# Lab 18: Dissection: Posterior Abdominal Wall (PAW) and Kidneys 1/12/2023

1. Demonstrate the fascias surrounding the kidneys.
2. Clean the kidneys and identify features of their external and internal anatomy.
3. Identify the ureters and trace them into the pelvis.
4. Identify the suprarenal glands and name their parts.
5. Identify the parts of the diaphragm.
6. Clean and identify the muscles of the posterior abdominal wall.
7. Identify major branches of the abdominal aorta and tributaries of the IVC.
8. Identify the branches of the lumbar plexus.
9. Find the lumbar sympathetic trunks and identify the aortic plexus and celiac (prevertebral) ganglia.
10. Identify structures that leave the PAW and enter the pelvic cavity through the pelvic inlet.

This lab will focus on the posterior abdominal wall (**PAW**) and the organs associated with it. **Clinicians refer to the PAW as the "retroperitoneum."** *We will do little dissection today in the pelvic cavity*, although we will follow some structures (ureters, branches of the lumbar plexus, and blood vessels) from the PAW into the pelvis.

## Review GI organs and inspect the PAW.

To access the PAW, you will need to work around the gastrointestinal tract that was dissected by MS2s during their GI block (you will get to do this next year in 511!). Start by finding and reviewing the major parts of the GI tract: esophagus, stomach, small intestine (duodenum, jejunum, ileum) and large intestine (cecum, ascending colon, transverse colon, descending colon, rectum). Recall that you

tied off and cut through the rectum when you hemisected the pelvis; this should allow you to move the distal portion of the GI tract out of the way during parts of today's dissection.

## Free retroperitoneal GI structures from the PAW.

In order to gain better access to the PAW, you will want to mobilize parts of the GI tract which are retroperitoneal (do you remember what these are?).

Locate the **paracolic gutters**, lateral to the ascending and descending colon, between the colon and the lateral body wall. If the colons are still adhered to the posterior abdominal wall, incise the peritoneum in the gutters. Using blunt dissection, pry away the ascending and descending colon from the posterior body wall. Moving the colon from side to side and moving the small intestine from left to right and back again will allow you access to the retroperitoneum behind. Do the same with the duodenum and pancreas—incise the peritoneum adjacent to the retroperitoneal parts of the duodenum and pancreas. Pry the duodenum and pancreas away from the retroperitoneum. Moving them will give you access to the kidney and PAW behind it.

## Get the lay of the land in the PAW and PALPATE.

The peritoneum may have been partially removed; the peritoneum on the PAW that is still intact should be thin enough to peer/palpate through. Do your best to look and palpate for:

- **Diaphragm**
- **Abdominal aorta** w/bifurcation into **common iliac arteries**
- **IVC**
- **Kidneys**, surrounded by copious amounts of extraperitoneal fat
- **Psoas major muscles**
- **Vertebral column**
- **Iliac crest**
- **Pelvic brim**
- **Bladder**
- **Uterus** w/**Fallopian tubes** and **ovaries** (if present!)

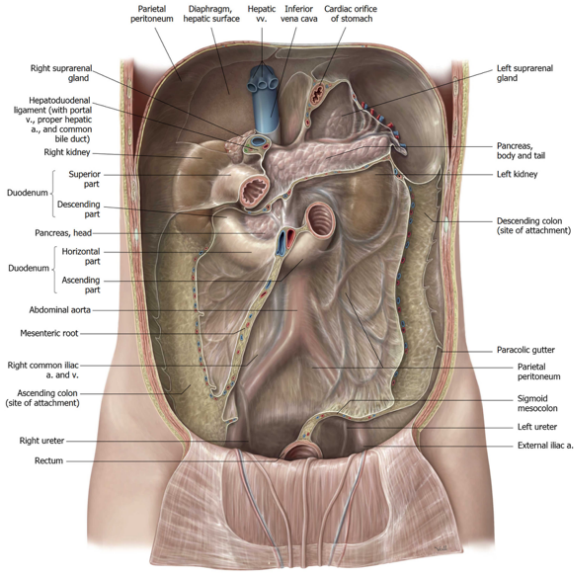




Figure 18.1.

- LOCATE the **gonadal** (**testicular** or **ovarian**) **vessels**. In the male, start at the **deep inguinal ring** and trace back to the aorta and IVC (consult an atlas). In the female, trace back from the ovaries. Follow the left gonadal (testicular or ovarian) vein upwards and note that it flows into the left renal vein.

