

Anatomy of the Posterior Abdominal Wall

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The abdominal cavity is a large body cavity which includes the following organs: the stomach, liver, gallbladder, spleen, pancreas, small intestine, large intestine, kidneys, and adrenal glands. The abdominal cavity is located below the thoracic cavity and above the pelvic cavity. The abdominal wall represents the boundaries of the abdominal cavity, the abdominal wall is also divided into the anterior (front), lateral (side), and the posterior (back) walls.



Posterior Abdominal Wall

The posterior abdominal wall is a complex musculoskeletal structure formed by the posterior abdominal muscles, their fascia, the lumbar vertebrae, and the pelvic girdle.

The posterior abdominal wall is supported by the 12th thoracic (T12) and all 5 of the lumbar vertebrae (L1-L5). It is related to the lower thoracic and lumbar vertebrae, the abdominal aorta, and the inferior vena cava as well as important retroperitoneal organs like the kidneys, the suprarenal glands, the pancreas, and the duodenum.

Boundaries of the Posterior Abdominal Wall

The posterior abdominal wall is surrounded:

- Anteriorly by the anterolateral abdominal muscles, the retroperitoneal organs, and the parietal [peritoneum](#)
- Posteriorly by the lumbar vertebrae, muscles, and fascia

- Superiorly by the 12th rib and diaphragm
- Inferiorly by the pelvic rim

Structures Forming the Posterior Abdominal Wall

The posterior abdominal wall skeleton includes the 12th vertebra, the intervertebral discs, the sacrum, and the 11th rib.

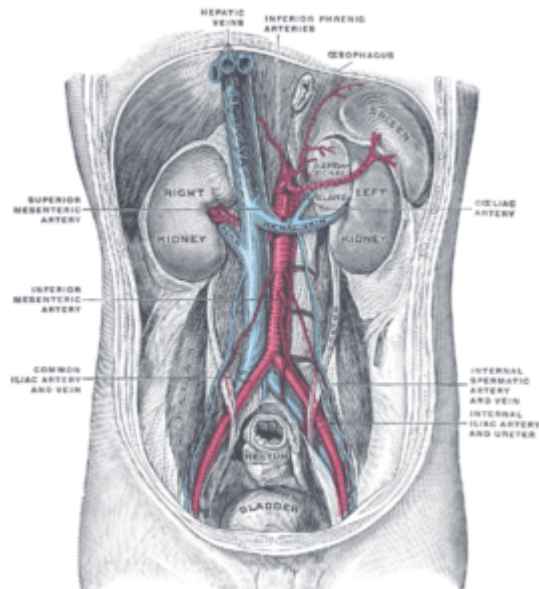


Image: "Posterior abdominal wall, after removal of the peritoneum, showing kidneys, suprarenal capsules, and great vessels." by Henry Vandyke Carter, Henry Gray (1918) *Anatomy of the Human Body*. Bartleby.com: Gray's Anatomy, Plate 1121. License: Public Domain

Lumbar vertebrae

The 12th thoracic (T12) vertebra, all 5 lumbar vertebrae (L1-L5), and their intervertebral discs support the posterior abdominal wall. The transverse processes, as well as the body of the vertebrae and the 12th rib, provide attachment to the muscles of the posterior abdominal wall.

There is a ventral curvature, or lordosis, of the lumbar vertebrae which is enhanced by the inferior vena cava and the aorta. In addition, the lordotic lumbar spine has the right and left paravertebral gutters on either side. The psoas and quadratus muscles lie in the paravertebral gutter.

Iliac crest



Image: "Iliac crest. Shown in red." by BodyParts3D is made by DBCLS - Polygondata is from BodyParts3D. License: [CC BY-SA 2.1 JP](#)

The ilium is the largest of the three bones that merge to form the os coxa (hip bone). The iliac crest is the curved superior border of the ilium. The iliac crest also forms the inferior boundary of the posterior abdominal wall, and the iliacus muscle originates from its inner lip.

Muscles

The posterior abdominal wall consists of several muscles: the diaphragm, psoas major, psoas minor, iliacus muscle, and quadratus lumborum.

