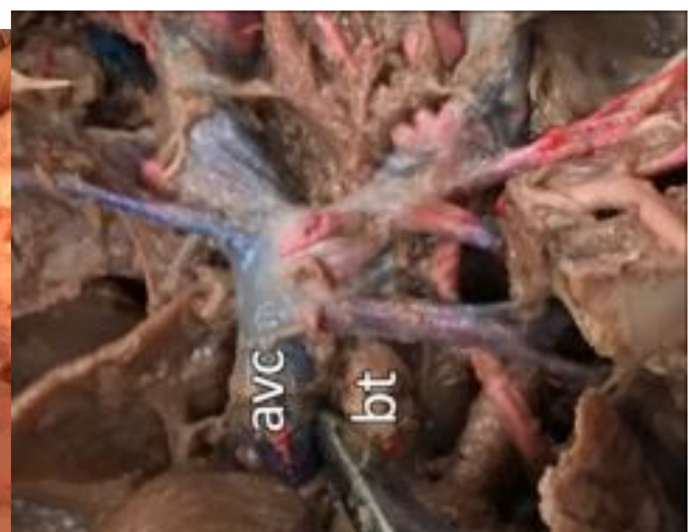


Fig. 44. (top image) To remove the thoracic veins, first cut the anterior vena cava (avc). Take care not to cut the brachiocephalic trunk (bt), which sits underneath. (left image) Cutting the anterior vena cava (indicated by white arrow) removes the only strong anchorage of the veins that drain into it.

All that holds the veins in place is fairly loose connective tissue. To remove the veins, simply grasp the free end of the anterior vena cava (Fig. 45) and pull it up toward the head. Most of the veins will pull away from the body easily, though some will need to be cut (Fig. 46). Any veins or parts of veins that remain in the way of visualizing arteries may be pulled or cut away.

Fig. 45. To remove the veins, grasp the anterior vena cava and pull.

Fig. 46. Some veins may need to be cut in order to remove them cleanly.

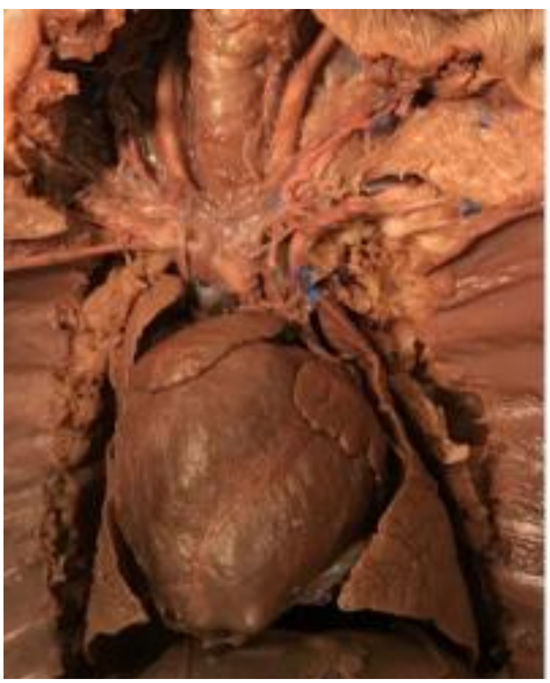


Fig. 47. The major arteries are covered by connective tissue following removal of the veins.

Fig. 48. The major arteries are now clearly visible.

Finally, clear away the connective tissue that bound the major veins to the tissues below (Fig. 47), so that the arteries are clearly visible (Fig. 48).

What Can I See Now? Major Arteries

<u>Stage 4 thoracic structures to identify</u>:

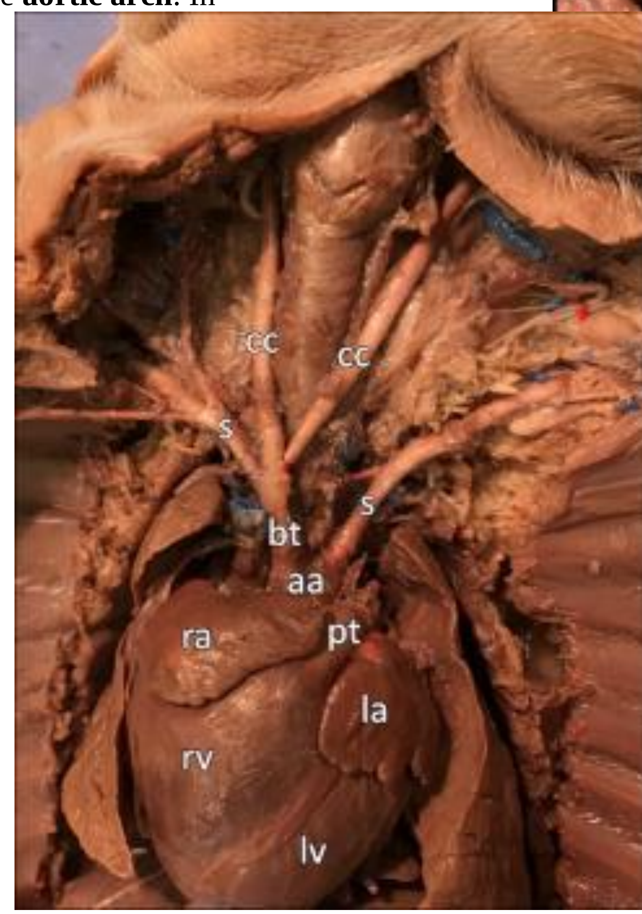
Arteries:
- Pulmonary trunk
- Aortic arch
- Brachiocephalic trunk
- Subclavian (R & L)
- Common carotid (R & L)

Heart:
- Right atrium
- Left atrium
- Right ventricle
- Left ventricle

Most **arteries** arise ultimately from the **aorta**. These arteries carry oxygenated blood from the left side of the heart out into the body. The exceptions to this rule are the pulmonary arteries, which in adults carry deoxygenated blood from the right side of the heart to the lungs. The **pulmonary trunk** is situated between the **right and left atria.** In adults, it is responsible for carrying blood from the **right ventricle** toward the lungs so that it can be oxygenated.

The aorta leaves the **left ventricle** at the top of the heart and quickly bends to form the **aortic arch**. In pigs, there are two branches off the aortic arch. The first is the **brachiocephalic trunk**, and the **left subclavian artery** is the second. It supplies the shoulder and upper extremity. In humans, the left common carotid artery arises from the aortic arch, with its branch point between the other two.

The brachiocephalic trunk has 3 major branches. The **left and right common carotid arteries** travel on either side of the trachea to supply the head, and the **right subclavian artery** serves the right shoulder and upper extremity. Since the left common carotid artery branches directly from the aorta in humans, the brachiocephalic trunk only gives rise to the right common carotid and subclavian arteries.



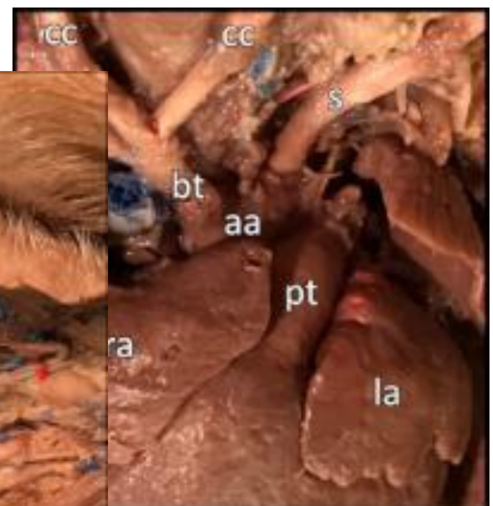


Fig. 49. Structures from the Stage 4 thoracic dissection include: right atrium (ra), right ventricle (rv), left atrium (la), left ventricle (lv), aortic arch (asterisk), brachiocephalic trunk (bt), right and left subclavian arteries (s), right and left common carotid arteries (cc), pulmonary trunk (pt). The inset above shows a top-down view that highlights the aortic arch.

Thoracic Dissection Stage 5: The Heart and Great Vessels
To visualize the great vessels, you will remove the heart from the thoracic cavity.

Table 8. Quick-view instructions for stage 5 of the thoracic dissection. Detailed instructions follow.

	Steps involved	Useful Figures
GOAL Remove the heart from the thoracic cavity	• About 0.5 cm away from the heart, cut the: ○ Brachiocephalic trunk ○ Left Subclavian artery ○ Pulmonary trunk ○ Posterior vena cava ○ Pulmonary veins • Use forceps and scissors to release heart from connective tissues • Avoid damage to respiratory structures	50-54

Thoracic Dissection Stage 5: Detailed Instructions
To remove the heart, first cut the brachiocephalic trunk (bt), the left subclavian artery (lsa) and the pulmonary trunk (pt; Fig. 50). To cut the pulmonary trunk, lift the left side of the heart and place your cut so that a significant length of the vessel remains.

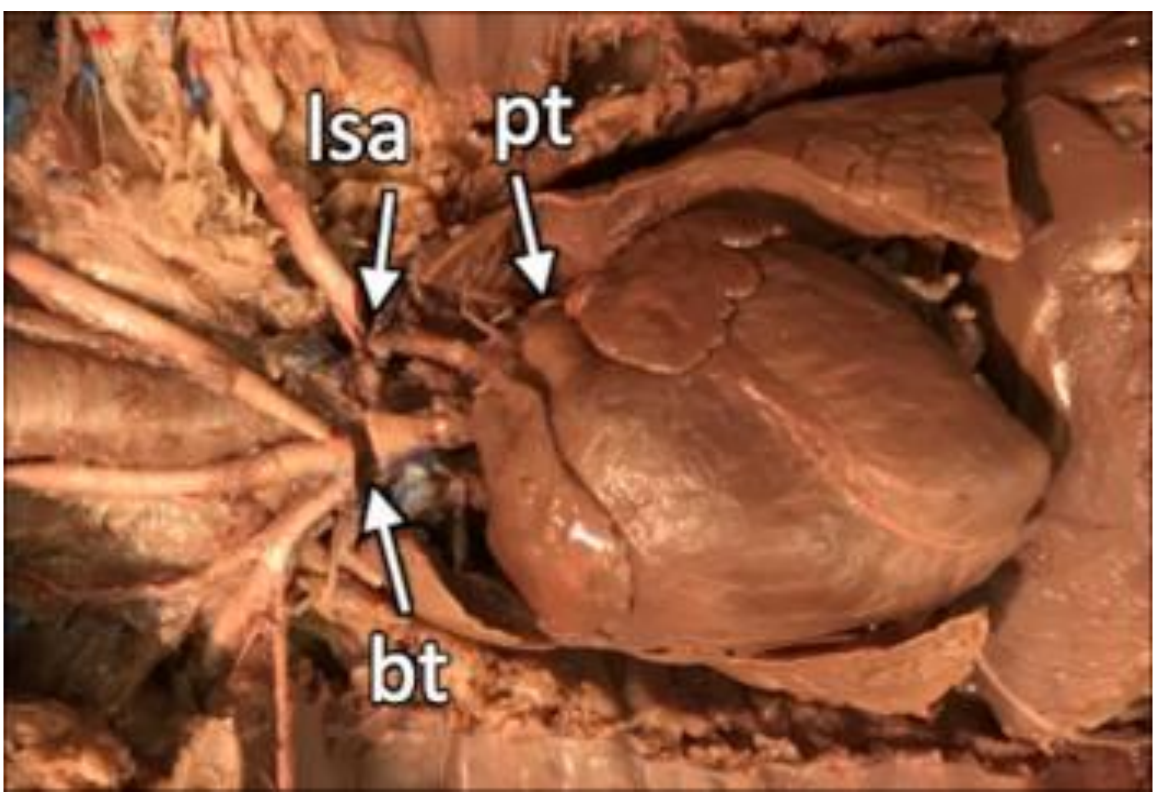


Fig. 50. Cuts at the top of the heart will detach the heart from the arterial system (arrows).

Next, lift the bottom of the heart, clear any connective tissue that obscures your view, and cut the posterior vena cava (Fig. 51). Then, snip the pulmonary veins without cutting further than necessary into the lungs. There are two pulmonary veins on the left (Fig. 52), and two on the right side of the heart.

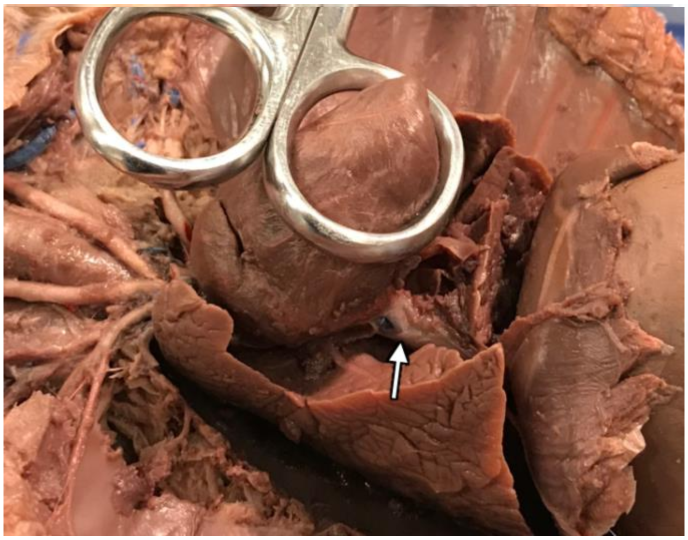
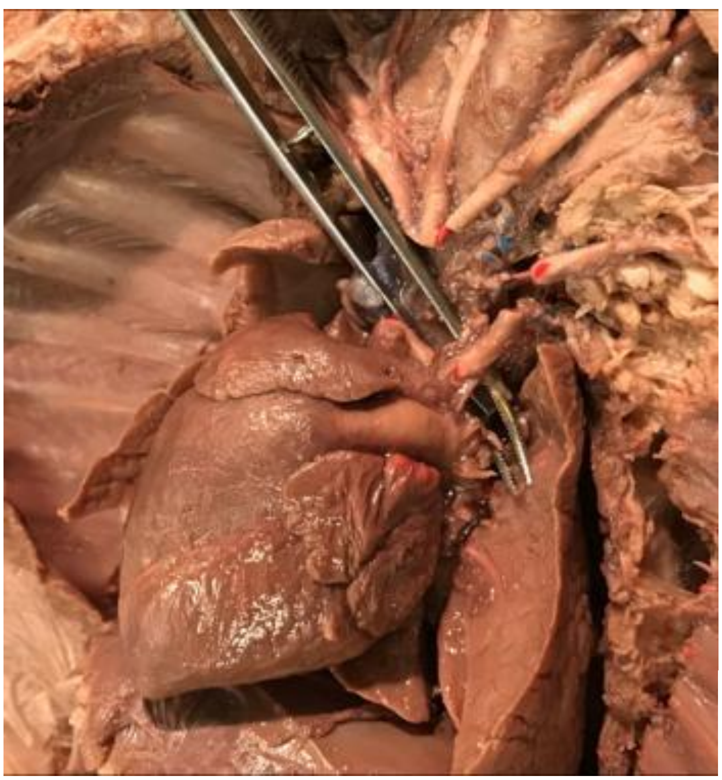


Fig. 51. The posterior vena cava is visible underneath the heart (arrow). The scissors are there to hold the heart out of the way for the photograph.

Fig. 52. Pulmonary veins from both the right and left lungs drain oxygenated blood to the left atrium. This photograph demonstrates the left pulmonary veins (arrow). The right pulmonary veins have the same appearance.



Use your forceps to clear the connective tissue binding the great vessels at the top of the heart down to the tissues below (Fig. 53).

As you do this, avoid damage to the respiratory tract, as shown on the next page.

Fig. 53. Use your forceps to start lifting the heart out of the mediastinum.

Take care to avoid the trachea, which sits right beneath the heart (Fig. 54). As you continue to lift the heart, use your forceps to disrupt connective tissue and use scissors to cut any remaining pericardium and vasculature holding the heart down.

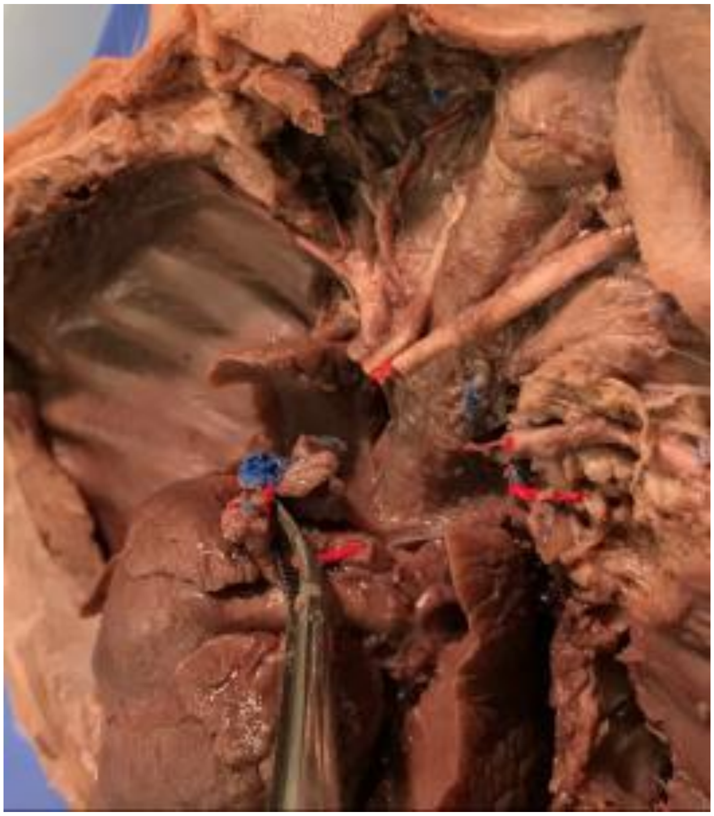


Fig. 54. The trachea sits just underneath the heart.

What can you see now?
Continue to the next page!

What Can I See Now? The Heart and Great Vessels

Visualizing the external features of the heart and great vessels may require the removal of some connective tissue.

Stage 5 thoracic structures to identify:

- Great vessels:
  - Pulmonary trunk
  - Aorta
  - Anterior vena cava
  - Posterior vena cava
  - Pulmonary veins
- Heart:
  - Right atrium
  - Left atrium
  - Right ventricle
  - Left ventricle
- Ductus arteriosus

In the adult heart, blood flow is one-way, with valves that ensure blood follows a predictable path. Deoxygenated blood is delivered to the **right atrium** from the upper body by the **anterior vena cava** and from the lower body by the **posterior vena cava**. It then flows to the **right ventricle**, and through the **pulmonary trunk** to the lungs, where it is oxygenated. Blood from the lungs is drained to the **left atrium** by the four **pulmonary veins**. It then moves on to the **left ventricle** and out the **aorta** for distribution to the rest of the body.

Remember that these pigs have been injected such that vessels that carry oxygenated blood contain red and vessels that carry deoxygenated blood contain blue. Given that the pulmonary trunk drains the right ventricle and carries blood to the lungs, you might wonder why it is injected with red. The answer to this question involves the ductus arteriosus. Looking closely, one can see that the pulmonary trunk actually appears to merge into the aorta. The ductus arteriosus is the vessel that connects the two. This is one of a few shunts that redirect blood flow during fetal development. The blood in the pulmonary trunk is oxygenated because fetal blood returned to the heart by the posterior vena cava carries blood from the umbilical vein. While some blood actually flows through the pulmonary vessels, it is only needed to properly develop the lung tissue. Blood is oxygenated in the placenta.

