# Anesthesia for Post Anesthesia Care Nurses

Video 7


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STORM ANESTHESIA

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# Introduction

Welcome to Storm Anesthesia's Anesthesia for Post Anesthesia Care nurses. This is a seven-video series on the basics on pharmacology and anesthesia techniques for the perianesthesia care nurse.

We, a group of five senior students from the University of South Carolina School of Medicine Nurse Anesthesia Program and one CRNA, have created this series in the hopes it will help the transition into the perianesthesia world. The series attempts to shine a bit of light on the techniques anesthesia uses during surgery, as well as explain the basics of the pharmacology behind our drug uses. This is by no means a series that will explain everything that happens during anesthesia, but our hope is that you, the perianesthesia nurse, will find our report a little less intimidating and a little more informative. After all, the better you understand the report, the better you can take care of the patient, and ultimately, this will increase the safety and satisfaction for both your patients and yourself.

The group consists of Alexandra Harman, BSN, RN; Braiden Sightler, BSN, RN; Jordan Coleman, BSN, RN, CCRN; Kelsey Squires, BSN, RN, CCRN; Victoria Koke, BSN, RN; and Michael Storm, DNAP, CRNA, CCRN.

The videos can be watched separately, but there are some references among the videos and the basics of the pharmacology along the way. Therefore, it may be beneficial to watch the series in order. Either way, have fun and don't forget to download the accompanying handouts. These handouts are the complete transcripts of the narrations and include all relevant pictures from the videos.

This video-series is sponsored by Storm Anesthesia and Palmetto Health Richland Anesthesia Department.

Enjoy and let's get started.

Michael Storm, DNAP, CRNA, CCRN
Editor
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# Regional Anesthesia

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Hello everyone, my name is Kelsey. I am a Registered Nurse and a senior Masters student in the anesthesia program at the University of South Carolina. Today we are going to discuss regional anesthesia, and how it is relevant to PACU nurses.

## Objectives

We will discuss why regional anesthesia is a great anesthetic technique, go over a few definitions, and discuss risks involved for all regional anesthesia. Then we will go into specifics about spinals, epidurals, combined spinal epidural technique, and then talk about some of the most common blocks on the extremities.

## Why regional?

Why is regional anesthesia a good option? It decreases the number of medications the patient receives, it requires less invasive devices that are needed to monitor the patient, it decreases the incidence of DVT and PE, the number blood transfusions necessary, respiratory complications (including pneumonia and respiratory depression), MI incidence, renal failure, and rate of infections (because it preserves the immune system).

# Definitions

Now to talk about some definitions that will be necessary to understand.

**Analgesics** are medications administered to relieve pain.

**Anesthetics** are medications administered to render the whole body or a portion of the body insensible to painful stimuli.

**Alpha-Adrenergic Vasopressors** are medications that constrict the peripheral blood vessels to increase blood pressure. An example is phenylephrine (Neo-Synephrine), which has a quick onset and duration of 5-20 minutes. A very common side effect is bradycardia do to the baroreceptor reflex.

A **CSE** is a combined spinal epidural technique. It is first a spinal injection and then an epidural catheter is placed after the injection for prolonged relief. We will go into more detail about this technique in a little bit.

A **dermatome level** is a spinal nerve root inverted into a horizontal fashion in 2-1 in bands. Each nerve has a specific dermatome, and that is how the level of a block is determined. Later on, we will talk about the important dermatome levels to know with a picture.

An example of an **alpha/beta adrenergic vasopressor** is ephedrine. It indirectly stimulates the alpha and beta receptors and leads to an increase in catecholamines. Onset is quick, and duration is 1-1.5 hours. Unlike Phenylephrine (Neo-Synephrine), ephedrine leads to an increase in heart rate along with an increase in blood pressure.

An **epidural** is the placement of a catheter into the epidural space with local anesthetic and is given continuously through the catheter. We will talk more about the epidural technique in a little bit.

A **high spinal block** is excessive spread of local anesthetic within the subarachnoid space. This can lead to apnea, loss of consciousness, and hypotension. We will talk more about this later.

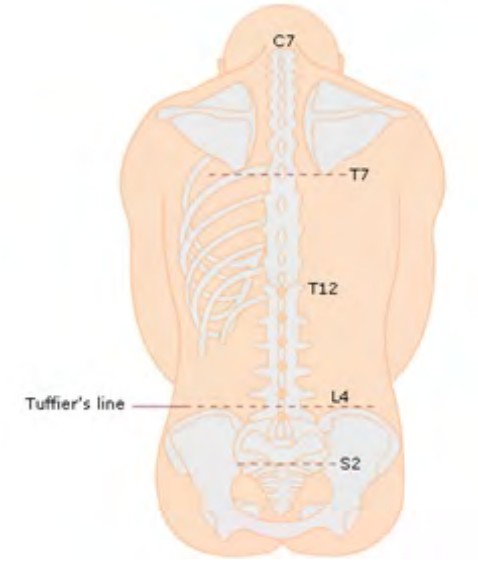
**Neuraxial anesthesia** is a generic term applied to spinal, epidural, or caudal anesthesia.