! They are very thin and vulnerable vessels, so having an idea where they are is <u>important</u> before you dissect!

Note the rigidity of the PAW. How does this compare with the anterior abdominal wall?

## Remove the peritoneum from the paw with forceps.

Gently peel the remaining peritoneum off the PAW. Note the large amounts of **extraperitoneal fascia** external to the peritoneum that is loaded with fat. This may become liquefied during the course of the lab, so have paper towels on hand, and take care to clean up spills on the floor.

### Fascial Layers of the Kidneys

Two categories of fatty tissue are associated with the kidneys.

**Paranephric (pararenal) fat** is the copious extraperitoneal tissue of the PAW that is mainly posterior and lateral to the kidneys. It is the padding that protects the kidneys.

**Perinephric (perirenal) fat** is a fairly thin layer that surrounds the kidney on all sides and is continued into the **renal sinus** of the kidney. Perinephric fat is deep to a layer of abdominopelvic fascia called **renal fascia (Gerota's fascia)**.

Renal fascia is between paranephric and perinephric layers of fat.

1. With blunt dissection and forceps, clean away the massive amounts of **paranephric fat** adjacent to the kidneys. This will mobilize the kidneys.
2. Locate the **renal fascia**, a thin layer of fibrous tissue deep to the paranephric fat. Deep to the renal fascia is the **perinephric fat**—also known as the **adipose capsule of the kidney**. *The renal fascia is not always easy to identify!*

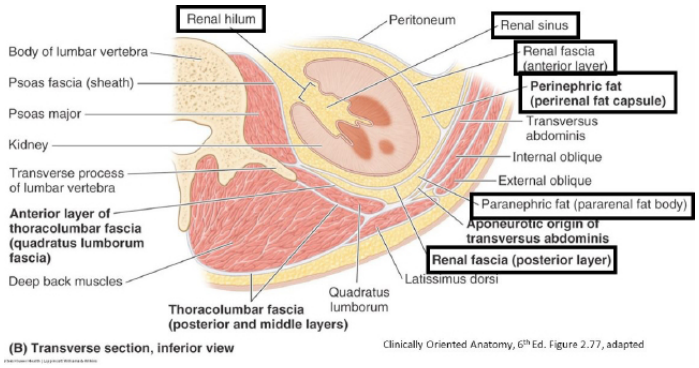


Figure 18.2.

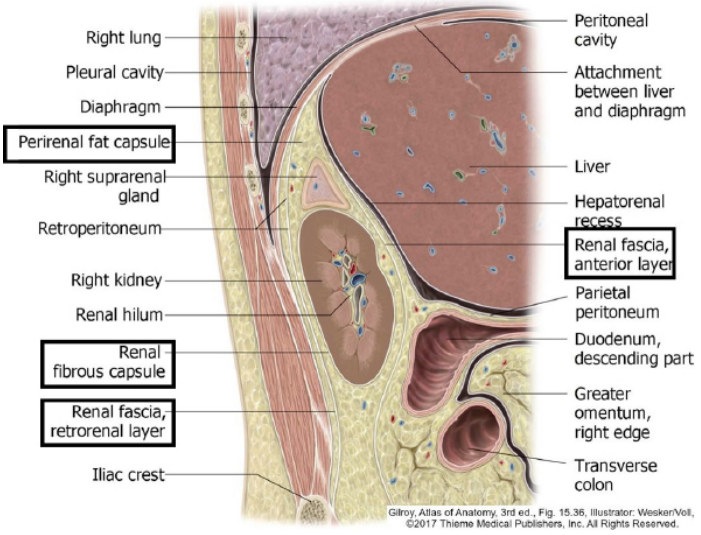


Figure 18.3.

## Suprarenal Glands

### Identify and carefully clean the suprarenal glands.

! CAREFUL—THEY ARE FRAGILE.

The **left suprarenal gland** is **semilunar** in shape and snuggled up against the left crus of the diaphragm. The **right suprarenal gland** is **triangle** shaped and partially hidden behind the IVC.

1. Clean the **left** and **right renal veins** and trace them to the **IVC.** They are anterior to the renal arteries. Which vein is longer?
2. Clean the **left** and **right renal arteries** and trace them to the **aorta**.
3. Clean the **suprarenal veins**—the left one is a tributary of the renal vein while the right flows to the IVC.