Diaphragm

An important respiratory muscle, the diaphragm forms the upper limit of the posterior abdominal wall. The diaphragm contains 3 apertures: the inferior vena caval opening at the level of the T8 vertebra, the esophageal hiatus at the level of the T10 vertebra, and the aortic hiatus at the level of the T12 vertebra.

The diaphragm is also composed of the sternal, costal, and vertebral parts.

- **Origin:** The vertebral part originates from the medial and lateral arcuate ligaments and from the lumbar vertebrae; it forms the right crus. The left crus arises from the L1 and L2 vertebrae and their intervertebral discs. The costal part arises from the lower six ribs (7th to 12th ribs) and their costal cartilages. Lastly, the sternal part consists of small left and right strips that arise from the posterior surface of the xiphoid process.
- **Insertion:** **The diaphragm is inserted into the central tendon which is a thin but strong aponeurosis that provides attachment (insertion) for the moving end of the muscle fibers.**
- **Nerve supply:** The two phrenic nerves, the left, and right, contain sensory, motor, and sympathetic nerve fibers and provide the only motor supply to the diaphragm in addition to sensation to the central tendon. It is formed within the cervical plexus and has nerve fibers from the 3rd, 4th and 5th cervical nerves (C3-C4-C5).
- **Actions:** The diaphragm is the major muscle of respiration. During inspiration (inhalation), it causes lung expansion while during expiration (exhalation), it reduces thoracic cavity volume.

Psoas major

The psoas major is a long fusiform (spindle-shaped) muscle located on the side of the lumbar region of the vertebral column and brim of the lesser pelvis. The psoas major

assists with both flexion and external rotation of the hip joint and joins the iliacus muscle to form the iliopsoas.

- **Origin:** from the transverse processes, sides of vertebral bodies and the intervertebral discs of the lumbar vertebrae
- **Insertion:** lesser trochanter of the femur as the iliopsoas muscle
- **Nerve supply:** L2–L4 anterior rami from the lumbar plexus
- **Actions:** flexes the thigh at the hip and helps to laterally flex the trunk when sitting

Psoas minor

The psoas minor is located in front of the psoas major and is present in only 60% of individuals.

- **Origin:** from the T12 and L1 vertebral bodies
- **Insertion:** attaches to the pectineal line on the superior pubic ramus
- **Nerve supply:** anterior rami of L1 spinal nerve
- **Actions:** flexes the vertebral column.

Iliacus

The iliacus is a fan-shaped muscle which, along with the psoas major, forms the iliopsoas—a major flexor of the thigh. The iliopsoas is considered a muscle of locomotion due to its insertion and attachment to the lower limb.

- **Origin:** Iliac crest
- **Insertion:** lesser trochanter of the femur as iliopsoas
- **Nerve supply:** femoral nerve (L2 –L4)
- **Actions:** flexes the thigh

Quadratus lumborum

- **Origin:** from the transverse processes of the lumbar vertebrae and the 12th rib
- **Insertion:** iliac crest
- **Nerve supply:** L1–L4 nerves
- **Actions:** laterally flexes and extends the vertebral column

Vasculature of the Posterior Abdominal Wall

Abdominal aorta

The abdominal aorta is a continuation of the thoracic aorta and supplies oxygenated blood to the abdominal organs, pelvic organs, and legs. The abdominal aorta enters the abdomen through the aortic hiatus in the diaphragm at the level of the T12 vertebra. It travels down the posterior wall of the abdomen—anterior to the vertebral column—and divides into the common iliac arteries at L4.

The common iliac arteries further divide into the internal iliac which supplies blood to the pelvis and the external iliac which supplies blood to the lower limb.