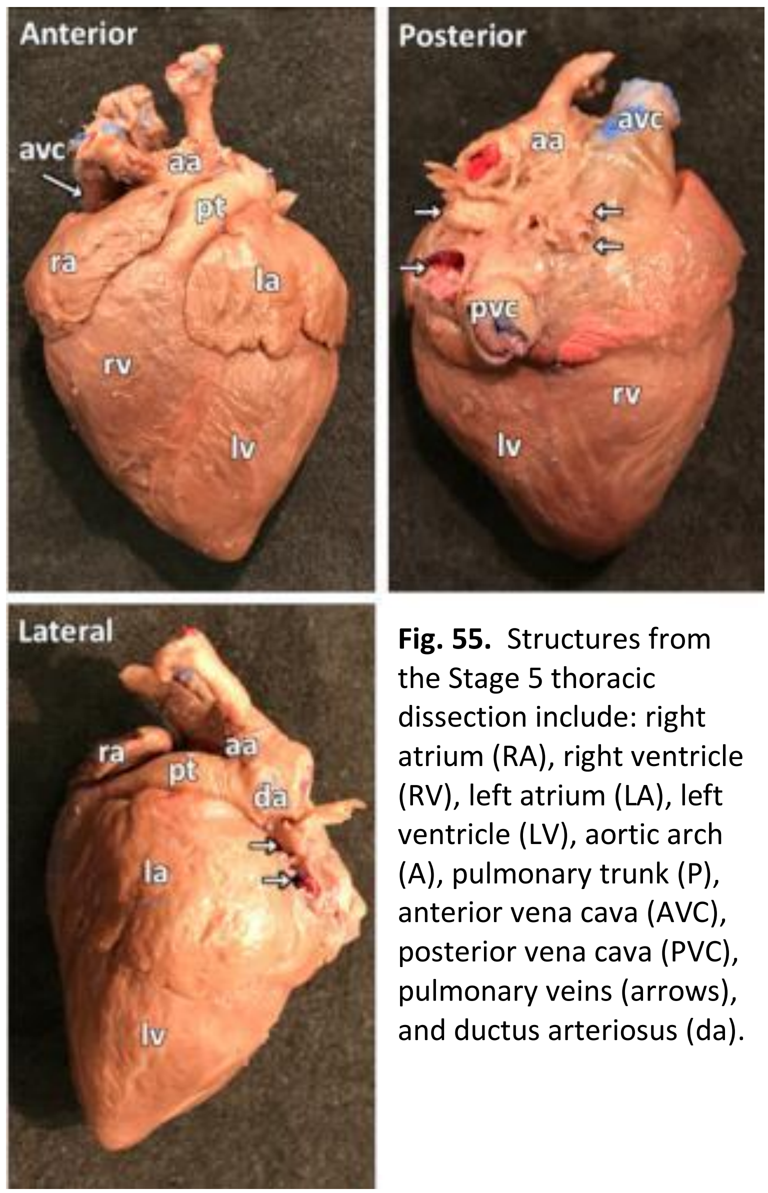


Fig. 55. Structures from the Stage 5 thoracic dissection include: right atrium (RA), right ventricle (RV), left atrium (LA), left ventricle (LV), aortic arch (A), pulmonary trunk (P), anterior vena cava (AVC), posterior vena cava (PVC), pulmonary veins (arrows), and ductus arteriosus (da).

Thoracic Dissection Stage 6: Respiratory Structures
The respiratory system and the esophagus of the digestive system sit toward the back of the thoracic cavity and can be fully viewed once the heart has been removed. Visualizing these structures is a matter of removing the arteries that block your view and clearing away connective tissue.

Table 9. Quick-view instructions for stage 6 of the thoracic dissection. Detailed instructions follow.

Steps involved		Useful Figures
GOAL 1 Remove excess tissues	• Locate respiratory structures to preserve • Grasp arteries with forceps and pull • Use forceps and scissors to remove connective tissues	56-58
GOAL 2 Dissect out airways	• Follow trachea to primary bronchi, and primary bronchi to smaller bronchi • Remove lung tissue to view smaller bronchi	59

Thoracic Dissection 6: Detailed Instructions
To remove the arteries, grasp cut ends with forceps, pull them away from surrounding tissue, and snip them with small scissors. Arteries do not pull apart as easily as veins do, as their walls are much thicker.

As shown in Figure 56, there are some tissues you should preserve. The esophagus sits underneath the trachea, and the airways are semi-transparent, which makes them easy to cut by accident.

Fig. 56. This view demonstrates what the thoracic cavity looks like once the heart has been removed. Asterisks indicate tissues that should be preserved. To fully view them, removal of some arteries is necessary.

Fig. 57. Once the arteries have been removed, viewing the respiratory system requires removing some

The trachea and esophagus run parallel and are bound together. To view them, remove the binding connective tissue. This task is easily accomplished by closing your curved forceps, working the tip into the groove between the two structures, and pulling the connective tissue away (Fig. 58).

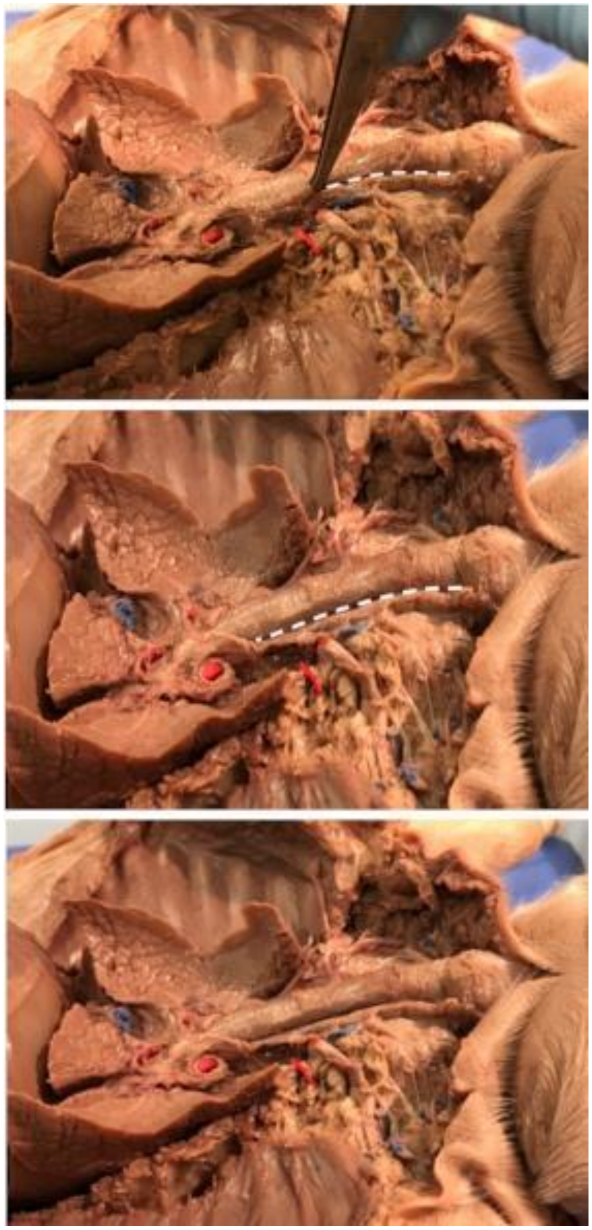


Fig. 58. (top) Closed forceps can be used like a hook to pull away the connective tissue binding the trachea and esophagus. (middle) The dashed line demonstrates the expanding gap between the trachea above the line and the esophagus below. (bottom) The completed separation of the trachea and esophagus.

In order to view smaller airways, tease away some of the lung tissue that sits medially, as demonstrated in Figure 59.

Protip: *This should be the last thing you do in this stage. Using the curved forceps, start at the trachea and look for branch points in the airway. The cartilage rings in their walls make them easier to see. When you locate a branch point, clean away enough lung tissue to make them more visible.*

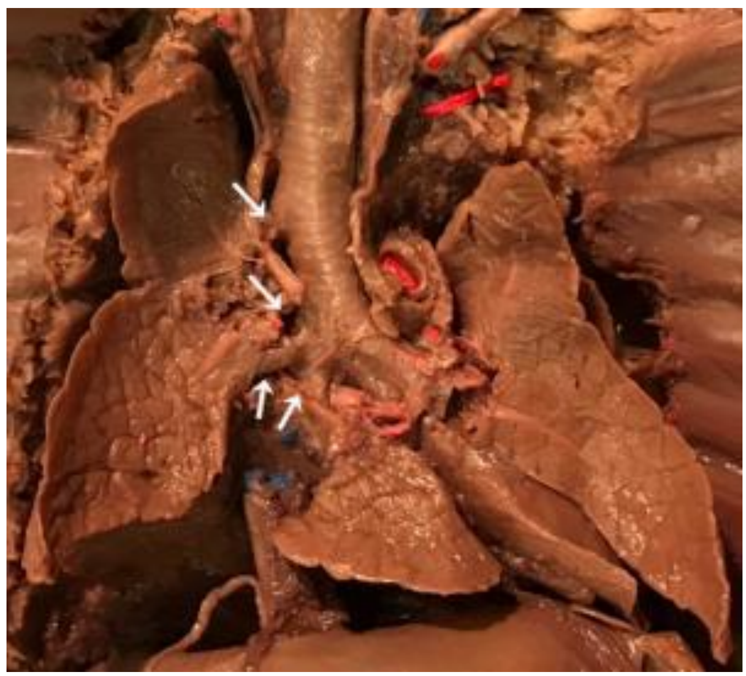


Fig. 59. The white arrows demonstrate branch points in the airways that have been cleared of enough lung tissue to see them clearly.

What Can I See Now? Respiratory Structures (and the Esophagus)

Stage 6 thoracic structures to identify:
- Larynx
- Trachea
- Lungs (R & L)
- Bronchi
- Diaphragm
- Esophagus

Fig. 60. Structures from the Stage 6 thoracic dissection include: larynx (L), trachea (T), esophagus (E), Lungs (L), bronchi (arrows), and the diaphragm.

The role of the respiratory system includes two major processes: the movement of air in and out of the lungs and the exchange of gasses in the lungs. The structures that are most apparent with the naked eye are the airways.

The **larynx** contains the epiglottis (not pictured) which covers the trachea when you swallow food. Otherwise, your larynx maintains an open airway to the trachea. It also contains the vocal cords, which are crucial for sound production.

The **trachea** is a hollow tube with walls supported by rings of cartilage that maintain an open airway. By contrast, the **esophagus** is collapsed except when food passes through it. At the lungs, the trachea branches into smaller airways that are also supported by cartilage. These smaller airways are called **bronchi** (singular: bronchus). In humans, there are two primary bronchi that branch off the trachea. The pig, which has a longer torso and larger lungs, has a less defined branching structure. As you can see, the top arrow indicates a bronchus that branches off of the trachea itself.

The **lungs** are the site of gas exchange and are divided into lobes. Human lungs have two right and three left lobes; whereas pig lungs have two right and four left lobes. Internally, the airways have a complex branching structure that delivers air throughout the many lobes. The primary role of the lungs is to harvest oxygen and to offload carbon dioxide. In the body, these gases are carried by the blood.

The **diaphragm** forms the dome-like floor of the thoracic cavity. When it contracts, it flattens, which changes the volume of the thoracic cavity and therefore alters pressure in the cavity and in the lungs, triggering inhalation. When the diaphragm relaxes, the previous pressure is restored and you exhale.

The role of the **esophagus** will be discussed with the rest of the digestive system in the abdomen.

Dissecting the Abdominopelvic Cavity

Unlike in the thoracic cavity, the organs of the abdominopelvic cavity do not layer on top of each other. There is also more room in the abdominal cavity, which means you can observe a variety of structures without having to remove anything. Instead, there will be abundant connective tissues to remove.

Because we can view all the abdominopelvic organs without removing any, this section of the lab will be organized by system.

Table 10. Quick-view instructions for the digestive system portion of the abdominopelvic dissection. Detailed instructions follow.

Steps involved		Useful Figures
GOAL 1 View visible structures	• No tissue removal required • See what you can find using Figure 61 as a reference	61
GOAL 2 Locate the gallbladder	• Just lift liver to view	62
GOAL 3 Locate the pancreas	• Lift stomach • Remove connective tissue underneath • Pancreas is made of loose tissue, take care to avoid damage	62-63
GOAL 4 Locate the esophagus in the abdomen	• Push stomach back down • Remove connective tissue where esophagus and stomach join under liver	64-65
GOAL 5 Locate the large intestine	• Depending on pig, you may need to shift the small intestine out of your way	66-67
GOAL 6 Locate the cecum and rectum	• Requires additional shifting of small intestine, but no tissue removal • Cecum at small/large intestine junction • Rectum is dorsal and enters pelvic cavity	68

Dissecting the Digestive System (and the Spleen): Detailed Instructions

When you pull back the flaps of the abdominal incision, there is a lot you can see right away (Fig. 61). In fact, of the nine organs discussed in this section, five of them are immediately viewable. To locate the other four, we will shift organs around a bit and remove some connective tissue.

Protip: *If your umbilical vein did not pull away from the umbilical cord, it will need to be cut with scissors.*

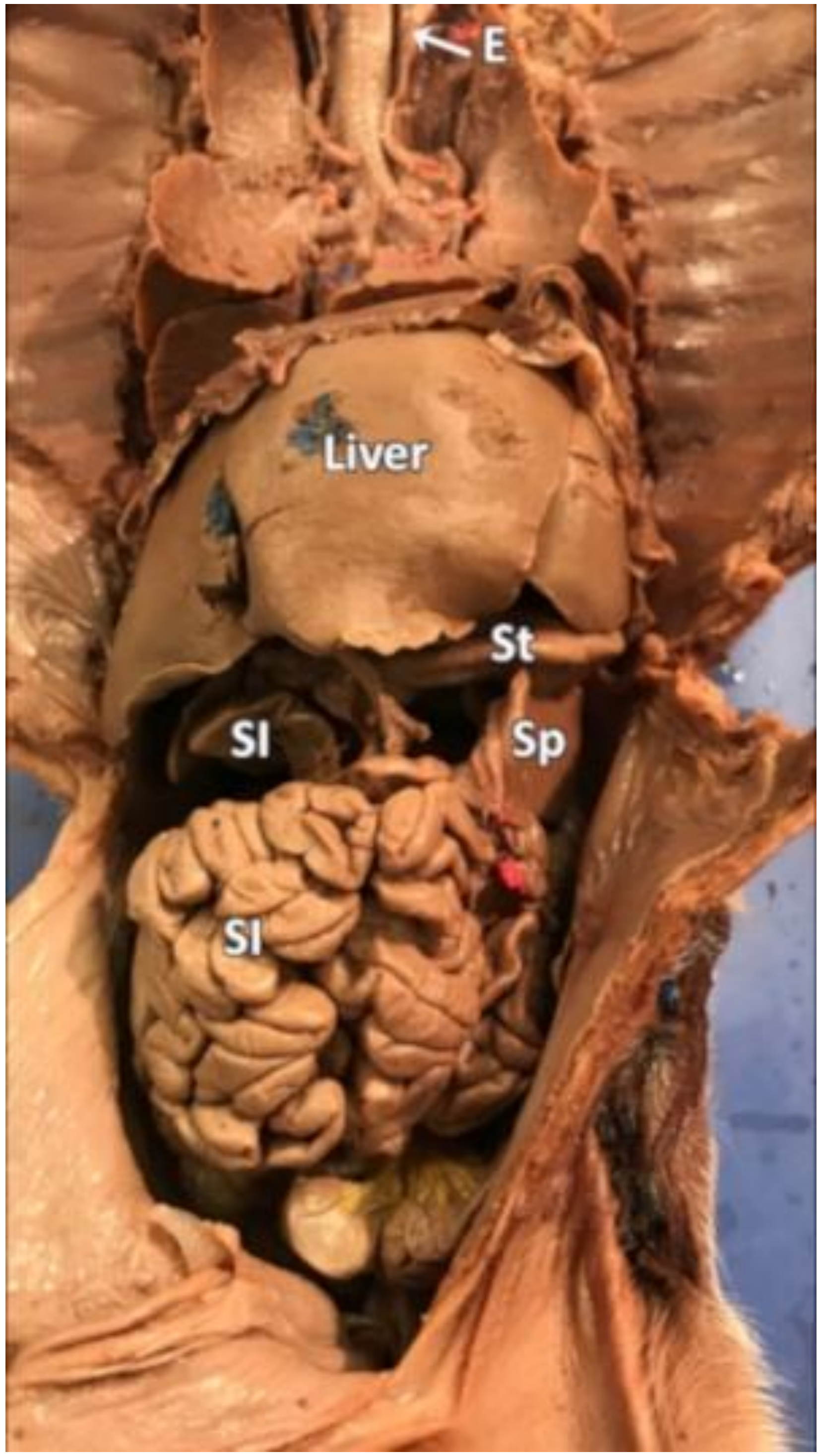


Fig. 61. With no additional dissection, five organs are already apparent: esophagus (E), liver, stomach (St), and spleen (Sp). The small intestine (SI) is labeled twice to demonstrate there is a portion under the liver, where it departs the stomach, and a part that is more ventral and caudal.

Identifying the gallbladder is a simple matter of lifting the liver and looking on its underside.

Lifting the liver allows you to lift the stomach, as well. The pancreas is embedded in some thin connective tissue and located between the stomach and the small intestine is the pancreas.