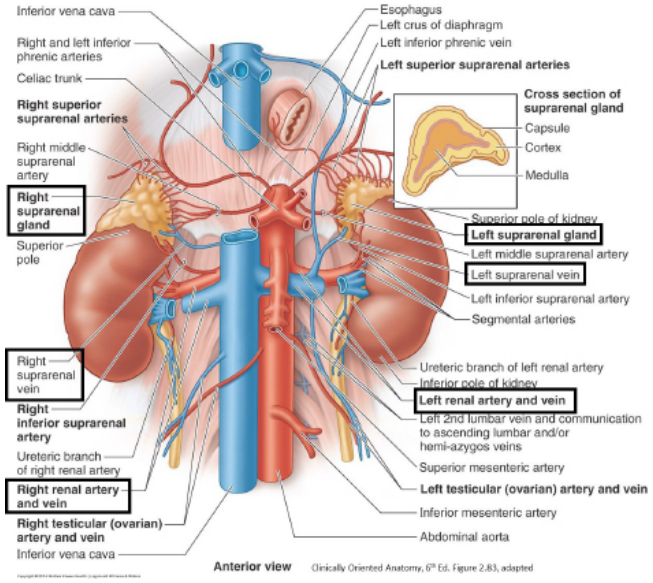


Figure 18.4.

The suprarenal glands are also called the adrenal glands. Why is "suprarenal" a better term?

Read up on the suprarenal glands. They are small but mighty organs! Functionally, they are "two organs in one". What are the functions of the two subparts?

## Kidneys

### Clean the remaining paranephric fat from the kidneys.

Rotate the kidneys toward the midline of the body using the renal vessels as hinges.

Clean away all the **paranephric fat** behind the kidneys. Then return the kidneys to their proper locations.

Between which vertebral levels are the kidneys located?

How are they oriented (in which directions are their "poles" oriented)?

Which kidney is located more superior?

With which bony and muscular structures do they relate?

## Clean and identify the renal pelvis and then follow the ureter inferiorly.

Carefully clean the hilum of each kidney and locate the **pelvis of the ureter**, aka = the **renal pelvis** (the wide part of the ureter that leaves the kidney).

The **renal pelvis** is the most posterior structure in the kidney hilum. From anterior to posterior the structures in the hilum are: **renal vein**, **renal artery**, and **renal pelvis**. Clean and trace the ureters down to the **pelvic brim**. Take care—the ureters are crossed by the delicate **gonadal vessels**.

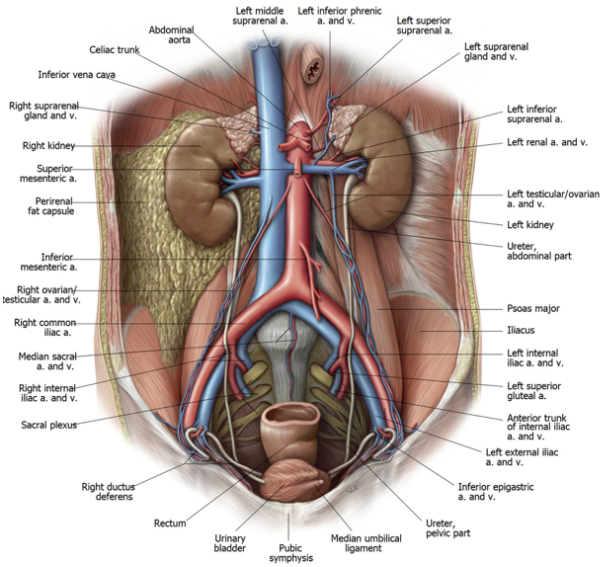




Figure 18.5.

The ureter is described as having three spots of real or potential narrowing, that is, three places where the diameter of the ureter's lumen actually narrows or where the ureter could be compressed by other nearby organs. Where are these? Why would these spots have clinical relevance?

## Remove and section one kidney.

Remove and section one kidney (right kidney if possible). Cut the renal artery, renal vein, and ureter of the kidney near its hilum and remove it from the body.

Examine the internal features and find:

- **Renal cortex** is the most external layer—it dips down between the **renal pyramids** as the **renal columns**
- All the **renal pyramids** together make the **renal medulla**. The tips of the renal pyramids are the **renal papillae.** The renal papillae project into the **minor calyces**.
- **Minor calyces** fuse to form 2 or 3 **major calyces**. **Major calyces** fuse to form the **renal pelvis**. The **renal pelvis** narrows to become the **ureter**.