- **Unpaired visceral:** to the GI tract e.g., [celiac trunk, superior and inferior mesenteric arteries](#)
- **Paired visceral:** to the kidneys e.g., middle suprarenal, renal and testicular and ovarian arteries

- **Paired parietal posterior branches:** e.g., lumbar arteries, inferior phrenic artery, and median sacral artery

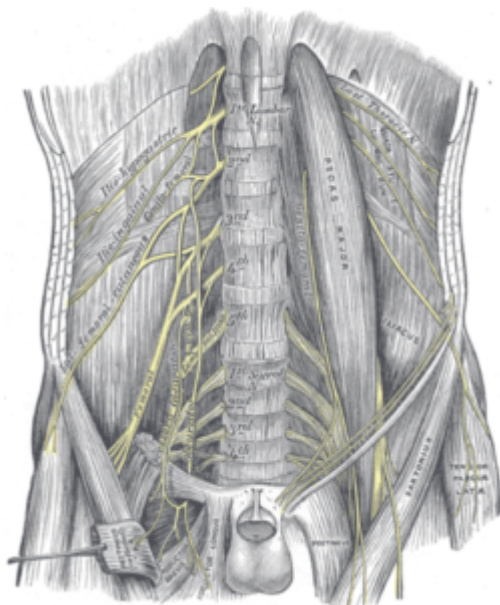
Inferior vena cava

The inferior vena cava is formed at the level of the L5 vertebra by the 2 common iliac veins, then ascends to the right of the aorta, and leaves the abdominal cavity at the level of the T8 vertebra through the caval opening in the diaphragm. The inferior vena cava receives blood from the lower limbs, abdominopelvic organs via the portal system, and the posterior body wall.

The main tributaries draining into the inferior vena cava are:

- Renal veins
- Right gonadal vein (the left gonadal enters the left renal vein which drains into the inferior vena cava)
- Suprarenal veins
- Hepatic veins

Nerves



[Image:](#) "The lumbar plexus and its branches." by Henry Vandyke Carter, Henry Gray (1918) *Anatomy of the Human Body*. Bartleby.com: Gray's Anatomy, Plate 823. License: Public Domain

Subcostal nerve: the T12th thoracic nerve.

Somatic nerves: contain both sensory and motor fibers which supply the skin of the abdomen and the skeletal musculature

Lumbar plexus: known for its variable pattern of branching nerves that supply the abdominal wall. It consists of the following: the ilioinguinal (L1) nerve, iliohypogastric (L1) nerve, genitofemoral (L1-2), branches to the psoas major and minor, nerve to the quadratus lumborum, nerve to the superior and inferior gluteal muscles, nerve to the obturator internus, quadratus lumborum, piriformis, lateral cutaneous nerve of the thigh (L2-3), obturator nerve (L2-4), femoral nerve (L2-4), sciatic nerve, pudendal nerve, nerve to the pelvic diaphragm, and pelvic splanchnic nerve.

Lumbosacral trunk: (L4-5) is considered to be a part of the sacral plexus

Lymphatics and Lymph Nodes

Numerous lymphatics and lymph nodes are located beside the vascular channels running along the posterior abdominal wall. These include the **inferior phrenic nodes, the lateral and pre-aortic nodes** (the celiac, superior and inferior mesenteric nodes), and the **lumbar nodes**. They all drain the **abdominal viscera** into the **cisterna chyli** through the right and the left lumbar and intestinal trunks. The cisterna chyli runs along the right side of the vertebral column and represents the abdominal part of the thoracic duct.

The lymph from the musculoskeletal structures and tissues of the posterior abdominal wall drains to the **lateral aortic** and **retro-aortic lymph nodes**. Either side of the upper part of the posterior abdominal wall drains into the **ipsilateral axillary lymph nodes**.

Posterior Abdominal Fascia

A continuous sheet of fascia covers the posterior abdominal muscles and connects to the **parietal peritoneum**. It is also connected and continuous with the anterolateral abdominal wall fascia, **the transversalis fascia**. The posterior abdominal wall fascia is named according to the structures which it overlies.

Thoracolumbar fascia

The Thoracolumbar fascia consists of a posterior, middle, and anterior layer. The anterior layer is attached to the **iliac crest**, the anterior part of the transverse processes of lumbar vertebrae, and the 12th rib. Superiorly, it thickens to form the **lateral arcuate ligament**, and laterally, it is continuous with the **aponeurosis** of the **transversus abdominis muscle**.