***Protip**: How do you identify the pancreas? It looks like a wad of chewed up chewing gum!*

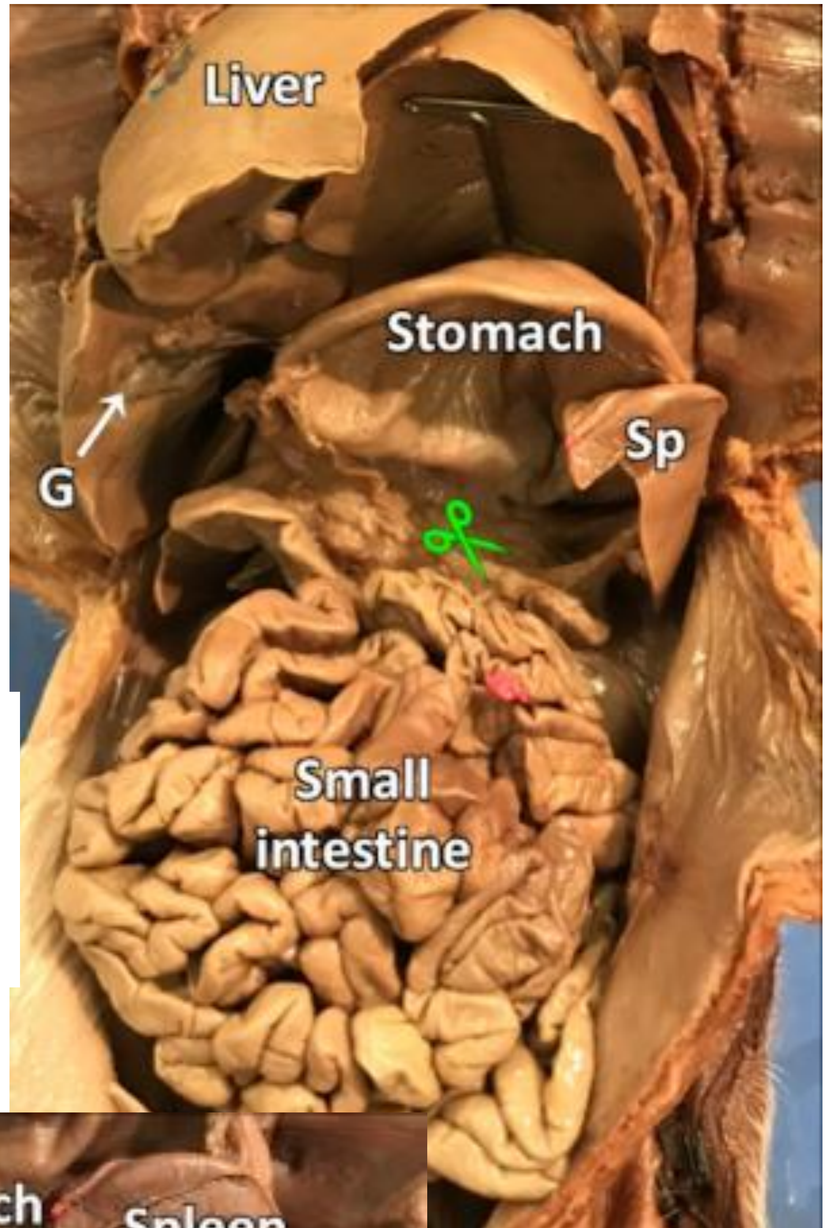


Fig. 62. No additional dissection is needed to see the gallbladder (G), stomach, or spleen (Sp). The pancreas, however, is covered by a very thin layer of connective tissue, indicated by the green scissors, which should be removed.

Fig. 63. The connective tissue has been dissected from around the pancreas.

While we can see the esophagus in the thoracic cavity, it is important to remember that the esophagus perforates the diaphragm, enters the abdominal cavity, and empties into the stomach.

In order to see this connection, you need to remove some of the connective tissue between the liver and the stomach (Fig. 64). Removing the connective tissue reveals some blood vessels that we will not identify, but this is important because it will allow us to pull the liver out of the way.

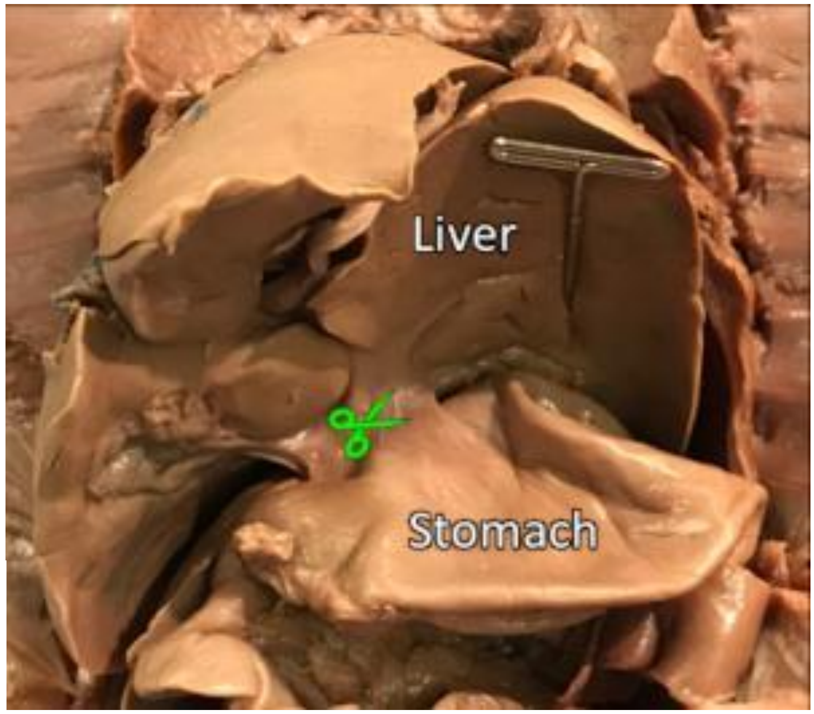


Fig. 64. The connective tissue that holds the liver to the stomach (green scissors) should be removed.

Pull the liver up and the stomach down. Use forceps to remove the connective tissue between the two. There are blood vessels embedded within this connective tissue. You do not have to remove all of the connection between the stomach and liver, you just need to relieve some of the tension between them so that you can pull the stomach down enough to see the esophagus in the abdominal cavity (Fig. 65).

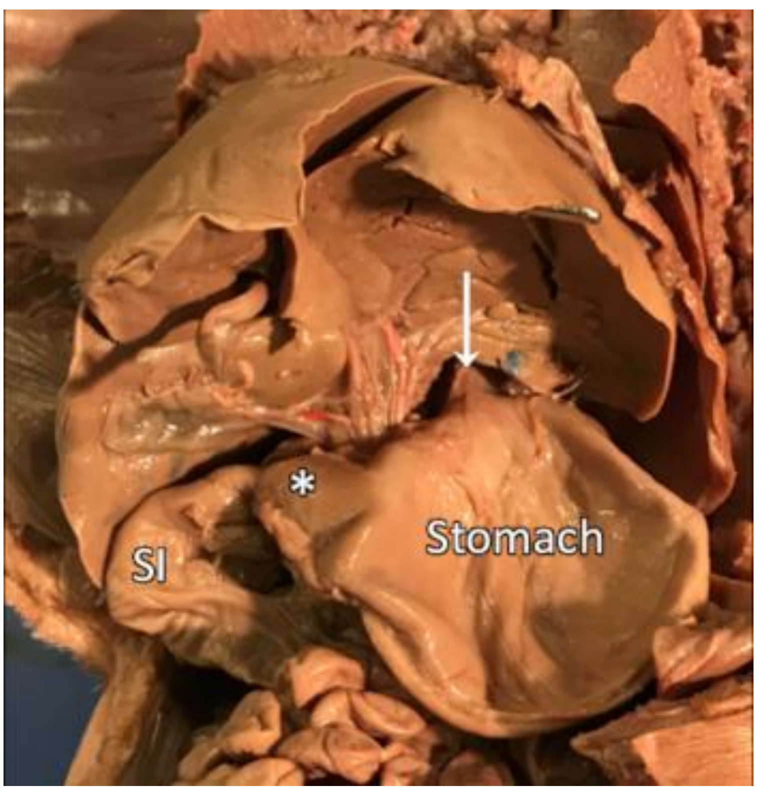


Fig. 65. The esophagus (arrow), stomach, and small intestine (SI) run one into the next. Passage of processed food from the stomach to the small intestine is tightly regulated by a valve located at the thickened region indicated by the asterisk.

The large intestine is generally visible without any manipulation required (Fig. 66).

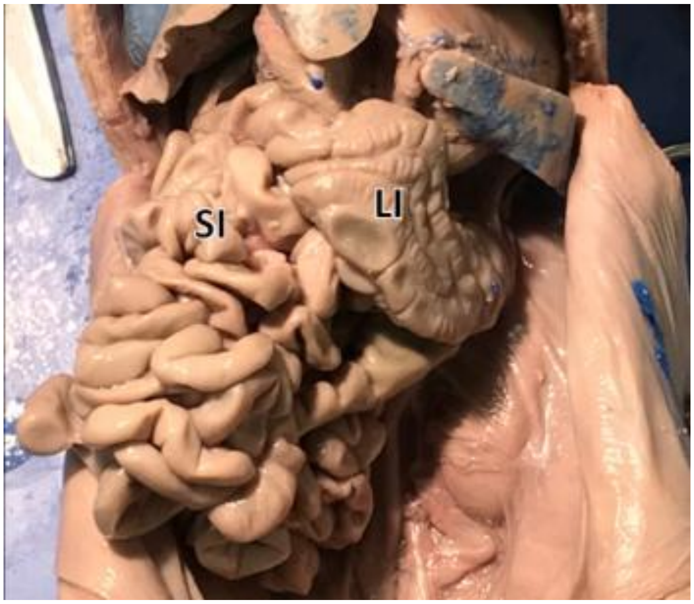


Fig. 66. The large intestine sits underneath the small intestine. Abbreviations: LI, large intestine; SI, small intestine.

The large intestine in pigs has a much different orientation than is found in humans. The bulk of the pig large intestine is coiled and tightly bound on the pig's left, with a descending portion that carries feces to the rectum in the pelvis (Fig. 68). In humans, the much shorter large intestine does not form a tight coil. Rather, the cecum is on the right side of the cavity, and the large intestine travels up, over, and then down the left side to the rectum.

There is also individual variation from pig to pig. While Figure 66 demonstrates the standard intestinal arrangement, in which both the small and large intestine visible without any reorganization, Figure 67 demonstrates an unusual intestinal configuration.

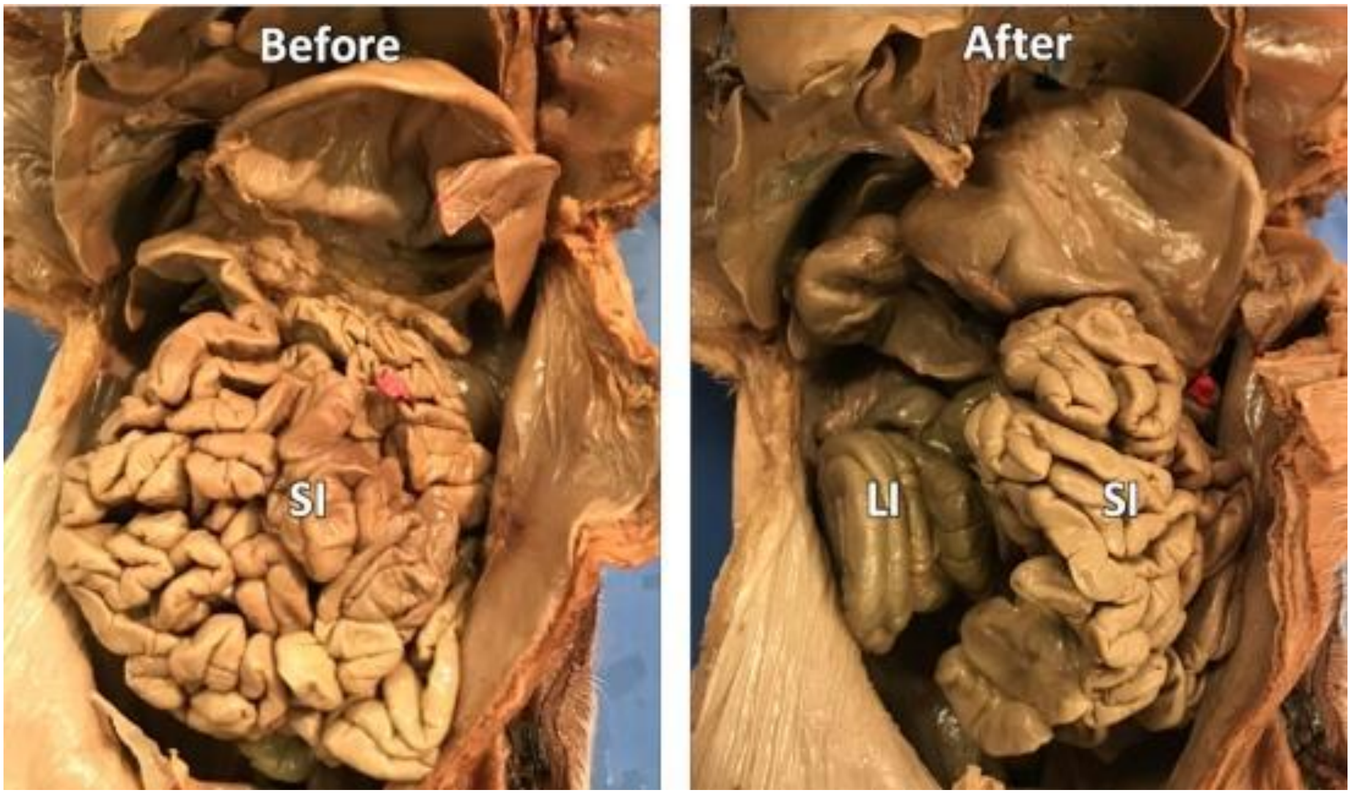


Fig. 67. This pig demonstrates two things. First, sometimes the coiled large intestine (LI) is on the right. Second, sometimes it is necessary to move the small intestine (SI) to view it.

To view the descending large intestine and rectum, simply lift the small and large intestine and shift them so that you can view the dorsal abdominal wall (Fig. 68 top).

Viewing the cecum takes a bit more manipulation. The cecum is a pouch found where the small intestine empties into the large intestine. Therefore, you need to look for that junction, and then locate the pouch. Typically, the small intestine is bound to the cecum by a connective tissue membrane, which can be torn so that you can appreciate the relationship between the two (Fig. 68 bottom).

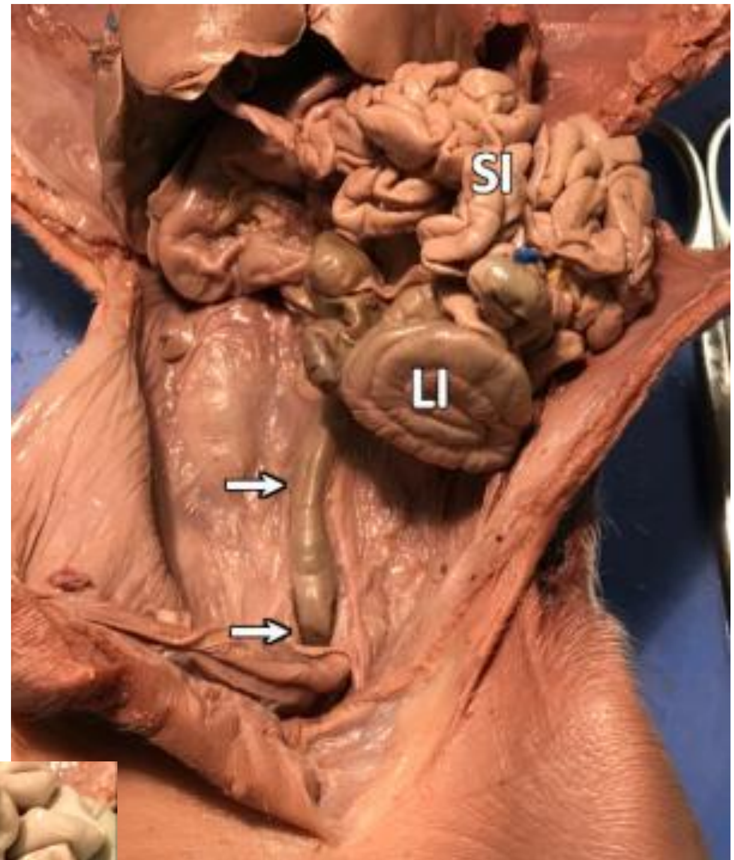


Fig. 68. (top) The descending large intestine (upper arrow) and rectum (lower arrow) are found on the dorsal abdominal wall. (bottom) The intestines may require a bit of rearrangement to view the cecum. Near the bulk of the large intestine (LI), you will find a pouch that is held to the small intestine (SI) by some connective tissue (*). The arrow demonstrates the path of processed food through the small intestine and into the cecum (dashed outline).

What Can I See Now? The Digestive System (and the Spleen)

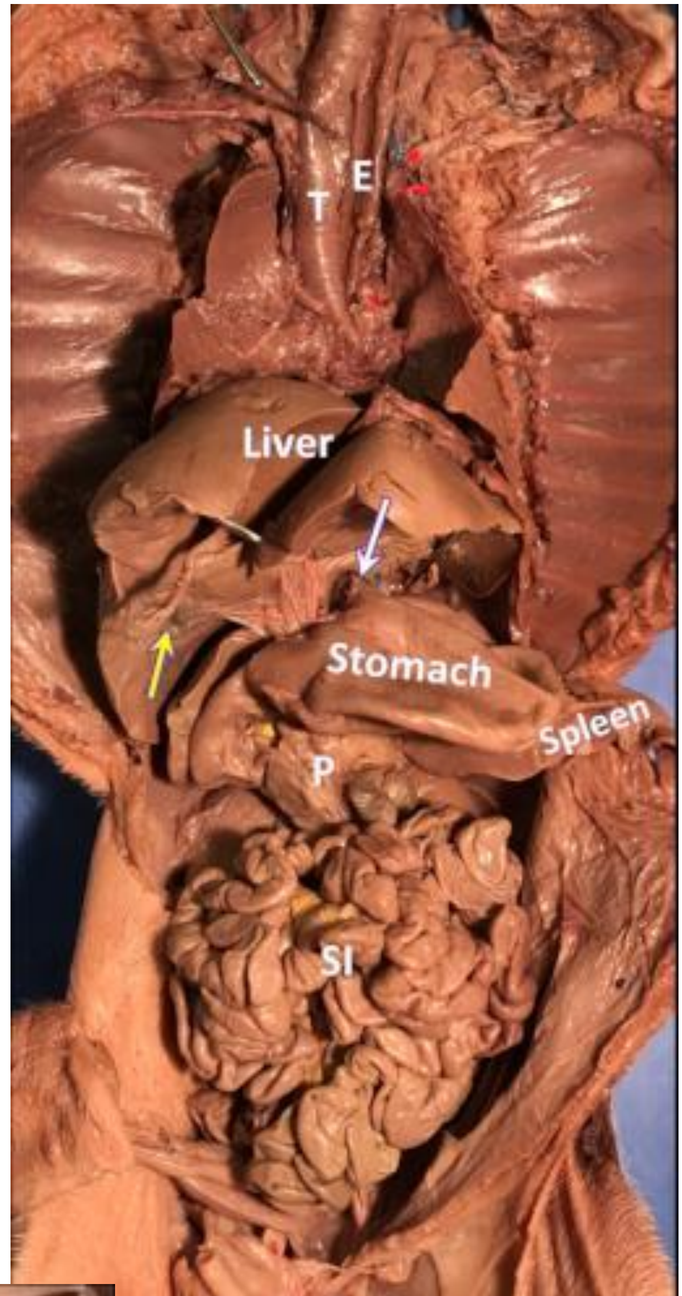
<u>Abdominopelvic digestive structures to identify</u>:

- Esophagus
- Stomach
- Small intestine
- Cecum
- Large intestine
- Rectum
- Liver
- Gallbladder
- Pancreas
- Spleen (Lymphatic)

The **spleen** is a lymphatic organ that has two primary functions. First, it is where old red blood cells are recycled. Second, it is a site where foreign substances are detected and attacked by the immune system.

The role of the digestive system is to provide nutrients to the rest of the body. The **esophagus** transports food from the mouth and throat to the **stomach**, which has a thick muscular layer that allows it to grind food down into a paste. The ground food is passed into the **small intestine** where it is chemically broken down into molecules small enough to be absorbed. Once absorption has occurred, the processed food is transported in bulk to the first part of the **large intestine**, the **cecum** (Fig. 70).

By comparison to humans, the stomach and the cecum of pigs are very large. These features allow pigs to eat and process very large meals, hence the phrase, “Eat like a pig.”