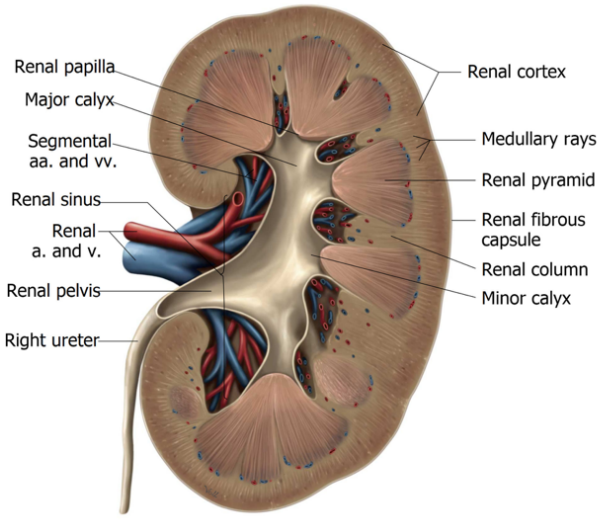




Figure 18.6.

Identify the **renal sinus**, the central cavity in the kidney that contains the calyces, renal pelvis, and renal vessels. The renal sinus usually contains quite a bit of fat.

Identify the **renal hilum** = the indented part of the medial border of the kidney that is the doorway to the sinus.

## Muscles of the PAW

### Clean away the remaining extraperitoneal fat from the paw.

PALPATE the **12th rib** and the **iliac crest** in preparation for studying muscles.

CLEAN **muscles of the PAW**. IDENTIFY:

- **Transversus abdominis**
- **Quadratus lumborum**
- **Psoas major**
- **Psoas minor** (40% of folks don't have one!)
- **Iliacus**

For each muscle—describe attachments. The psoas major and iliacus muscles fuse below the inguinal ligament to form the **iliopsoas muscle.**

What is its function?

EXAMINE the inferior surface of the **diaphragm** and clean the two **crura of the diaphragm** = the "legs" of the diaphragm that attach it to the vertebral column.

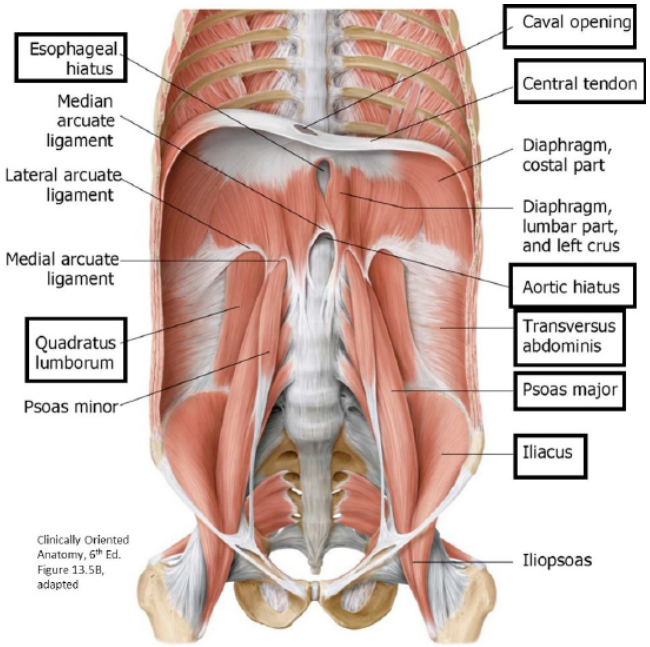


Figure 18.7.

IDENTIFY:

- **Central tendon of diaphragm**
- Opening for **inferior vena cava** (T-8)
- **Esophageal hiatus** (at T-10) = located left of the midline
- **Aortic hiatus** (at T-12)

**A MNEMONIC for remembering the vertebral levels of the 3 major apertures in the diaphragm:**

**I Ate 10 Eggs At Twelve**

**I Ate** = Opening for **Inferior Vena Cava** is at the level of **T-8**

**10 Eggs** = **Esophageal hiatus** is at the level of **T-10**

**At 12** = **Aortic hiatus** is at the level of **T-12**

Besides the esophagus, what else is transmitted through the esophageal hiatus?