The posterior layer of the thoracolumbar fascia stretches from the 12th rib to the iliac crest and laterally extends to the **internal oblique** and **transversus abdominis muscles**. It also overlies the **latissimus dorsi muscle**.

The anterior and middle layers of the thoracolumbar fascia enclose the quadratus lumborum muscle while the middle and posterior layers enclose the deep muscles of the back.

Psoas fascia

The psoas fascia is attached to the lumbar vertebrae. It is continuous with the **iliac fossa** inferiorly and the **thoracolumbar fascia** laterally. The psoas fascia also derives its name from the fact that it overlies the psoas major muscle.

Iliac fascia

The iliac fascia cannot be recognized as a distinct entity from the thoracolumbar fascia. It is inserted into the inner side of the iliac crest.

Lumbar Triangles

The **lumbar triangles** can either refer to the inferior lumbar (Petit) triangle or the superior lumbar (Grynfeltt-Lesshaft) triangle. The inferior triangle lies superficially and is often referred to as simply the lumbar triangle. The superior triangle, however, is deep and more consistently found in cadavers. The superior lumbar triangle is also more commonly the site of herniation.

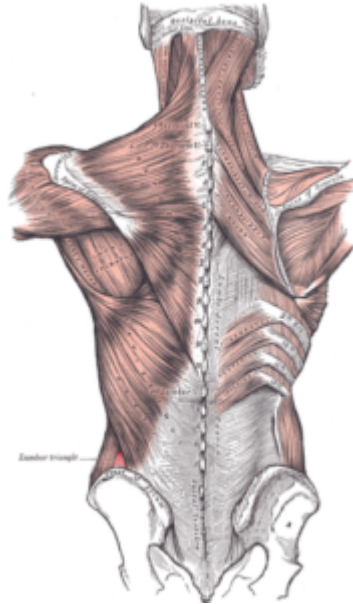


Image: "Posterior view of muscles connecting the upper extremity to the vertebral column." by Mikael Häggström. When using this image in external works, it may be cited as follows: Häggström, Mikael. "Medical gallery of Mikael Häggström 2014". Wikiversity Journal of Medicine 1 (2). DOI:10.15347/wjm/2014.008. ISSN 20018762. - Image:Gray409.png. License: Public Domain

Inferior lumbar triangle (Petit's)

The boundaries of the triangle are:

- Anterior: external oblique
- Posterior: latissimus dorsi
- Inferior: iliac crest
- Floor: internal oblique

Superior lumbar triangle (Grynfeltt-Lesshaft)

The boundaries of the triangle are:

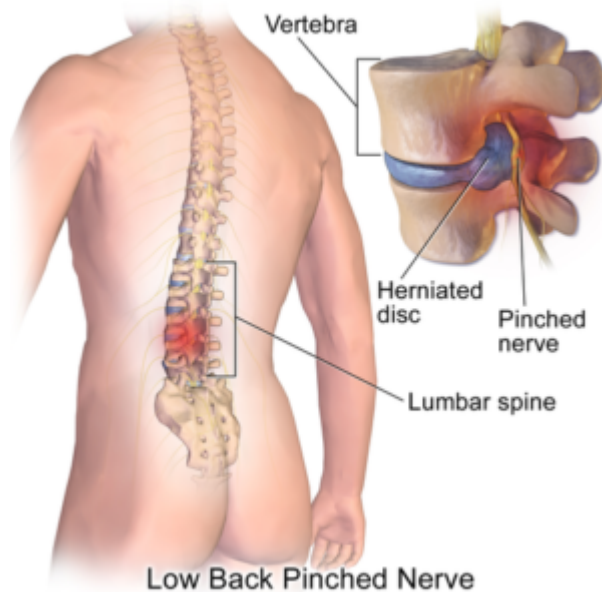
- Roof: external oblique
- Floor: transversalis fascia
- Superiorly: 12th rib
- Medially: quadratus lumborum
- Laterally: internal oblique

Organs in the Posterior Abdominal Wall

The following organs are found the posterior abdominal wall: 2nd and 3rd parts of the duodenum, the [pancreas](#), the [kidneys](#), the suprarenal glands, and the ureters.