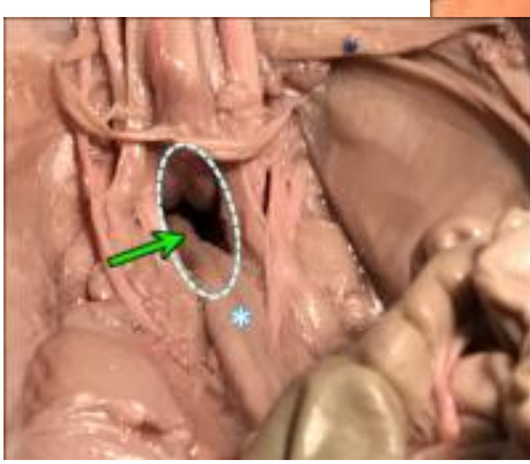


Fig. 69. (top) Structures demonstrated include: esophagus (E, white arrow), liver, gallbladder (yellow arrow), stomach, pancreas (P), small intestine (SI), and the spleen. The trachea (T) is labeled for reference. (bottom) The descending large intestine (*) transitions into the rectum (green arrow) once it enters the pelvic cavity (the dashed oval marks the border).

The large intestine absorbs water, vitamins, and minerals, leaving waste products in feces that pass from the last segment of the large intestine, called the **rectum** (Fig. 69), into the anal canal for passage through the anus.

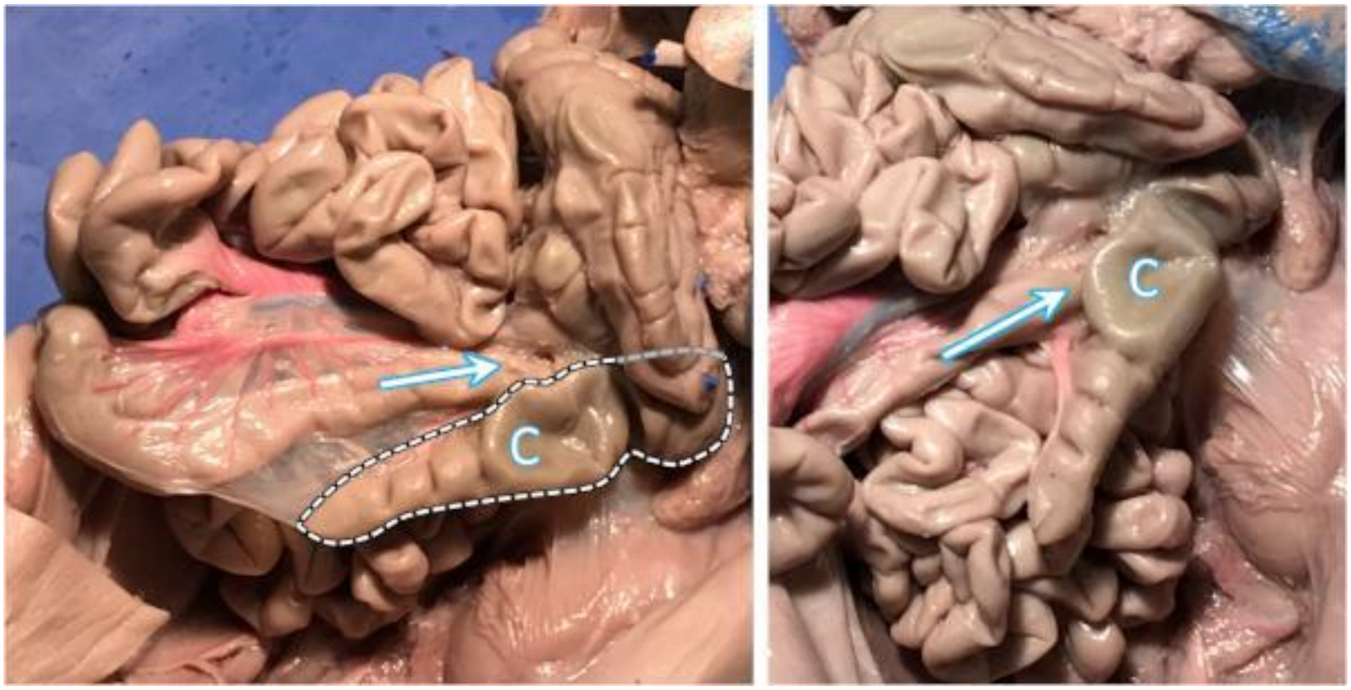


Fig. 70. The cecum (C) is a blind pouch that collects the full contents of the small intestine. The full size of the cecum is shown in the figure to the left by the dashed line. The arrow indicates the direction in which processed food is passed in the small intestine to the cecum.

The **liver**, **gallbladder**, and **pancreas** are called accessory organs because, while food does not pass through them during digestion, their products are crucial for chemical breakdown of nutrients in the small intestine. Figure 71 shows that these three organs are situated very close to the small intestine, and in fact, they empty their contents into the marked region of the small intestine through ducts. The liver produces a substance called bile, which is stored and concentrated in the gallbladder. Bile is crucial for fat digestion. The pancreas produces a variety of enzymes that chemically breakdown nutrients in preparation for absorption, as well as bicarbonate, which balances the acidity of your stomach juices.

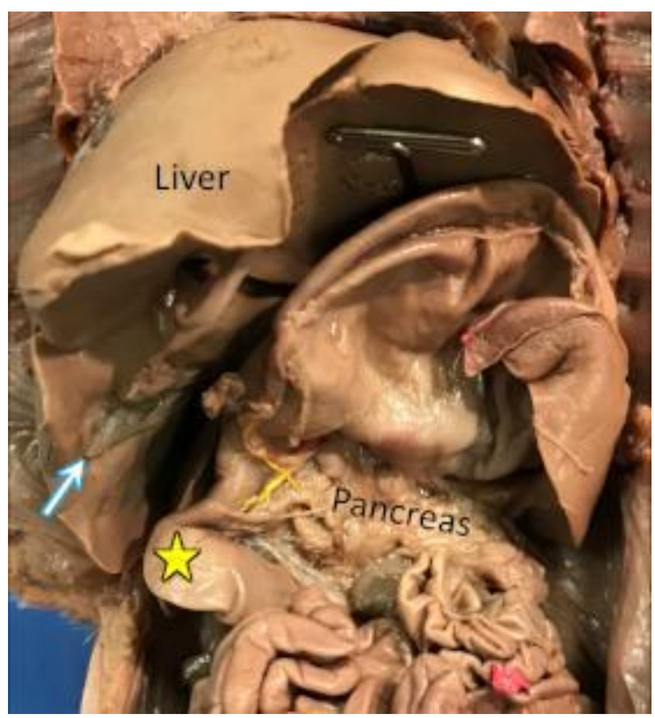


Fig. 71. The pancreas, liver, and gallbladder (arrow) sit close to the site where they contribute their products to the small intestine (star).

Dissecting the Abdominopelvic Cavity: The Urinary Systems (Unisex)
The steps necessary to visualize urinary structures are the same for both males and females; however, there is some overlap with the dissection for reproductive structures. Therefore, after following these instructions for dissecting the kidney and ureter, you should go to the appropriate section (male or female) to complete the dissection of the urinary and reproductive systems.

Table 11. Quick-view instructions for the initial urinary system portion of the abdominopelvic dissection. Detailed instructions follow.

Steps involved		Useful Figures
GOAL 1 Locate and uncover the kidney	• Move all intestines aside to view dorsal abdominal wall • Locate kidneys about midway up • Remove membranes covering each kidney	72-73
GOAL 2 Locate and dissect the ureter	• Each kidney drains medially to a ureter • Remove membranes covering each ureter	73
GOAL 3 Locate and dissect the urinary bladder	• Lift the ventral abdominal flap that includes umbilical cord • Detach urinary bladder and umbilical arteries from the body wall and each other	74

Detailed instructions are on the next page.

Dissecting the Unisex Urinary System: Detailed Instructions

Start the dissection by shifting the intestines so that you can view the dorsal abdominal wall, as shown in Figure 72. The abdominal cavity is lined by a thick membrane. Most of the abdominal cavity organs reside within that membrane; however, there are also some that sit behind it. The kidney and ureter are found underneath the membrane. Therefore, it is necessary to peel the membrane back.

Fig. 72. The kidney (K) and ureter sit under a membrane (left) that may be removed with forceps (right).

Tear the membrane with the tips of your forceps (Fig. 72, right) and peel it back until you can see the entire kidney (Fig. 73).

Once each kidney has been uncovered, locate the ureters and clear the membranes from on top of them. The ureter leaves the kidney from midway up its medial side. To the best of your ability, trace the ureter all the way to the urinary bladder. This is more straightforward in males than in females.

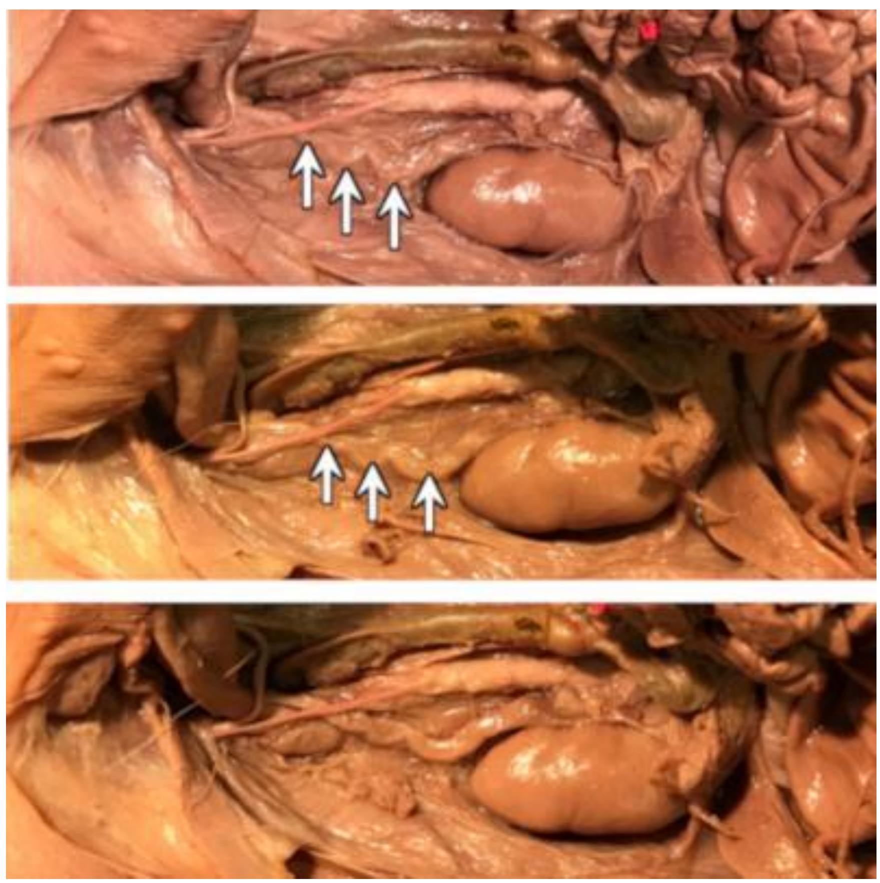
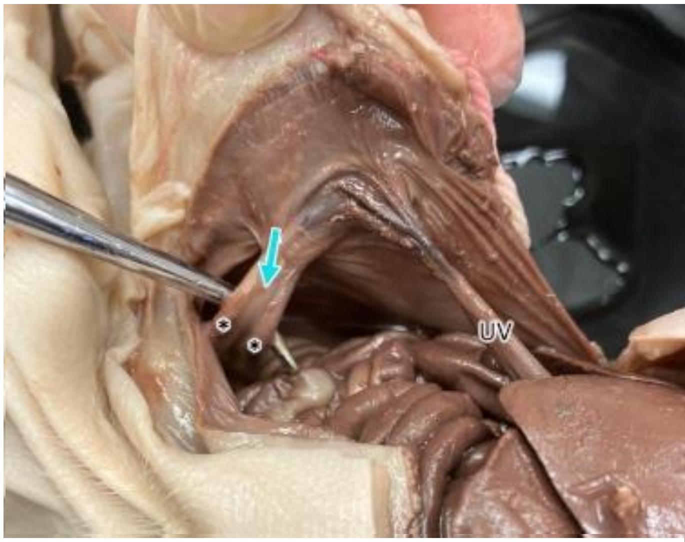


Fig. 73. From top to bottom, the ureter (arrows) becomes more visible as membrane is removed.

To dissect out the urinary bladder, lift the flap of the body wall that includes the umbilical cord. The umbilical arteries should still be attached, and the urinary bladder is positioned between them. Remove the connective tissue that attaches the urinary bladder to the ventral body wall (Fig. 74).



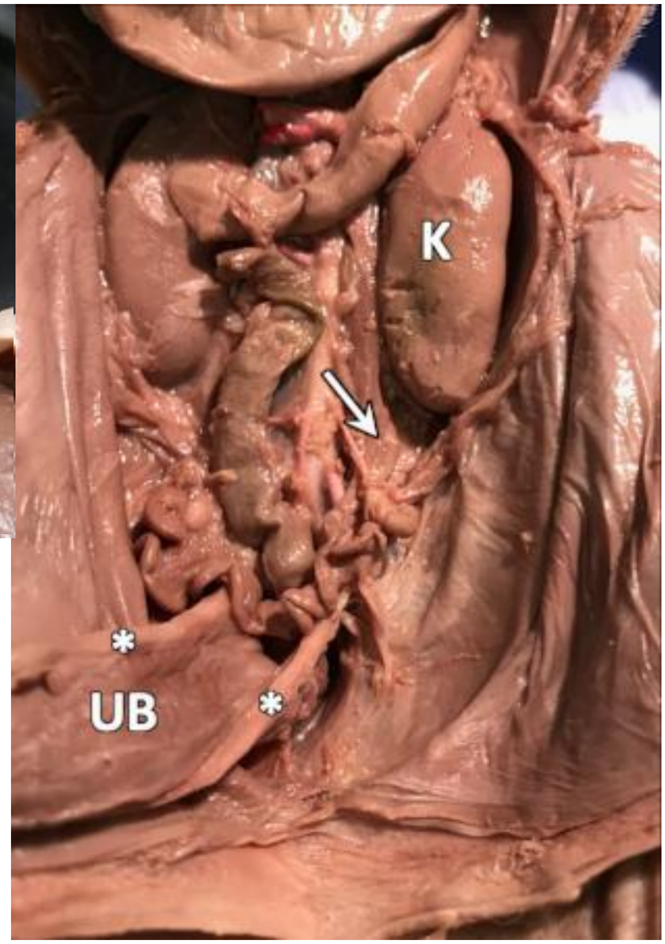


Fig. 74. The urinary bladder (blue arrow, UB) is found between the two umbilical arteries (asterisks). Also visible is the left kidney (K) and ureter (white arrow).

The remainder of the urinary system dissection overlaps with the reproductive system dissections. If you have a female pig, continue to the next page. If you have a male pig, skip to page 57.

***Protip**: Not sure if your pig is male or female? Go look at Figure 4 on page 5.*

Dissecting the Abdominopelvic Cavity: The Female Urinary and Reproductive Systems
There is limited dissection and tissue removal needed to visualize the female reproductive system.

Pigs are different from humans in that they birth litters, rather than a single offspring (usually) at one time. The human uterus is a single chamber, and the female reproductive tract resides entirely within the pelvic cavity. Animals that birth litters have uterine horns (Fig. 77). This means the uterus and vagina together are shaped like a “Y”. The two arms are the uterine horns, they meet at the body of the uterus, and then the vagina provides a single outlet for birth. Because the uterine horns are long, they stretch out into the abdominal cavity, and the ovaries are found at each end.

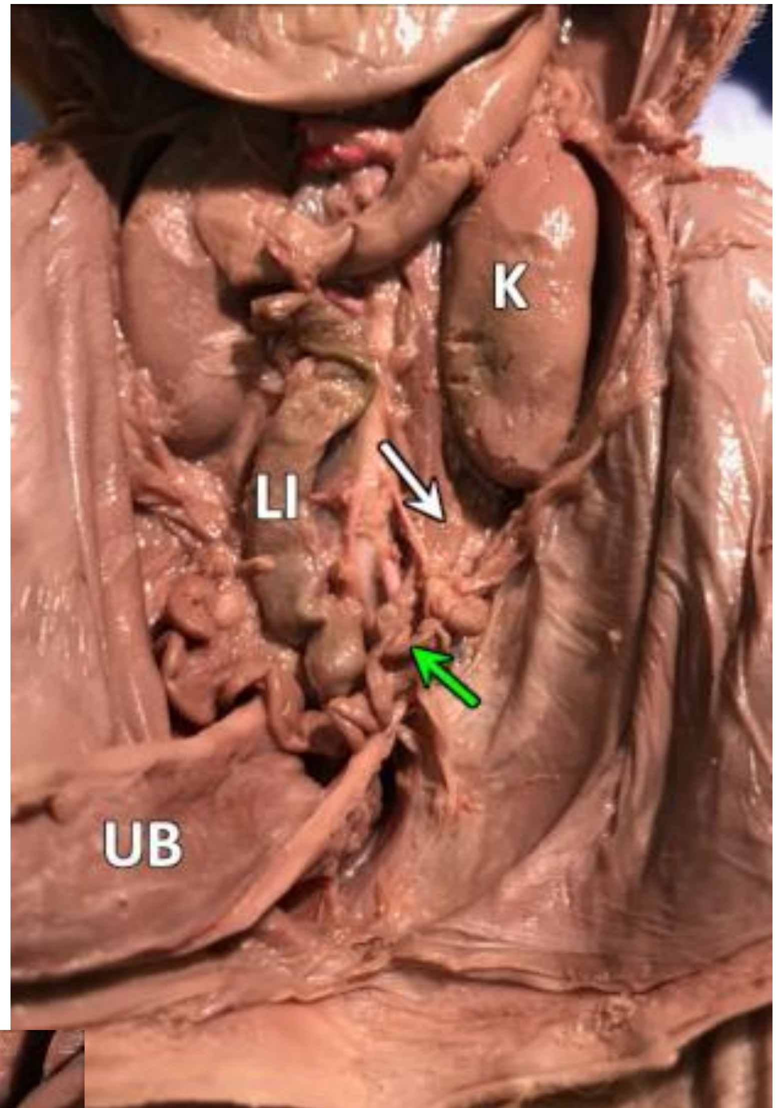
Table 12. Quick-view instructions for the female urogenital portion of the abdominopelvic dissection. Detailed instructions follow.

Steps involved		Useful Figures
GOAL Locate and uncover female urogenital structures	• Continuation of unisex urinary system dissection • Remove all membranes on dorsal abdominal wall • Remove all connective tissues that obstruct view of urinary and reproductive structures • Make it look like Figures 76 (after) and 77-79	75-76

For detailed instructions, see the next page.

Dissecting the Female Reproductive System: Detailed Instructions

The reproductive system is found within the membrane that lines the abdominal cavity, so one need only move the intestines out of the way, and it is immediately visible (Fig. 75).