[Hint: The esophagus is at T-10; Cranial Nerve 10 accompanies it.]

Besides the aorta, what else passes through the aortic hiatus?

## Examine and clean the surface of the abdominal aorta and IVC.

A tough network of autonomic nerve fibers (**aortic plexus**) covers the entire length of the abdominal aorta. Like the cardiac plexus in the thorax, the aortic plexus contains a mixture of:

**Sympathetic, Parasympathetic, and Visceral Afferent nerve fibers**

Each time a branch of the aorta is given off, part of the plexus follows the artery. The concept is that autonomic nerves follow vessels to their target organs.

<u>In order to clean the vessels, you will need to use scissors to remove the tough nerves</u>.

Within the aortic plexus of nerves, identify the **celiac ganglia. These are the largest of the prevertebral ganglia**. They are about the size of a dime and are flat. The celiac ganglia can be mistaken as lymph nodes. There are usually 2 celiac ganglia, one on either side of the celiac trunk.

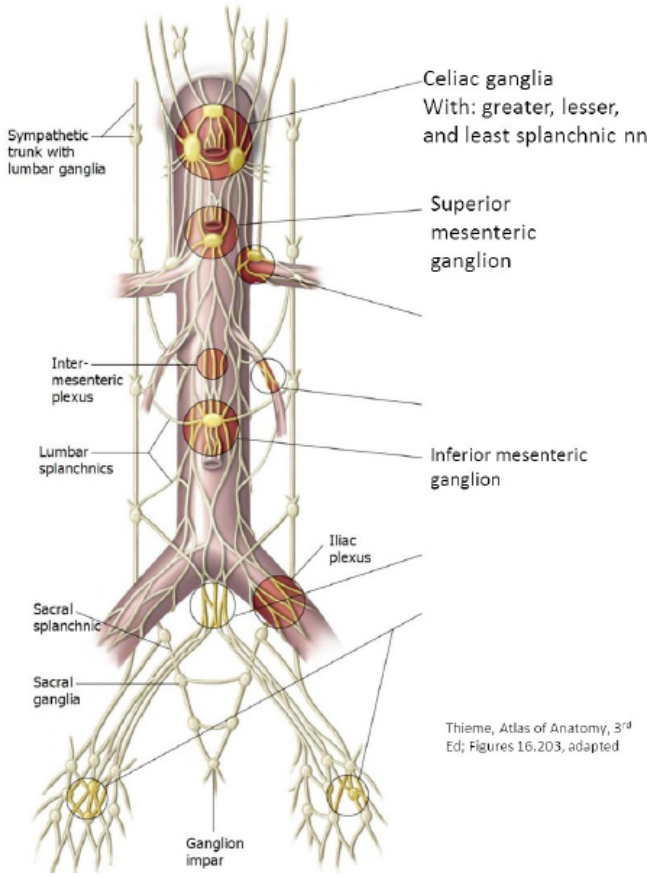


Figure 18.8.

As you clean the aorta and IVC, look for **lymph nodes**. In general, these are called **lumbar nodes**.

Clinicians have schemes for naming the subgroups of lumbar nodes. You may hear the terms **para-aortic nodes** for the lumbar nodes on the left side, and **paracaval nodes** for the lumbar nodes on the right side.

What is the difference between PARA-aortic (lumbar) nodes and PRE-aortic nodes? (Consider which areas/structures each drain.)

## Abdominal Aorta

**Find these branches of the abdominal aorta:**

Unpaired visceral branches:

- **Celiac trunk**, **superior mesenteric artery**, and **inferior mesenteric artery**

Paired visceral branches:

- **Middle suprarenal arteries** (very difficult to find)
- **Renal arteries**
- **Testicular/Ovarian arteries** (long, thin, and fragile)

Branches to body wall:

- **Inferior phrenic arteries** (to diaphragm)
- **Lumbar arteries** (lift the aorta—they originate from the posterior side).