Clinical Relevance of the Posterior Abdominal Wall

Low back pain



[Image](#): "Herniated Lumbar Disc." by Blausen.com staff. "Blausen gallery 2014". Wikiversity Journal of Medicine. DOI:10.15347/wjm/2014.010. ISSN 20018762. - Own work. License: [CC BY 3.0](#)

Lower back pain is one of the most common disorders affecting the musculoskeletal structures of the posterior abdominal wall. In most cases, the cause for the pain cannot be determined and is labeled as **muscle strain**.

The pain is usually relieved with **pain medication and activity** as tolerated. Surgery may be indicated in chronic, unrelenting back pain due to [intervertebral disc herniation](#) or **spinal canal stenosis** with accompanying neurological deficits or disability.

Renal diseases/enlargement

The kidneys can be clinically examined through the **costovertebral angle** of the posterior abdominal wall. The angle is formed by the 12th rib and the vertebral column.

Enlarged kidneys can be palpated by **ballottement** while the patient is supine. Costovertebral angle tenderness may indicate **pyelonephritis**, an inflammation of the kidneys. Enlarged kidneys may indicate either a **tumor or hydronephrosis**.

Psoas sign

This clinical sign is an indication of **irritation of the iliopsoas muscle**. A positive psoas sign on the right is indicative of [acute appendicitis](#). The sign can be elicited by asking the patient to flex the **hip**. The sign is considered positive if the patient has pain and is

unable to flex the hip.

Psoas abscess



[Image](#): "Paraspinal abscess in the psoas muscle." by James Heilman, MD - Own work. License: [CC BY-SA 4.0](#)

In rare cases, an abscess can form along the psoas muscle primarily (*S. aureus*, *P. aeruginosa*) and more often secondary to **vertebral body infection** or **appendix infection** (*E. coli*, streptococci or *M. tuberculosis*). Patients may present with fever and difficulty flexing the hip (positive psoas sign). **Surgical drainage** may be required to treat this abscess.

Trans-psoas approach

The trans-psoas approach is a minimally invasive approach to the lumbar and thoracic vertebral bodies and intervertebral discs used for **fusing vertebral bodies**. It has gained popularity in recent times as it is associated with reduced blood loss, shorter operative time, short hospital stays, and decreased postoperative morbidity and pain.

This approach, however, can be associated with **intra-operative vascular injuries** (to the great vessels) and **postoperative neurological deficits**.

Diaphragmatic paralysis

Diaphragmatic paralysis can occur due to **phrenic nerve lesion, cervical cord injury, or brainstem lesion**. An additional cause of diaphragmatic paralysis includes traumatic damage or compression of the phrenic nerve or myopathy/neuropathy.

Diaphragmatic paralysis causes **paradoxical movement of the diaphragm**. Unilateral paralysis is generally asymptomatic, but bilateral paralysis can lead to orthopnea, poor exercise tolerance, and respiratory fatigue since the diaphragm is the main muscle of respiration at rest.

Posterior abdominal hernias

The posterior abdominal hernias condition is also known as **lumbar hernias**. These

hernias can occur through the superior triangle (Grynfeltt-Lesshaft) or the inferior triangle (Petit). Presentation in the inferior triangle, however, is rare. The hernias may be either congenital or acquired.

Congenital lumbar hernias are more common than the acquired hernias. Acquired hernias may be either primary or secondary.

Primary lumbar hernias occur spontaneously while **secondary hernias** can follow infection, trauma, or a surgical procedure. Severe **blunt trauma** can lead to “diffuse” hernias by devascularization or scarring of the muscles. These hernias are not through the two lumbar triangles and are difficult to repair. They are diagnosed clinically as they present with **flank hematomas** or ecchymoses, bulges, or localized or referred pain.

The diagnosis can be confirmed with a **CT scan**, and treatment consists of **emergency celiotomy** if there is an **intra-abdominal injury** to organs associated with trauma.

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