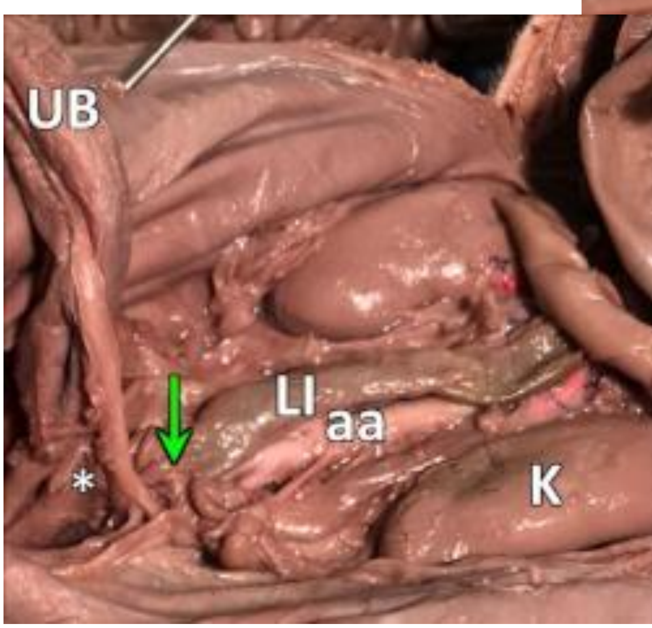


Fig. 75. Membrane has been cleared from the kidney (K) and ureter (white arrow). Note the ureter runs under the uterine horn (green arrow) to the urinary bladder (UB). The body of the uterus (asterisk) is lost in shadow above, but to the left, can be seen at the base of the urinary bladder. The large intestine (LI) and abdominal aorta (aa) are labeled for reference.

Remove any connective tissue that obstructs your view of the female reproductive and urinary systems. Pay particular attention to the pelvic cavity. Frequently, the vagina and urethra are surrounded by fat. You need to look into the pelvic cavity and see these structures. A properly cleaned female reproductive system looks like the "After" panel in Figure 76.

Fig. 76. Before and after view of the fully dissected female urinary and reproductive systems. Because there is so little tissue to remove, it is difficult to clearly label it. However, you can see clearly tissue that has been removed around the major arteries in the abdomen.

What Can I See Now? The Female Urinary and Reproductive Systems

<u>Female urinary and reproductive structures to identify</u>:

- Kidney
- Ureter
- Urinary bladder
- Urethra
- Ovary
- Uterine tube
- Uterine horn
- Body of uterus
- Vagina

The role of the urinary system (Fig. 77 & 79) is to filter the blood, removing wastes that are excreted as urine. The filtration organ is the **kidney**, which actually produces the urine. The remaining urinary structures are for transport and storage. The **ureter** transfers urine from the kidney to the **urinary bladder**, where urine is stored. When the urinary bladder is full, a nervous reflex is triggered that prompts urination, or urinary bladder drainage through the **urethra** into an appropriate receptacle.

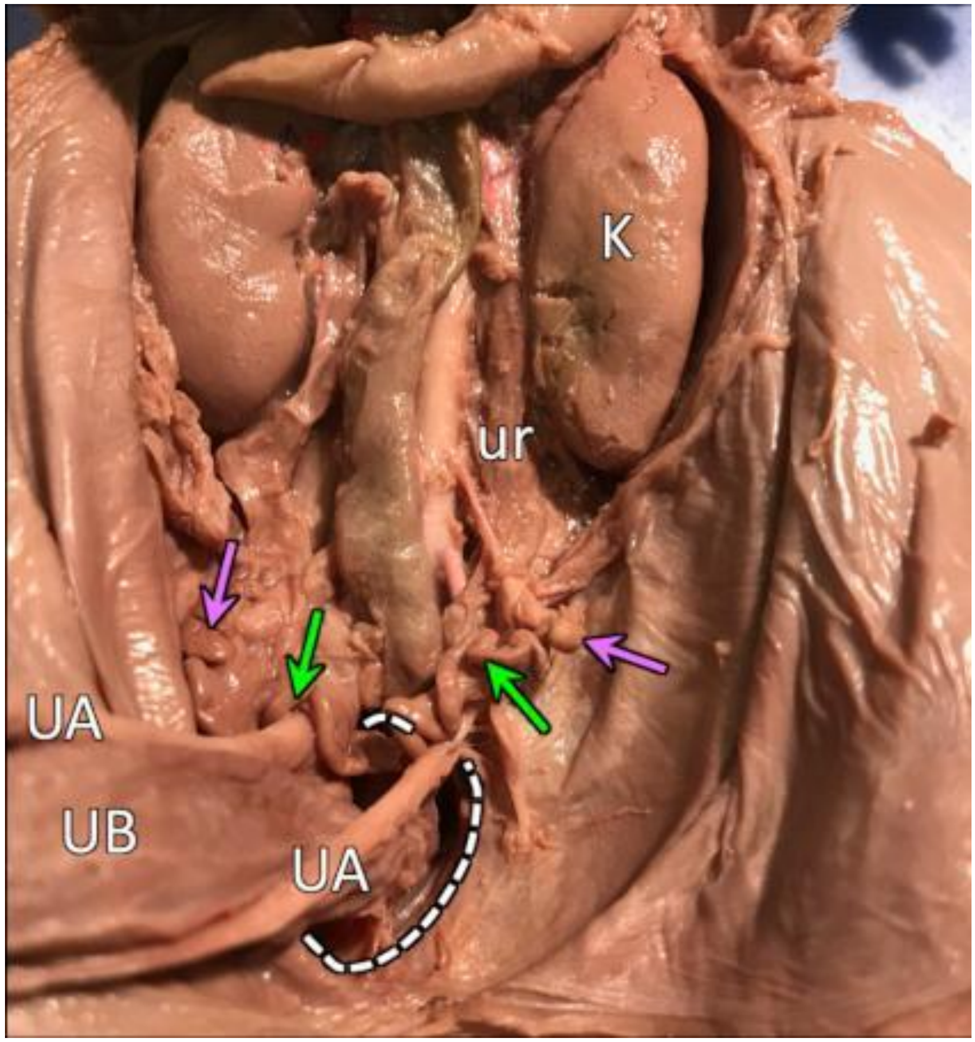


Fig. 77. Structures demonstrated include: kidney (K), ureter (ur), urinary bladder (UB), ovary (purple arrows), uterine horn (green arrows). The umbilical arteries (UA) and the border of the pelvic cavity (dashed line) are labeled for reference.

The role of the reproductive system (Fig. 77-79) is to propagate the species by producing offspring by sexual reproduction. Male sperm and female eggs are required for this process to occur. In females, the **ovary** is responsible for producing eggs. The eggs are released into the **uterine tube** (a.k.a. fallopian tube, oviduct) where fertilization by sperm occurs. Sperm are introduced to the female reproductive system at the **vagina**. They enter the **uterine tubes** after travelling through the body of the **uterus** and the **uterine horns**. If fertilization occurs, the dividing embryos travel from the **uterine tube** into the **uterine horn**, where the lining has been prepared for implantation. Glands in the uterine horn release chemicals that encourage implantation. This process is similar in humans; however, they lack uterine horns, and a single embryo simply implants in the much simpler chamber-like uterus. Following gestation, which occurs entirely within the uterus, the **vagina** serves as the birth canal.

Since pigs give birth to litters, it is crucial that embryos do not implant too close together so that they have enough room to grow. The means by which they ensure this is very interesting: when an embryo implants in the wall of the uterine horn, it releases its own chemicals that prevent any other embryos from implanting nearby. Once an embryo moves out of the range of these chemicals, then it is able to implant. This ensures that all offspring are properly spaced and able to develop.

Protip*: The uterine tube is located on the dorsal surface of the ovary. So, if you cannot see it, flip your ovary over (Fig. 78).*

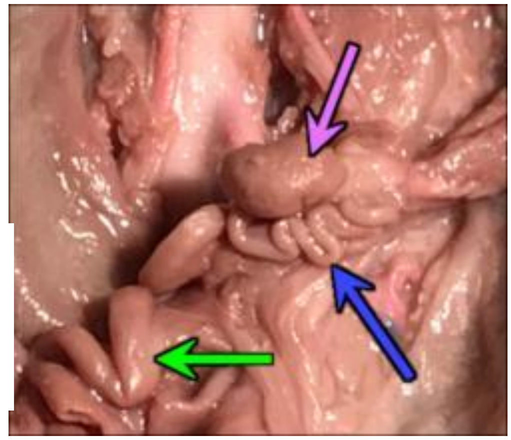


Fig. 78. The uterine tube is on the dorsal surface of the ovary. Structures demonstrated include: ovary (purple arrow), uterine tube (blue arrow), and uterine horn (green arrow).

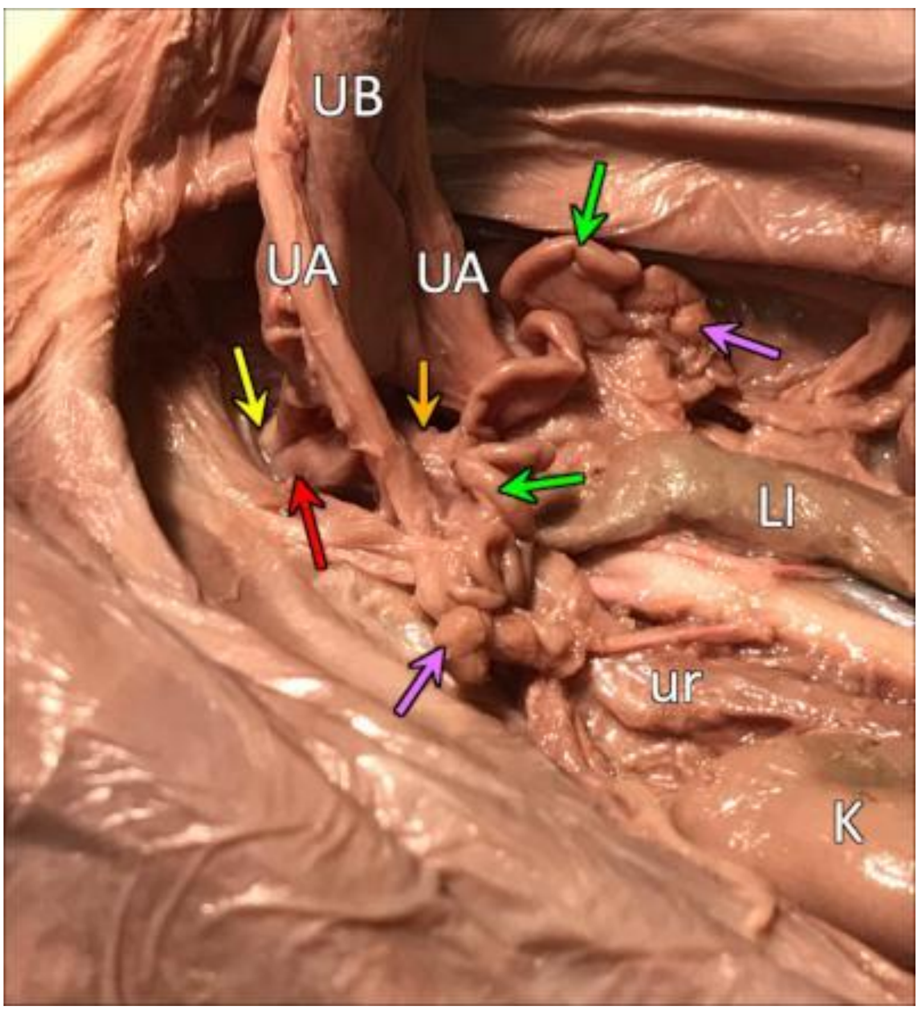


Fig. 79. This image was taken from the cranial and lateral perspective, so you can see into the pelvic cavity. This allows us to see the relative positions of the ovaries (purple arrows), uterine horns (green arrows), which merge into the body of the uterus (orange arrow), which opens into the vagina (red arrow). Ventral to the vagina is the urethra (yellow arrow). Also demonstrated are the left kidney (K) and ureter (ur). This view demonstrates clearly that the urinary bladder (UB) is located between the umbilical arteries (UA). The large intestine (LI) is labeled for reference.

Dissecting the Abdominopelvic Cavity: The Male Urinary and Reproductive Systems
There is extensive overlap in the dissection and anatomy of the male urinary and reproductive systems. Completing the dissection of the male will require a bit more scissor work than females do.

Table 13. Quick-view instructions for the male urogenital portion of the abdominopelvic dissection. Detailed instructions follow.

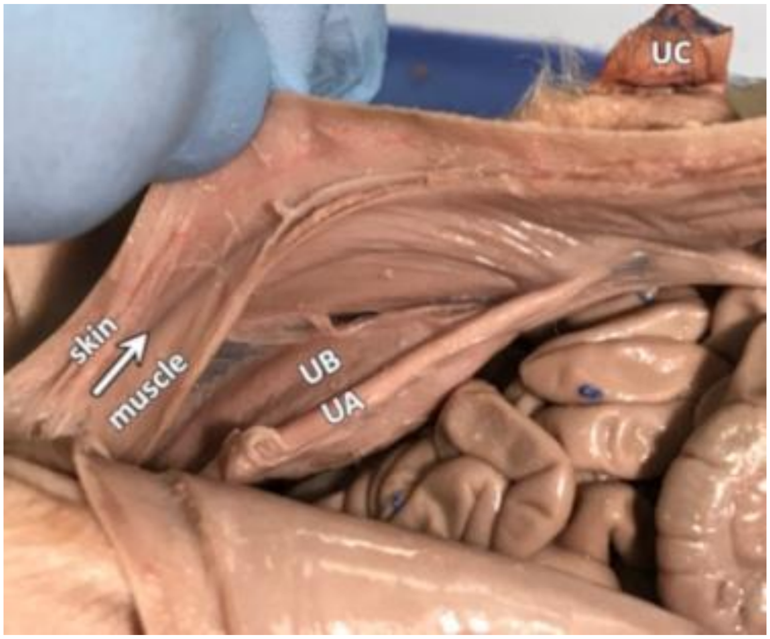
Steps involved		Useful Figures
GOAL 1 Dissect the urethra and penis	• Continuation of the unisex urinary system dissection • Palpate ventral abdominal flap to locate the urethra • Separate skin from muscle on the ventral abdominal wall reveal it • Remove connective tissue cranially • Penis = enlargement at urethra end just below umbilical cord	80-81
GOAL 2 Dissect the scrotum	• Extend abdominal incision into one side of the scrotal wall • Remove fine connective tissues • Cut open the fibrous sac • Remove testes from scrotum • Protect urethra along midline • Dissect testis and epididymis from fibrous sac on one side	82-86

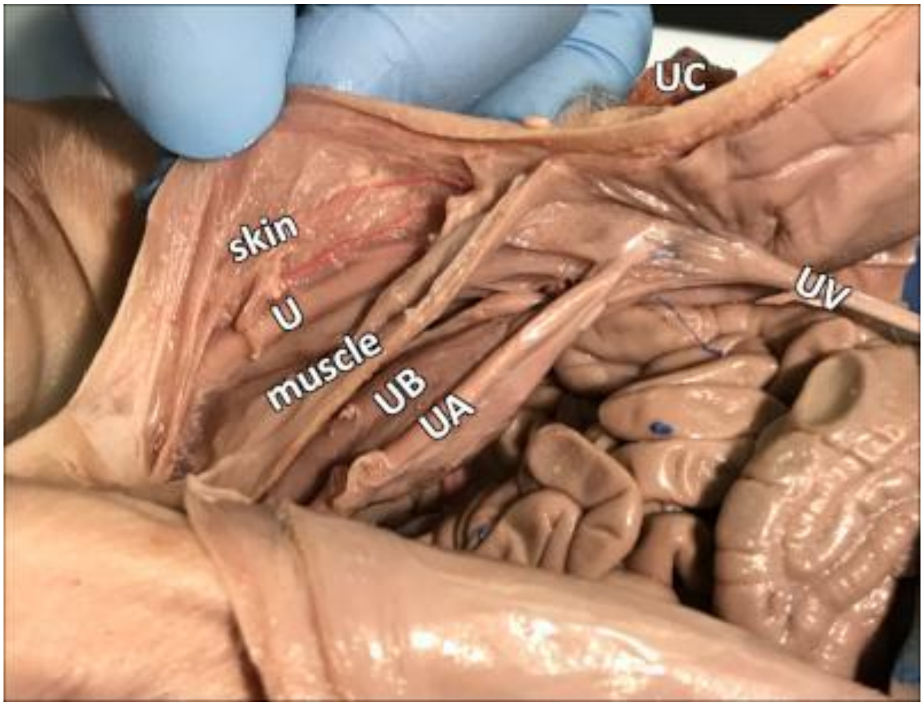
GOAL 3
Detach the umbilical cord and penis from the abdomen
	• Allows better look at reproductive structures
	• Make two left-to-right cuts
	  ○ Muscle between urethra and urinary bladder
	  ○ Skin ventral to the urethra
	• Cut skin and muscle caudal-to-cranial, mirroring original abdominal incision
		87-88

In human males, the penis is an external structure, and the urethra is embedded within it. In the pig, the penis is sheathed between the skin and the muscular layer beneath it at all times except during erection. The urethra is a long tube that eventually ends in the penis. To visualize the penis and the urethra, use your forceps to carefully separate the skin of the ventral body wall from the abdominal muscles beneath (Fig. 80). Once you have located the urethra, completely detach it from the surrounding connective tissue.

Protip: If you'd like to determine where the urethra is located prior to separating skin from muscle, just use your thumb and forefinger to squeeze the body wall. You will be able to feel the tube embedded within!

Fig. 80. (top image) The urinary bladder (UB) is located between the two umbilical arteries (UA). Locating the urethra (U) requires that you separate the skin of the lower abdomen from the muscle beneath at the location indicated by the arrow. The umbilical cord (UC) and umbilical vein (UV) are labeled for reference. (bottom image) The separation is complete.





You first should continue detaching the urethra in the cranial direction, toward the penis. This is a simple matter of removing and tearing through connective tissue between the skin and the abdominal muscle. The male urogenital opening is just caudal to the umbilical cord, so you have an external visual marker on where you should start to find the enlargement of the penis (Fig. 81).