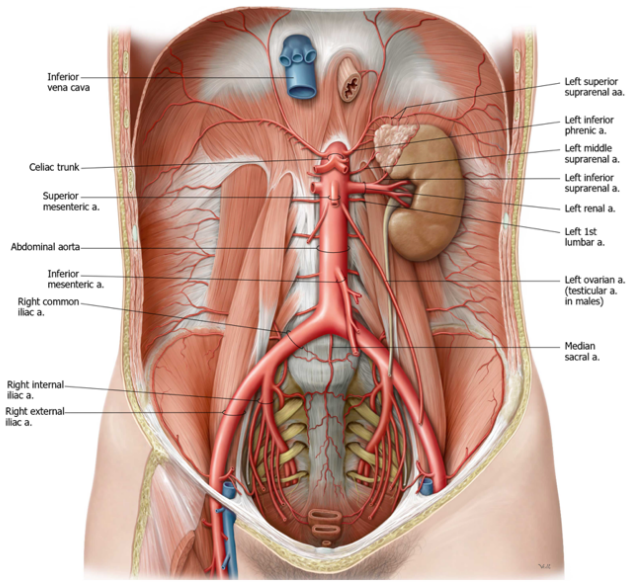


Figure 18.9.

The terminal branches of the abdominal aorta are the **common iliac arteries.** The **aortic bifurcation** is at **L-4**—about the level of the umbilicus.

## Inferior Vena Cava

**Find these tributaries of the IVC:**

- **Hepatic veins** (2–3; may be with the liver)—if the liver has been removed, you will see these with the segment of IVC attached to the liver. If the liver is still intact, you won't see these flowing into the IVC
- **Renal veins**
- **Right suprarenal vein**
- **Right ovarian/testicular vein**
- **Lumbar veins** (enter on posterior side)

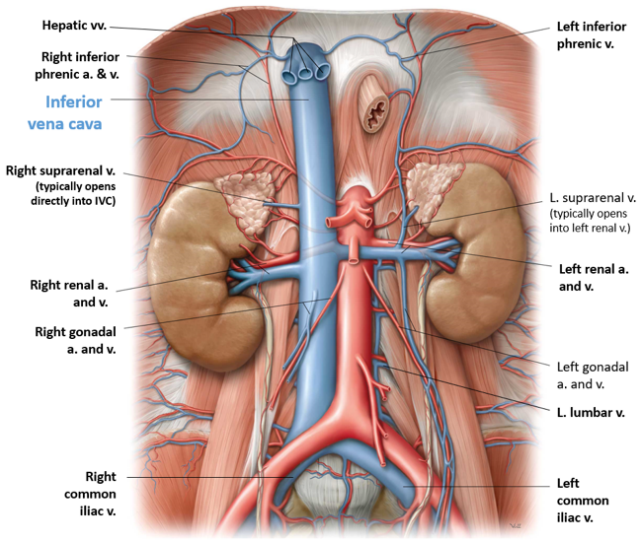


Figure 18.10.

The **left suprarenal vein** and **left testicular/ovarian vein** are tributaries of the **left renal vein**.

**Chalk Talk**

Diagram and discuss the branches of the abdominal aorta and tributaries of the IVC.

## Cisterna Chyli

Back to Lymph for a second:

For a thrill, widen the **aortic hiatus** with scissors by cutting away parts of the **crura**.

Displace the aorta and look for the **cisterna chyli behind it.** This variably-shaped sac (sometimes it resembles a plexus of vessels rather than a sac) is the starting point of the **thoracic duct**.

The cisterna chyli is formed by the union of the two **lumbar lymph trunks** and the single **intestinal lymph trunk**. This item is a prize!

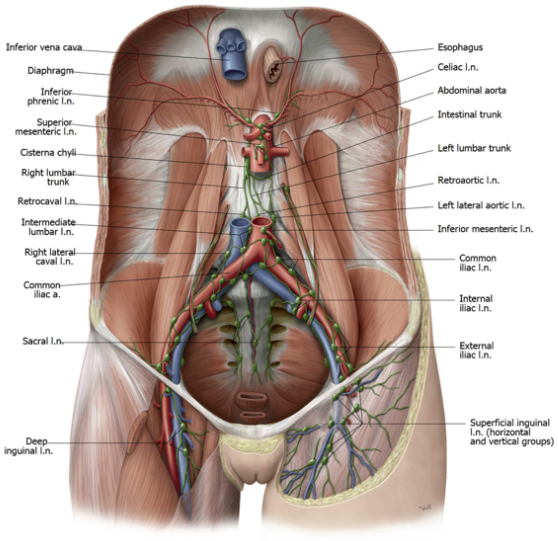




Figure 18.11.