Protip*: It is difficult to tell exactly where the penis begins to sheath the urethra, so it is best indicated on the enlarged head.*

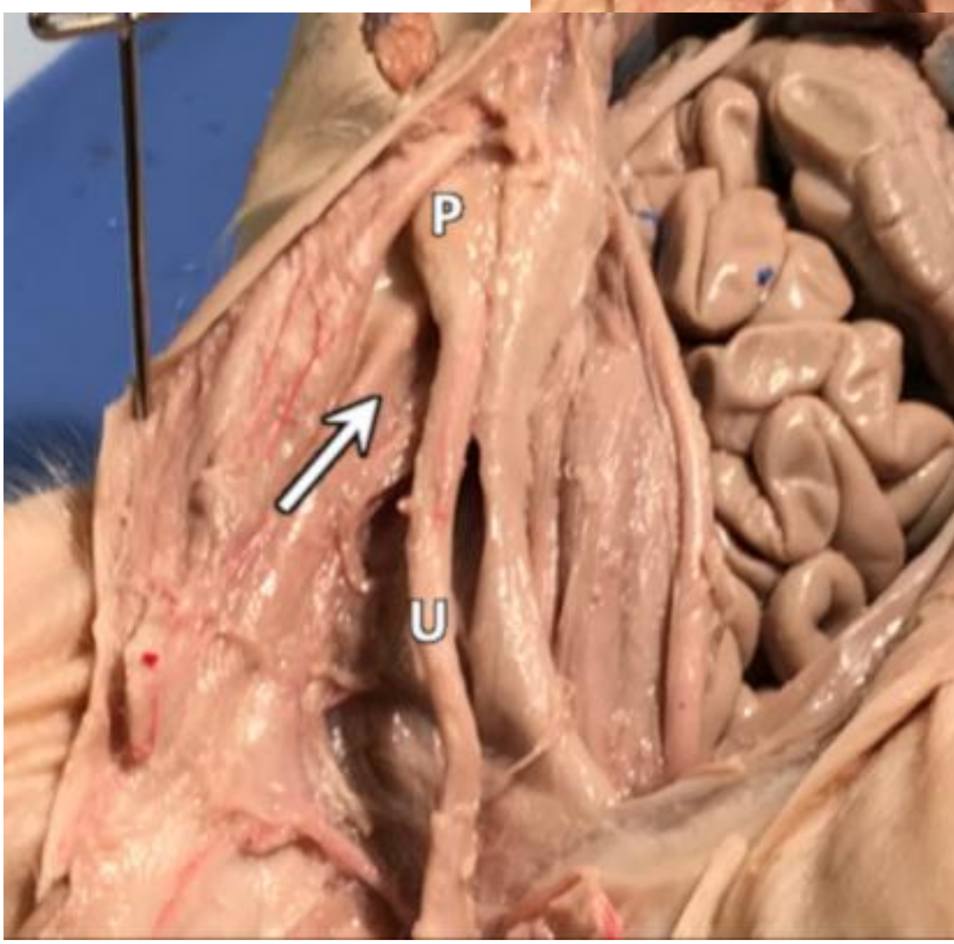


Fig. 81. The penis (P) is apparent at the urogenital opening, and encloses the urethra (U). The arrows in the two panels are placed in the same location, indicating how much further dissection was necessary.

Next, the abdominal incision should be extended into the skin only of the scrotal sac (Fig. 82). Take care to separate the skin from the underlying connective tissue prior to cutting. Note that this cut should be made away from the midline to avoid harming the urethra. Keep your scissor tips up.

Once you have cut into the scrotal sac, you will likely be able to make out the shape of one or both testes (Fig. 83). Gently remove the web-like connective tissue with a pair of forceps until you locate the fibrous sheath that encloses both testes in the scrotum (Fig. 83)

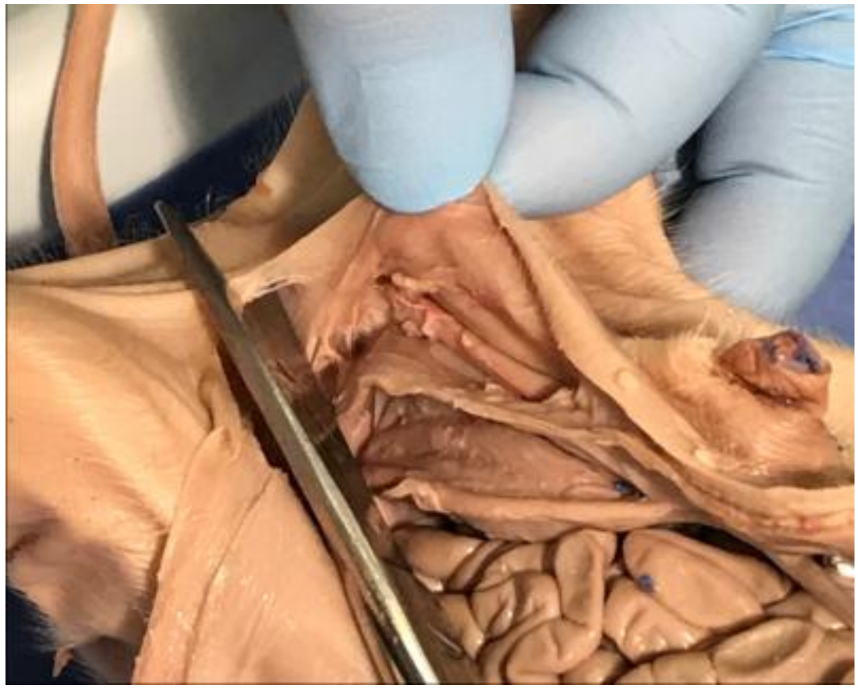


Fig. 82. When cutting into the scrotal sac, use scissors on the skin only.

Fig. 83. (above) The arrow indicates the location of a testis. (right) The arrow demonstrates a tear in the fibrous sheath enclosing both testes. The urethra's (U) path takes it between the two testes, so take care not to damage it.

Cut open the fibrous sac that encloses both testes with the small scissors. You can visually confirm that you will not damage the scrotal contents since the sac is transparent, so you can see what you're cutting.

Once the sac is open, use your fingers to carefully lift the testes out of the scrotum. You will see that each testis is enclosed by a smaller, separate fibrous sac (Fig. 84).

Fig. 84. The testes can be lifted out of the scrotal sac individually. Be careful as you cut connective tissue, as the urethra (U) passes through the gap indicated by the arrow.

Once the testes have been removed from the scrotal sac, one of them should be removed from its individual sheath. In order to prevent harming the delicate tissue inside, it is better to snip the sac than it is to try and tear it with your forceps.

Like the sheath within the scrotal sac, this fibrous tissue is transparent (Fig. 85). Be sure to carefully place your scissors and visually check to be sure you have not caught any tissue between the blades before cutting.

Once you have opened the fibrous sheath, you do not need to do any further dissection to view its contents (Fig. 86).

Fig. 85. The fibrous sheath enclosing each testis is transparent, allowing you to cut carefully. The urethra (U) is labeled for reference.

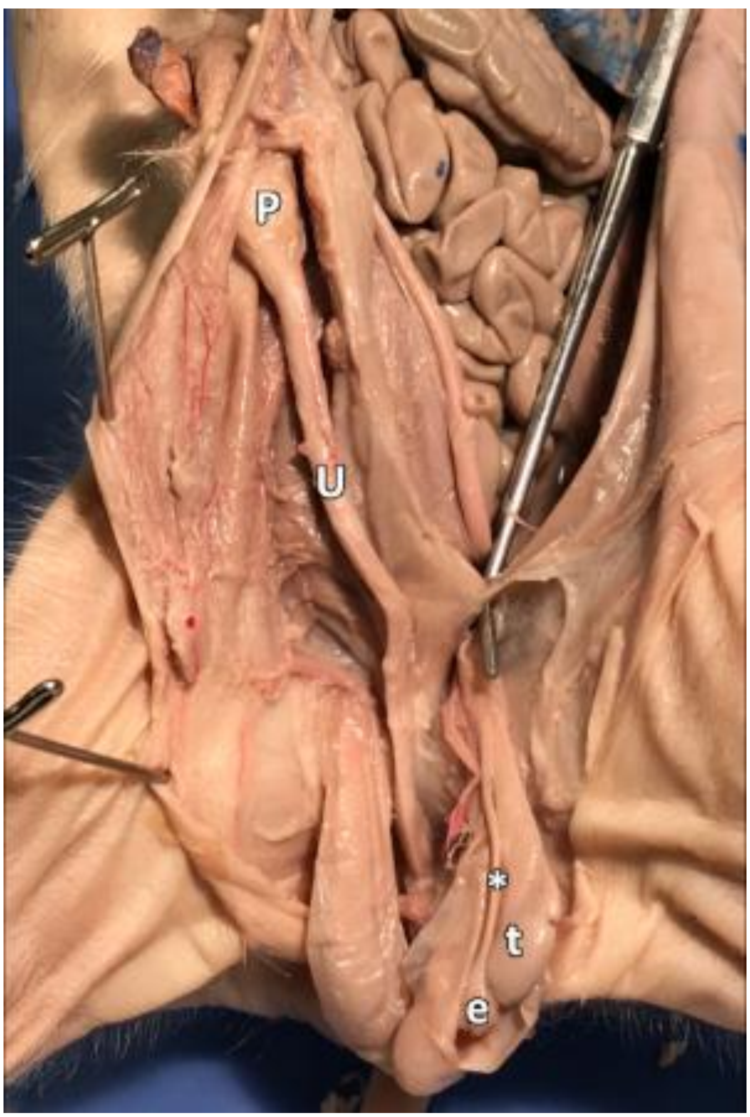
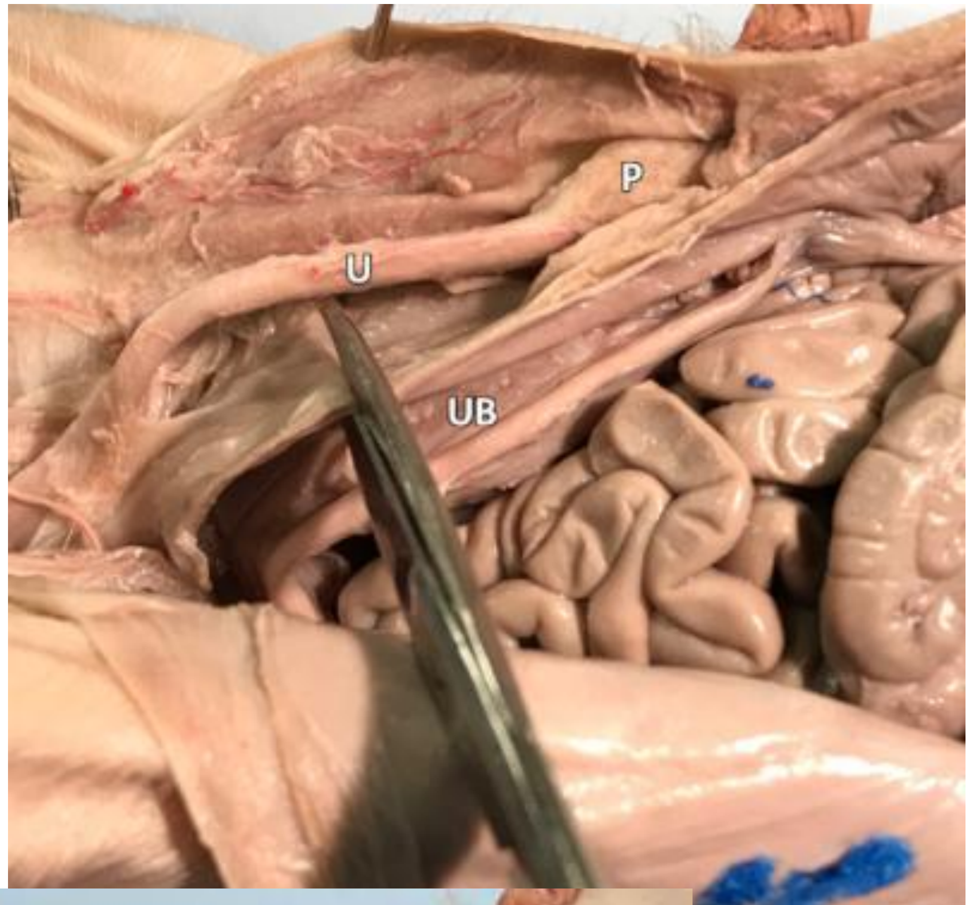


Fig. 86. The fibrous sheath encloses the testis (t), epididymis (e) and vas deferens (*). The urethra and penis are labeled for reference.

In order to get the best view of the urinary and reproductive structures, it helps to separate the skin around the umbilical cord and urogenital opening from the rest of the abdomen. However, the urethra is at risk of being cut during this process.

First, cut the abdominal muscle layer between the urethra and the urinary bladder (Fig. 87). Before cutting, ensure that only the muscle is caught between the blades.

Second, make a similar cut in the skin, taking care to cut only skin.



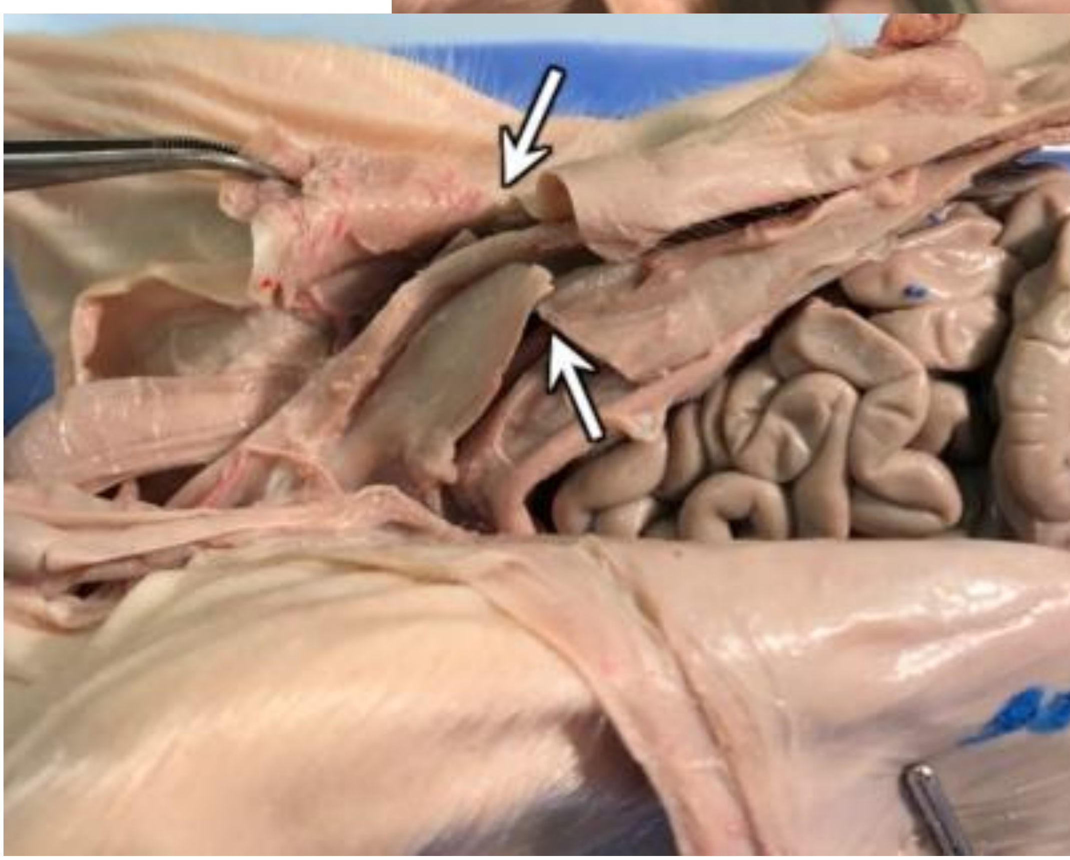


Fig. 87. First steps in the detachment of the umbilical cord and penis from the abdomen.

By cutting the skin surrounding the umbilical cord and penis away from the rest of the abdomen, you will be able to move them as needed to visualize other structures. It is very important to leave the intact so that they remain in the correct position urethra.

Before cutting on the urethra side of the umbilical cord, peel the skin off of the underlying muscle. The skin and muscle will need to be cut separately on the urethra side. On the other three sides, you can cut through the skin and muscle together with no problem.

***Protip**: If you'd like to trim closer to the umbilical cord, flip the flesh over so that you can view the internal face. This way, you can avoid damaging the bladder and umbilical arteries.*

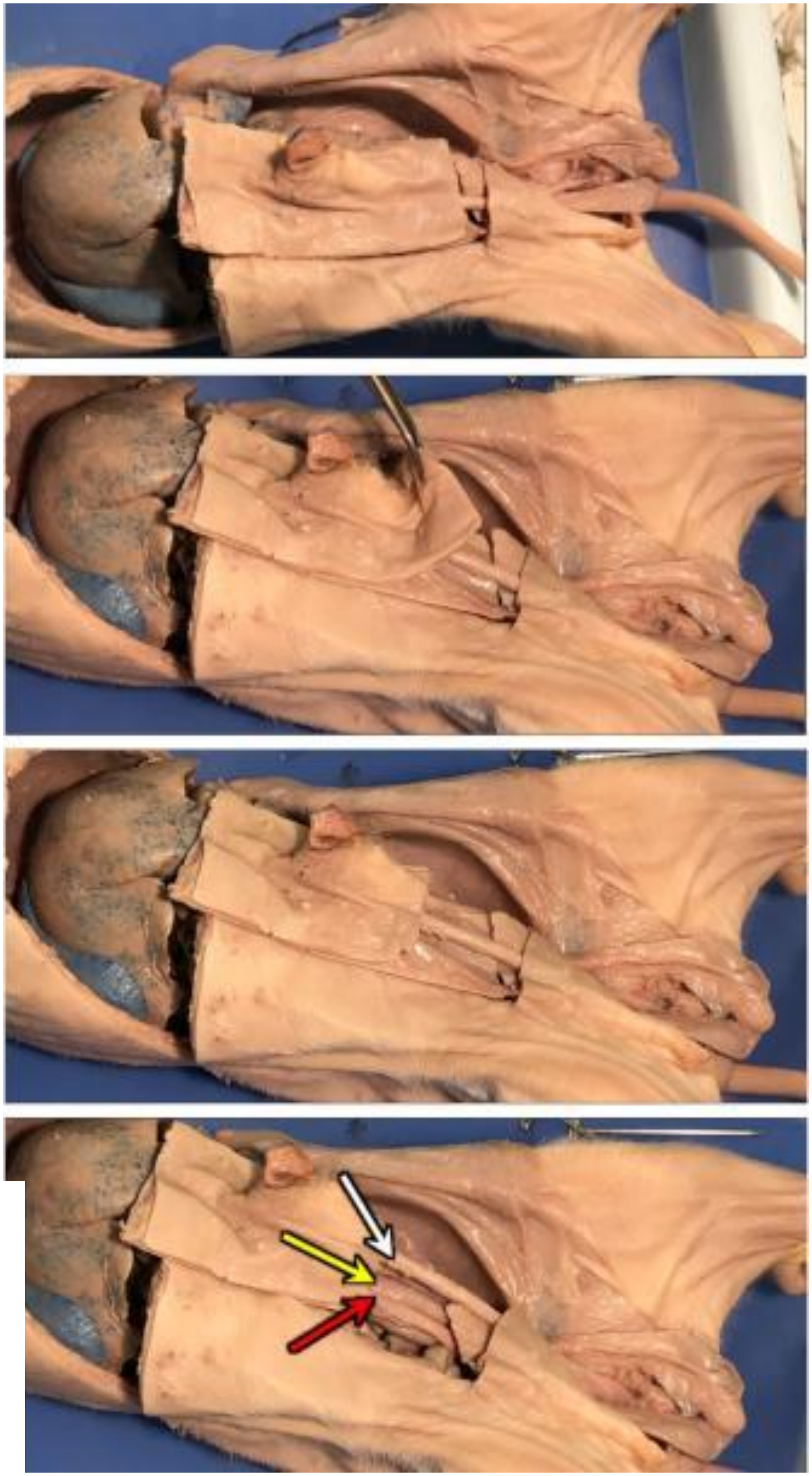


Fig. 88. Completing the detachment of the umbilical cord and penis from the abdomen. In the bottom panel, labeled by arrows: urethra (white), urinary bladder (yellow) and umbilical artery (red).

What Can I See Now? The Male Urinary and Reproductive Systems

<u>Male urinary and reproductive structures to identify:</u>
- Kidney
- Ureter
- Urinary bladder
- Urethra
- Testis
- Epididymis
- Vas deferens
- Penis

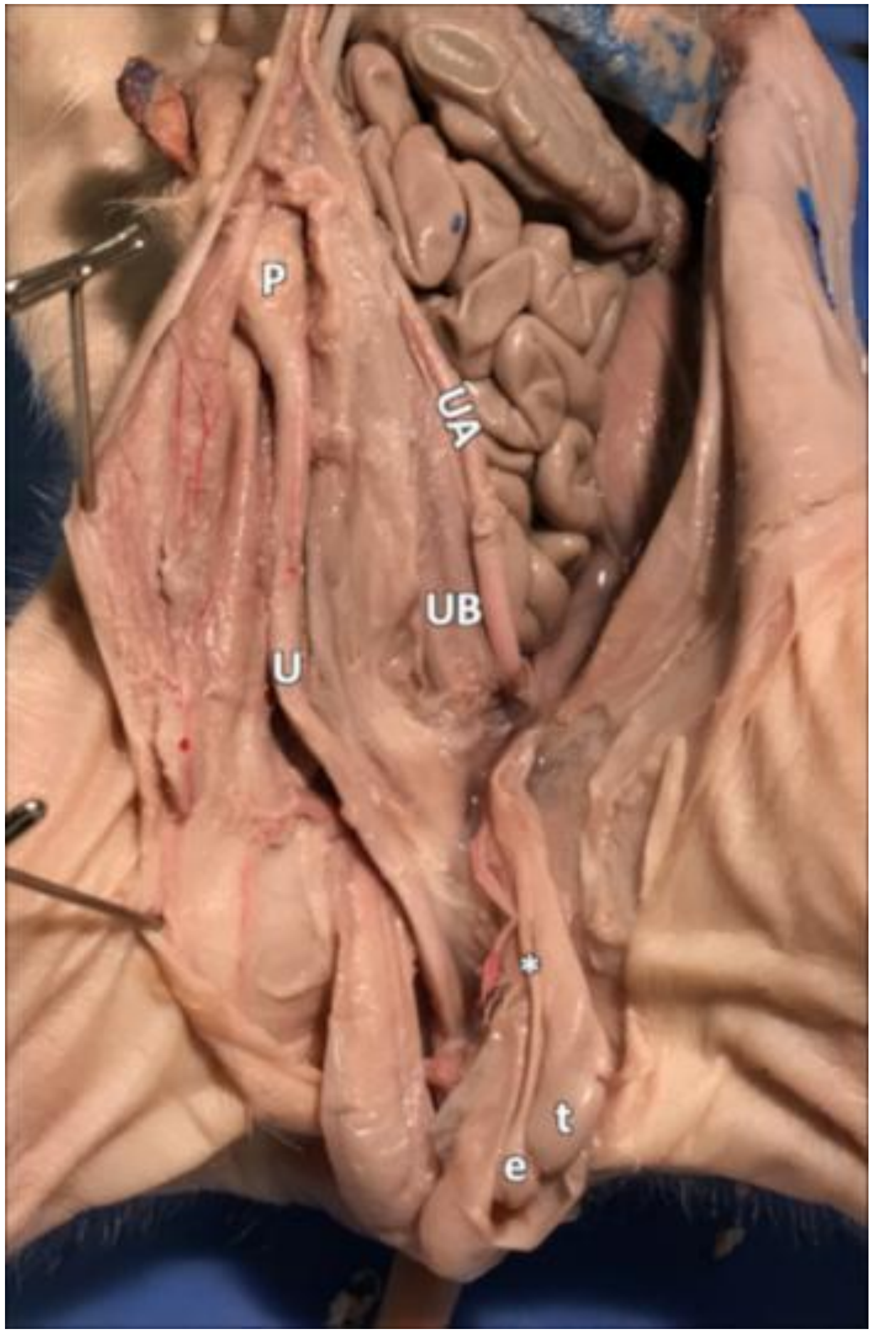


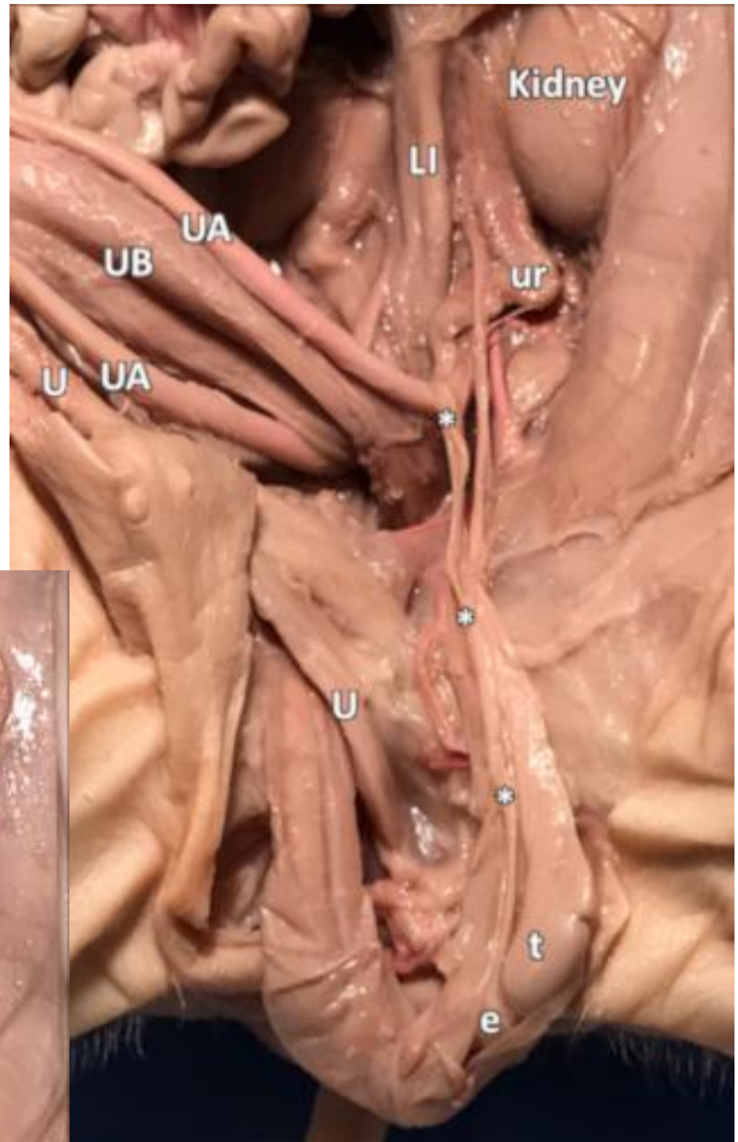
Fig. 89. Structures demonstrated include: urinary bladder (UB), urethra (U), penis (P), testis (t), epididymis (e), and vas deferens (*). The umbilical artery (UA) is labeled for reference.

The role of the urinary system (Fig. 89-91) is to filter the blood, removing wastes that are excreted as urine. The filtration organ is the **kidney**, which actually produces the urine. The remaining urinary structures are for transport and storage. The **ureter** transfers urine from the kidney to the **urinary bladder**, where urine is stored. When the urinary bladder is full, a nervous reflex is triggered that prompts urination, or urinary bladder drainage through the **urethra** into an appropriate receptacle.

The role of the reproductive system (Fig. 89-91) is to propagate the species by producing offspring by sexual reproduction. Male sperm and female eggs are required for this process to occur. Male sperm are produced in the **testis** and mature in the **epididymis**. During ejaculation, sperm are propelled from the epididymis into the **vas deferens**, which empties into the **urethra**. The urethra originates at the base of the urinary bladder and carries urine, as well. There are muscles that contract to prevent urination and ejaculation from happening at the same time.

The contents of the scrotal sac are located outside of the body wall. The vas deferens therefore must carry sperm out of the sac, in through the body wall, and up and over the umbilical arteries and ureters before they merge into the urethra in the pelvic cavity.

If you orient the umbilical cord to the pig's right, you can see an extensive view of the path of the vas deferens (Fig. 90 top). If you position the umbilical cord so that it sits between the pig's legs (Fig. 90 bottom), you get a good view of the path of the vas deferens into the pelvic cavity, where it merges with the urethra.



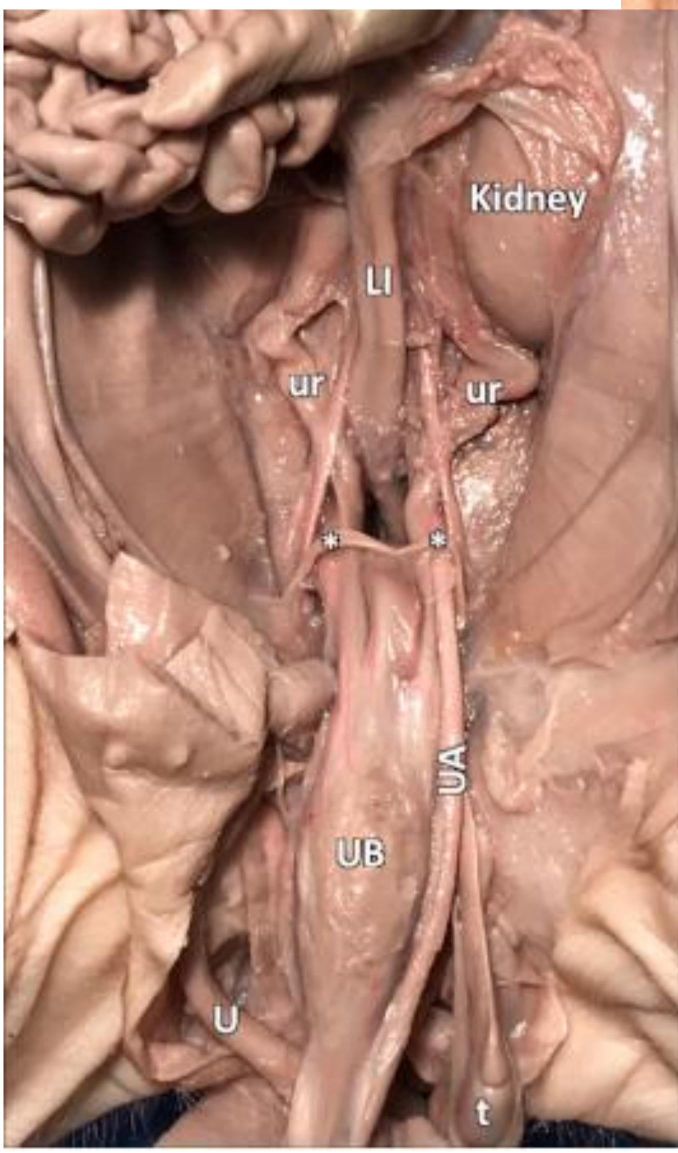


Fig. 90. The orientation of the umbilical cord alters your view of the urinary and reproductive structures. Above, the umbilical cord is positioned laterally (pulled to the side). To the left, it is positioned caudally (pulled between the legs). Structures demonstrated include: kidney, ureter (ur), urinary bladder (UB), urethra (U), penis (P), testis (t), epididymis (e), and vas deferens (*). The large intestine (LI) and umbilical artery (UA) are labeled for reference.

Keeping the umbilical cord between the legs and then looking from to the head of the pig, you can get a good view into the pelvic cavity (Fig. 91). The rectum is found in the dorsal aspect of the cavity, and the urethra can be seen exiting the urinary bladder on the ventral wall.

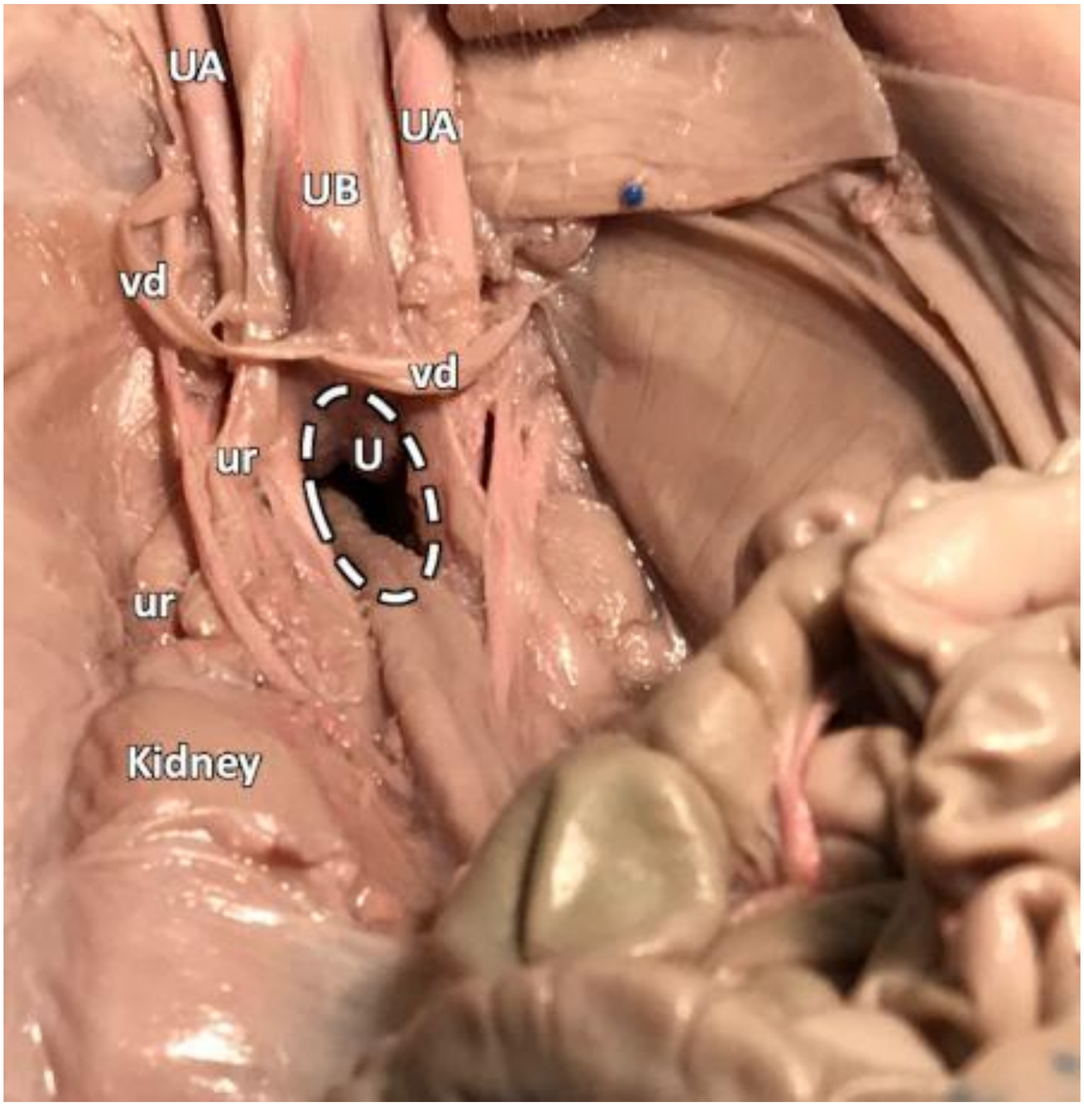


Fig. 91. Structures demonstrated include: kidney, ureter (ur), urinary bladder (UB), urethra (U), vas deferens (vd). The umbilical arteries (UA) are labeled for reference.

Dissecting the Abdominopelvic Cavity: Major Blood Vessels

Table 14. Quick-view instructions for the abdominal vessel dissection. Detailed instructions follow.

	Steps involved	**Useful Figures**
GOAL Locate and dissect abdominal vessels	• Involves a lot of connective tissue removal • Best approach is typically from the pig's left • Shift all abdominal structures over • Remove membrane to find vessels on dorsal abdominal wall • Using forceps and blunt probe, trace vessels to separate from other tissues	92-94

For detailed instructions, see the next page

Abdominal Blood Vessel Dissection: Detailed Instructions

After the aorta bends to form the aortic arch, it descends through the dorsal thoracic cavity, perforates the diaphragm, descends through the dorsal abdominal cavity, and supplies blood to the abdominopelvic cavity. We will look at the major branches of the abdominal aorta that supply the organs we have discussed. There is very little additional dissection needed to see these branches.

The general rule for dissecting these vessels is to shift the position of the abdominal organs to the pig's right in order to get access to the abdominal aorta itself, which sits just left of the midline. In some images, you'll see T-pins that hold the organs out of the way. Feel free to use pins in your own dissection.

***Protip**: Make sure you pin your structures down to muscle, avoid damage of structures you want to visualize, and do not put the pin all the way to the blue pad of your dissection tray!*

The easiest place to start is just above the pelvic region since you have already removed significant connective tissue in this area (Fig. 92). Remove connective tissues that surround the aorta and the branches that arise from the aorta. You will find a single branch that serves the descending large intestine, called the posterior mesenteric artery, as well as two branches (left and right) that serve the gonads, the gonadal arteries.

We will not dissect the branches that serve the pelvis due to space and time constraints.

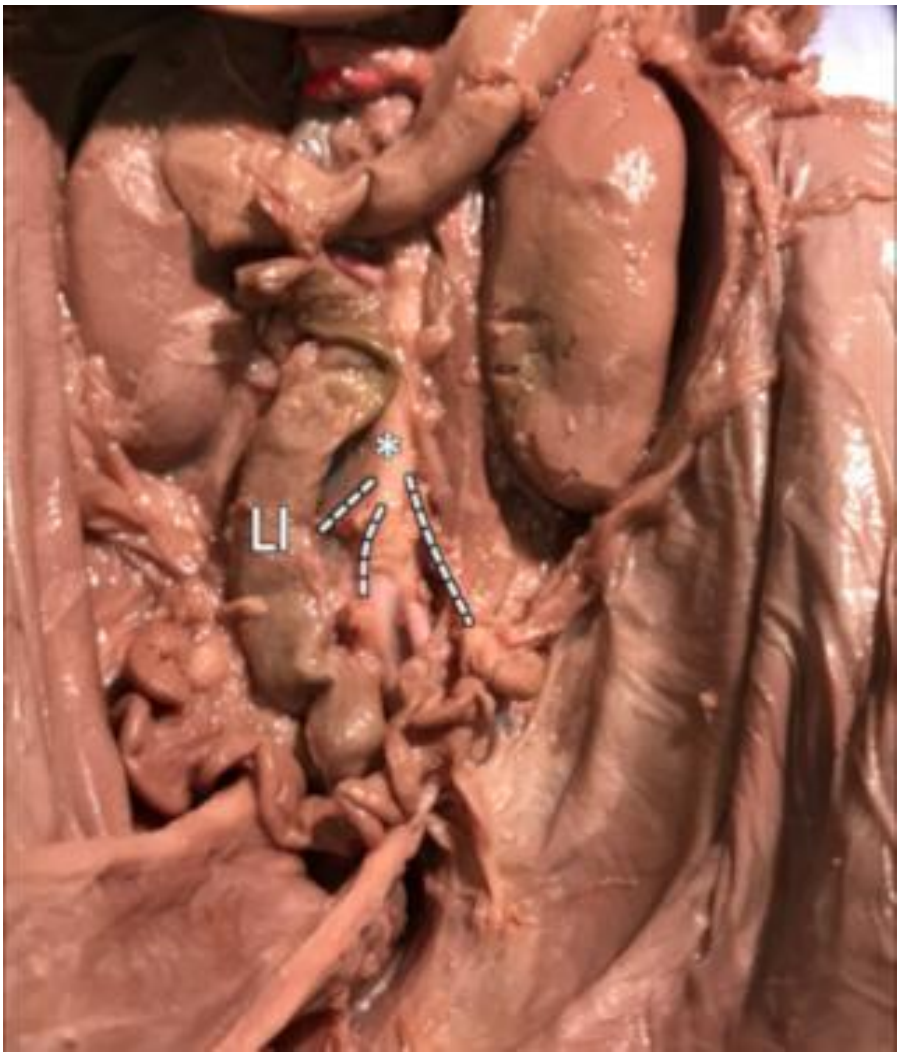


Fig. 92. The abdominal aorta (*) sits to the left of the midline on the dorsal abdominal wall. Dissecting its branches is a matter of connective tissue removal. The dashed lines indicate the locations of the posterior mesenteric and gonadal arteries. The right gonadal artery is covered by the large intestine (LI).