## Lumbar Plexus and Sympathetic Trunk

### Dissect the lumbar plexus and trace its branches.

You will approach this task in <u>two different ways</u>:

1. On the side with the pelvis and lower limb still **INTACT**: leave the psoas major muscle and demonstrate the relationship of the nerves to the muscle;
2. On the OTHER side, where the pelvic hemisection was completed and the lower limb removed: remove the psoas major muscle to show how the lumbar plexus is formed by the union of **ventral rami of lumbar spinal nerves**.

# Intact side

Recall from our earlier study of the lower limb that the psoas major muscle is a landmark we can use to organize the branches of the lumbar plexus:

- Most branches are lateral to the psoas
- A few branches are medial to the psoas
- One branch is on the anterior surface of the psoas.

1. Remove fatty tissue and fascia from the **quadratus lumborum** and **psoas major**. Palpate and identify the **12th rib**. Start here by finding the thick **subcostal nerve** below the rib.
2. Work down to locate branches of the lumbar plexus along the *lateral border of the psoas major*.
    - Carefully use blunt dissection, scissors and forceps to clean the **iliohypogastric** and **ilioinguinal nerves** (both from L-1 spinal nerve). These two nerves head out toward the iliac crest to enter the neurovascular plane of the body wall.
    - Next, find the **lateral cutaneous nerve** of the thigh (L-2 and L-3). It passes across the iliacus muscle as it heads toward the ASIS to pass under the inguinal ligament to the lateral thigh.

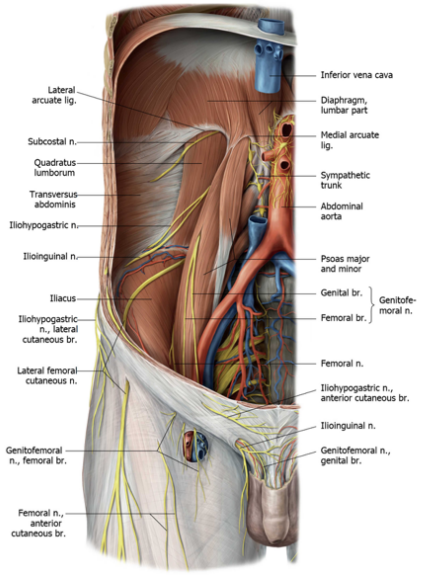




Figure 18.12.

**Note**

A common L1 nerve is often present in the PAW, which later divides into the iliohypogastric and ilioinguinal nerves within the body wall. Don't despair if you only see one L-1 nerve in your dissection.

- Clean the deep groove between the **psoas major** and **iliacus muscles** to find Big Daddy = the **femoral nerve** (L-2, L-3, and L-4). It passes through the **subinguinal space** into the thigh. Note that it gives muscular branches to innervate the **iliacus muscle**.

3 Carefully clean along the *anterior surface of the psoas major* to find the **genitofemoral nerve** (L-1 and L-2).

4 *Medial to the psoas major*, in the lateral wall of the pelvic cavity just below the pelvic brim, find:

- The **obturator nerve** (L-2, L-3, and L-4). It passes out of the pelvic cavity through the **obturator canal** to the medial thigh.
- Look for the **lumbosacral trunk** (L-4 and L-5 rami) passing into the pelvic cavity anterior to the **sacro-iliac joint**. This nerve is better seen in the pelvis—you might remember seeing it when you studied the sacral plexus in 501.

DISCUSS with your team the spinal nerve segments in each of these nerves (e.g. iliohypogastric is L-1) and their functions.

These nerves serve the anterior abdominal wall, pelvis, and lower limb, all areas you studied in 501, so now is a good time to review these innervations.

## Intact side: Clean and identify the sympathetic trunk in the PAW.

On the side of the body with the intact psoas major, clean along the attachment of the muscle to the vertebral column to find the **sympathetic trunk**.

The ganglia here are hard to see and there is not a one-to-one ratio of ganglia and vertebrae.

The sympathetic trunk enters the abdominal cavity by passing behind the diaphragm. Trace it down over the pelvic brim onto the pelvic surface of the sacrum.

See any tiny nerves joining the sympathetic trunk to the anterior rami of lumbar spinal nerves? These would be **gray rami communicantes.**

## Hemisected side: On the other side of the cadaver, remove the psoas major muscle in a piece-meal fashion by carefully shredding the muscle into fragments with scissors and forceps.