Moving cranially, move the spleen, stomach and intestines to the right to view more aortic branches. In addition, we will visualize the posterior vena cava and renal vein.

First, locate the point at which the ureter departs the kidney (Fig. 93). The renal artery and vein are found in the same area. Remove connective tissue to view the renal arteries. The renal vein crosses over the abdominal aorta to drain into the posterior vena cava, which runs parallel and to the right of the aorta. In the region of the kidney, there are two renal arteries (left and right), the anterior mesenteric artery and the celiac trunk (Fig. 94).

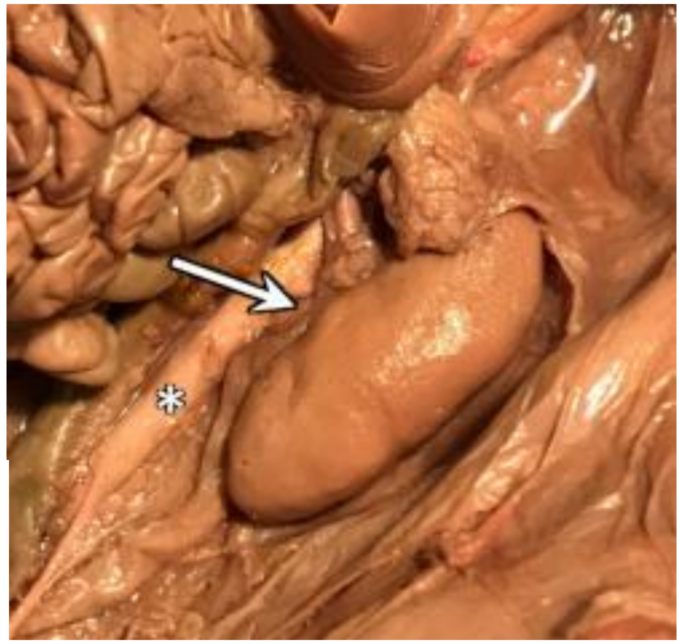


Fig. 93. The abdominal aorta (*) runs between the two kidneys. The renal artery and vein supply the kidney in the same location as the ureter (arrow).

Fig. 94. The dashed lines indicate the locations of the renal arteries, renal vein, celiac trunk and superior mesenteric artery.

What Can I See Now? Major Abdominopelvic Blood Vessels

<u>Abdominal vessels to identify</u>:

- Abdominal aorta
  - Celiac trunk
  - Anterior mesenteric artery
  - Renal arteries
  - Gonadal arteries
  - Inferior mesenteric artery
- Posterior vena cava
  - Renal vein

The celiac trunk supplies the spleen, pancreas, stomach, small intestine, liver, and gallbladder. The anterior mesenteric artery serves the cranial two-thirds of the small and large intestine. The renal arteries and vein supply the kidney. The gonadal arteries serve the testes (male) and ovaries (female). The posterior mesenteric artery serves the remainder of the small and large intestine, including the rectum.

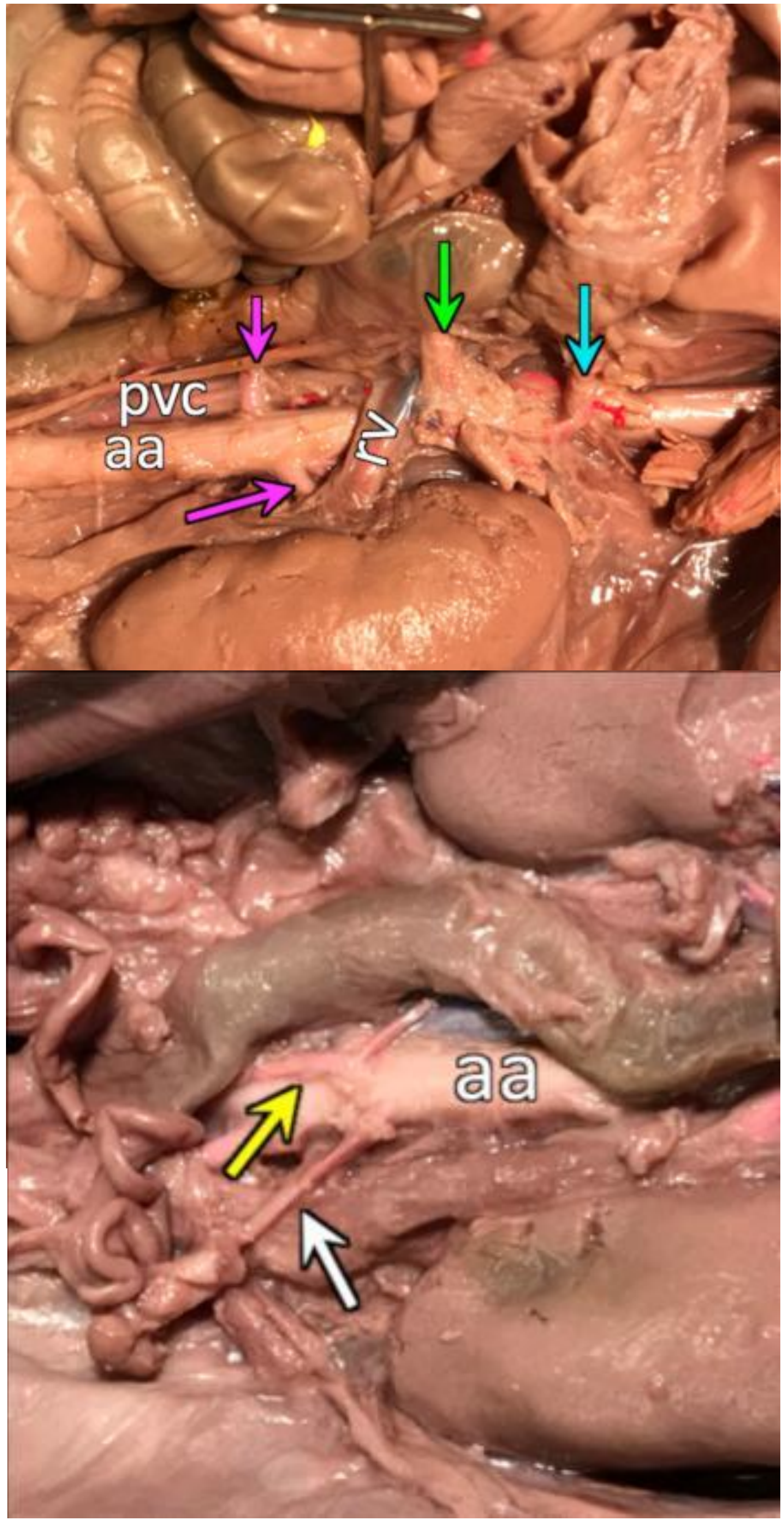
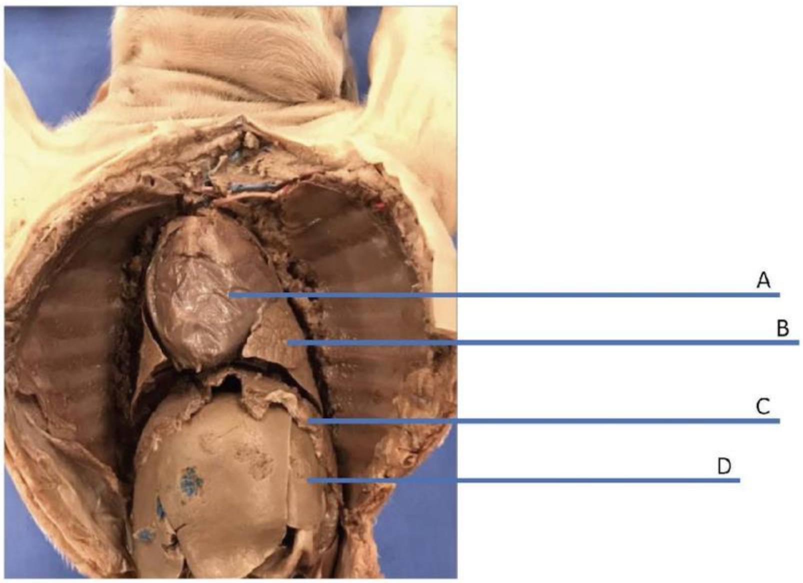


Fig. 95. Vessels demonstrated include: abdominal aorta (aa), celiac trunk (blue arrow), anterior mesenteric artery (green arrow), renal arteries (pink arrows), gonadal arteries (white arrow), posterior mesenteric artery (yellow arrow), abdominal aorta (aa) and the posterior vena cava (pvc).

Name ______________________________ Lab 6 – Fetal Pig Dissection Post Lab Questions
Due March 30, 2020

This worksheet should be completed in your own words. You should not copy from any source including other students.



1. Structure A is located in the ________________________ body cavity and the ___________________________ sub-cavity.
2. Structure A is covered by a sac called the ____. What is the best dissection tool to use to cut through this sac? ____
3. Name Structure B. ____
4. Name Structure C. ____
5. What organ system does Structure D belong in? _________________________________
6. What is the best tool to use to cut through the ribs during your dissection?
____

7. Name 2 characteristics that allow you to classify pigs as mammals.

____

____

8. Name 2 differences between the body of the pig and the body of a human.

____

____

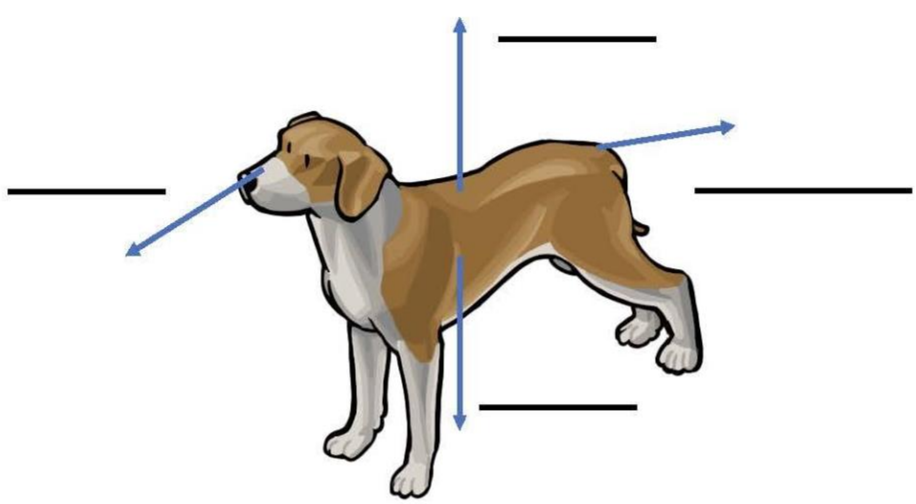
9. How would you know if you found the pancreas during your pig dissection?

____

10. What is the function of the following structures?

Structure	Function
Umbilical Cord	
Thyroid Gland	
External Jugular Vein	
Subclavian Artery	
Larynx	
Spleen	
Gallbladder	
Kidney	

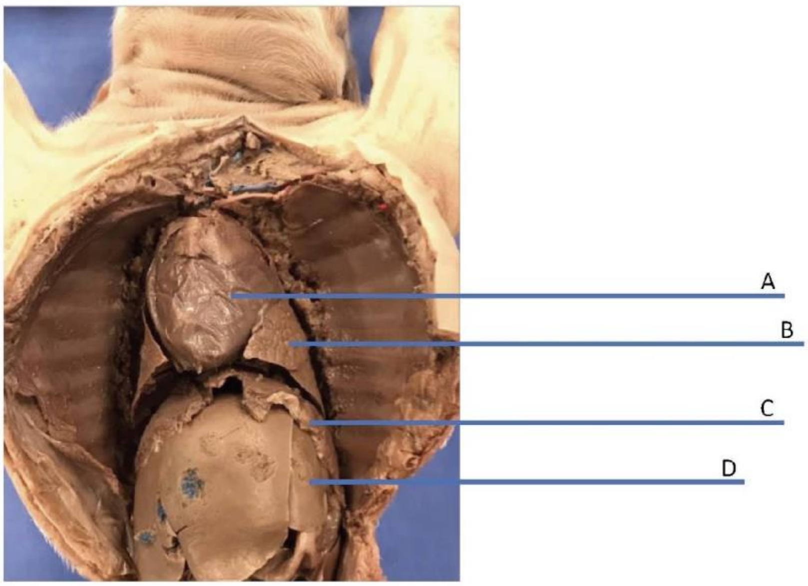
11. Label the appropriate directional terms



Name KEY **Lab 6 – Fetal Pig Dissection Post Lab Questions**

Due March 30, 2020

This worksheet should be completed in your own words. You should not copy from any source including other students.



1. Structure A is located in the thoracic body cavity and the Mediastinum sub-cavity.
2. Structure A is covered by a sac called the pericardium. What is the best dissection tool to use to cut through this sac? small scissors
3. Name Structure B. Lung
4. Name Structure C. Diaphragm
5. What organ system does Structure D belong in? Digestive
6. What is the best tool to use to cut through the ribs during your dissection? large scissors

7. Name 2 characteristics that allow you to classify pigs as mammals.
various- produce milk, have hair, sweat glands, ossicles, 4-chambered heart, etc.

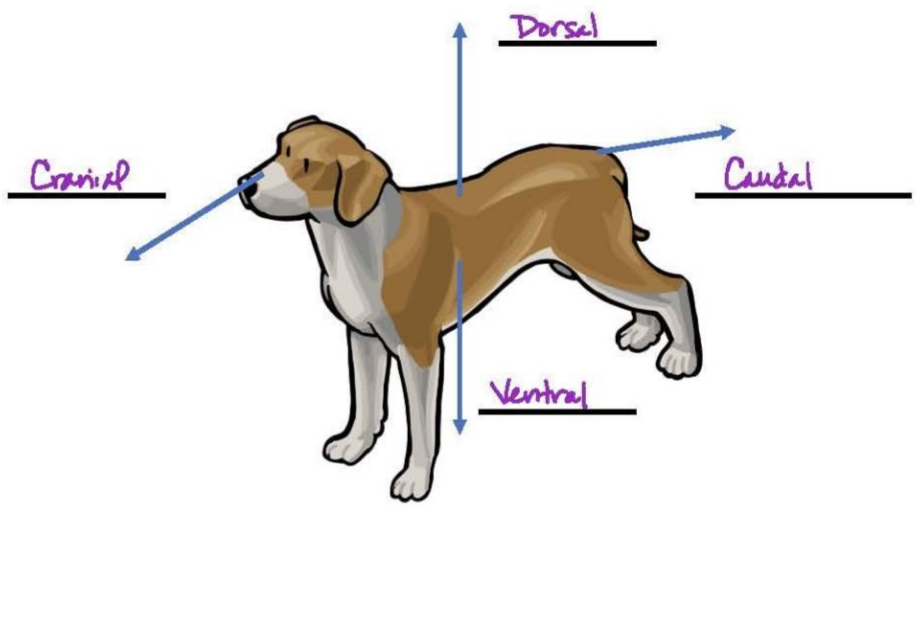
8. Name 2 differences between the body of the pig and the body of a human.
various- bronchial tree, R lung lobes, uterine horns vs single chamber, orientation, vessel branching, large intestine layout, large cecum/stomach, etc.

9. How would you know if you found the pancreas during your pig dissection?
under stomach- looks like chewed gum

10. What is the function of the following structures?

Structure	Function
Umbilical Cord	gas/nutrient/waste exchange w/ maternal
Thyroid Gland	produces hormones (metabolism, calcium)
External Jugular Vein	returns deox. blood → heart
Subclavian Artery	carries ox. blood → arm
Larynx	top of airway, blocks inhalation of food
Spleen	erythrocyte recycling & immunity
Gallbladder	modifies & stores bile
Kidney	removes waste from blood, regulates blood pressure

11. Label the appropriate directional terms



Materials

Double injected Fetal Pigs (BioCorp Catalog number FP1314D)
Small, curved forceps, blunt tip
Large Scissors, one blunt tip, one sharp tip
Small scissors, sharp tip
Blunt probe
Dissection trays
Rubber bands

Notes for the Instructor

This lab was designed to be used in both non-majors and lower-level majors courses. It is expected that instructors will modify which sections they wish to use and how much detail to cover for each dissection topic. For example, the dissection of the major vessels is included in this lab, but we do not cover that portion in the non-majors course. We have provided both quick reference tables and detailed dissection instructions in paragraph form. You can decide which to provide your students (or use both) based on your student's needs. You may also want to trim portions of the lab based on the length of your lab period. You are welcome to email us if you would prefer to have an editable version of this lab or want higher quality images.

The instructions are written for students with dissection experience to work through the lab with limited assistance. But our non-major students have very little prior dissection experience and are able to complete the lab with some assistance. We recommend beginning this lab by reviewing each of the dissection tools and key terms. An image and description are included at the start of the lab document, but we find that students do not always read this portion or match it up correctly with the tools in front of them. A quick note, we intentionally do not use scalpels in this lab. It is too easy for students to make errors using a scalpel or to cut themselves. Many students are also not familiar with terms such as dorsal, ventral, caudal, cranial, lateral, and medial. A quick game of "Simon Says" can help familiarize them with these directional terms. We also find it very useful to demonstrate the first few cuts and ask everyone to do them together at the same pace. This way, you can help field questions about dissection methods and start everyone at the same level of understanding. It is critical to circulate around the classroom through the lab period to ensure all students are accessing and identifying structures correctly.

We occasionally have students who are unable to perform dissections due to religious, personal, or medical reasons. In these cases, we first determine if they are willing/able to watch others perform the dissection in the classroom. If watching others is not possible, we have used the pictures within this lab to create a guided, "virtual" lab with questions throughout. You can contact us if you want tips on how to put together a virtual lab or wish to see our version.

If you don't have the specialized dissection trays shown in Figure 20, you may use the standard metal trays. We recommend that you tie the arms and legs down by securing one end of a piece of yarn or heavy string to one limb then run the string under the tray and securing down the other limb.

Pigs are available from multiple sources. We have had success with pigs from BioCorp (www.biologyprodcuts.com), who donated the pigs used at the ABLE 2022 conference.

We recommend that students use gloves, safety goggles, and a lab coat through the dissection. Consult your institution's safety guidelines to determine if additional PPE is required for your lab. After the dissection is complete, be sure to use your institution's required method for disposal of biohazardous materials.

Acknowledgments

We'd like to thank those students who gave us useful feedback in the refinement of this lab, and for our work-study students who made themselves available to help.

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