1 Identify and clean the nerves of the lumbar plexus as you did on the other side, but on this side note how the lumbar plexus is formed posterior to and within the psoas major by **ventral rami of spinal nerves.**

2 See if you can identify the anterior rami of spinal nerves **L1–L4** as they appear from the **intervertebral foramina**.

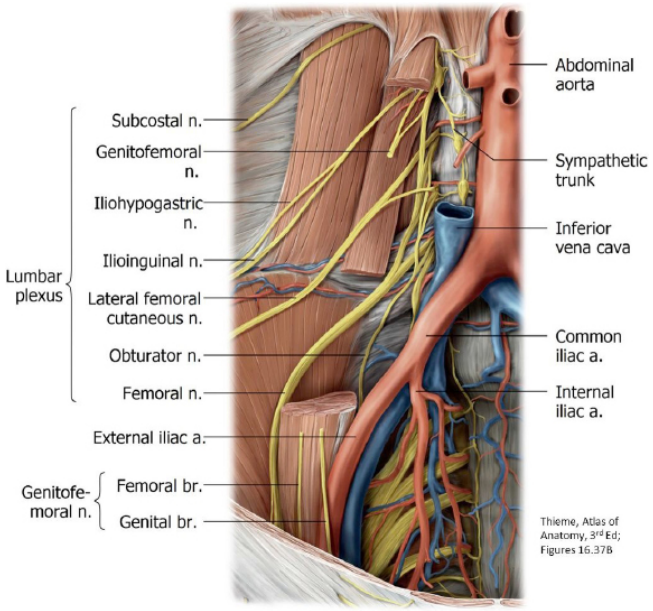


Figure 18.13.

**Chalk Talk**

Draw and discuss the formation and branches of the lumbar plexus. Show the relationship of its branches to the psoas major muscle.

## CHECKLIST, LAB #18

REVIEW AND MAKE SURE YOU HAVE IDENTIFIED EACH OF THE STRUCTURES BELOW.

- [ ] Para- and perinephric fat
- [ ] Renal fascia—you are a superstar ⭐ if you can find it
- [ ] Hilum of kidney

### KIDNEYS: INTERNAL ANATOMY

- [ ] Cortex and medulla
- [ ] Renal columns and pyramids
- [ ] Major and minor calyces
- [ ] Renal papillae
- [ ] Renal sinus
- [ ] Renal pelvis (of ureter)

- [ ] Suprarenal glands (L and R)
- [ ] Abdominal aorta and its branches

### UNPAIRED VISCERAL ARTERIES

- [ ] Celiac trunk; superior mesenteric and inferior mesenteric arteries

### PAIRED VISCERAL ARTERIES

- [ ] Renal arteries
- [ ] Gonadal arteries (ovarian/testicular)—thin and fragile = if you find them, give a “shout out”

## ARTERIAL BRANCHES TO THE BODY WALL

- [ ] Inferior phrenic arteries
- [ ] Lumbar arteries (lift the aorta—they originate from the posterior side)
- [ ] Bifurcation of aorta into common iliac arteries
- [ ] External and internal iliac arteries

## VEINS

- [ ] IVC
- [ ] Renal veins
- [ ] Right suprarenal vein and right gonadal (testicular/ovarian) veins → To IVC
- [ ] Left suprarenal vein and left gonadal (testicular/ovarian) veins → To left renal vein
- [ ] Common iliac and external iliac veins

## MUSCLES

- [ ] Diaphragm—crura, central tendon, opening of IVC, esophageal hiatus, aortic hiatus
- [ ] Psoas major muscle
- [ ] Psoas minor muscle—if present
- [ ] Transversus abdominis muscle
- [ ] Quadratus lumborum muscle
- [ ] Iliacus muscle and iliac crest above it.

## NERVES

- [ ] Subcostal nerve
- [ ] Lumbar plexus

- [ ] Iliohypogastric nerve
- [ ] Ilioinguinal nerve
- [ ] Lateral cutaneous nerve of the thigh
- [ ] Femoral nerve
- [ ] Genitofemoral nerve
- [ ] Obturator nerve
- [ ] Lumbar sympathetic trunk and ganglia
- [ ] Celiac ganglia (these are the largest of the prevertebral ganglia)

### OTHER

- [ ] Ureter
- [ ] Cisterna chyli (and thoracic duct)—another superstar item! ★