**Palsy** is a traumatic injury to a peripheral nerve that results in a loss of motor and normal sensory function.

**Paralysis** is a traumatic injury to central nervous system nerves resulting in the loss of motor function and normal sensory functions.

A **postdural puncture headache** is also called a spinal headache. This is a headache that is characterized by an increased intensity of symptoms when in an upright position and a decrease or absence of symptoms when supine. It is caused by a leak in cerebral spinal fluid after the dura has been punctured with a needle.

**Tuffier's Line** is a landmark used to identify appropriate levels for administration of a neuraxial blockade. The anesthetist will feel for the iliac crests on either side with their fingers, and then will reach across and feel the associated interspace with their thumb. That interspace is L3 to L4 and it is the targeted space for spinals. The picture to the right shows Tuffier's line.

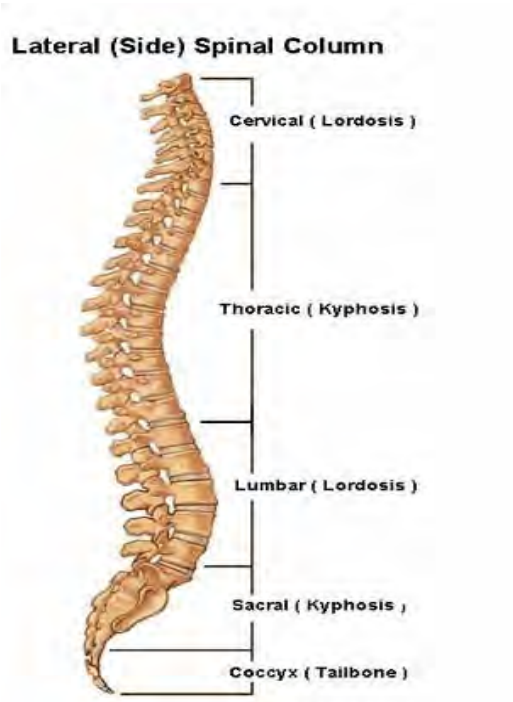


# Risks Involved

Risks involved for neuraxial anesthesia and peripheral nerve blocks include transient or permanent nerve trauma, local anesthetic toxicity, formation of a hematoma, and technique specific complications. We will revisit this subject in just a little bit.

# Anatomy of the Spine

Now we will talk about the anatomy of the spine. First it is important to know how the spine is divided. It is set up into 4 sections of vertebrae including 7 cervical, 12 thoracic, 5 lumbar, 5 sacral. The coccyx is also called the tailbone. In the adult, the coccyx has 3 to 5 fused coccygeal vertebrae.

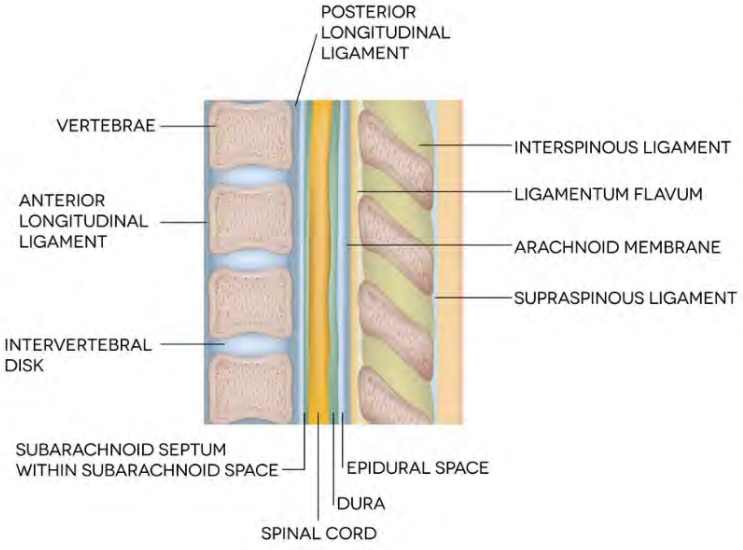



The shape of the spinal cord is also important especially when placing a spinal. The patient's position during the placement of a spinal is important because as you can see when a patient arch's their back, it opens that area for us to correctly find the right spot.

This picture also shows lordosis and kyphosis. It is normal to have lordosis and kyphosis. Lordosis is the normal outward curvature in the lumbar and cervical regions. Kyphosis is the normal curvature inward in the thoracic and sacral regions. Deformities come when those natural curves are exaggerated or reversed, usually from poor posture.

## Spinal Column Ligaments

The ligaments of the spinal column from outside to inside include skin, subcutaneous tissue, supraspinous ligament, interspinous ligament, and ligamentum flavum. After that is where you can see the epidural space, dura, and spinal cord, which we will talk more about in the next slide.



## Spinal Column Membranes

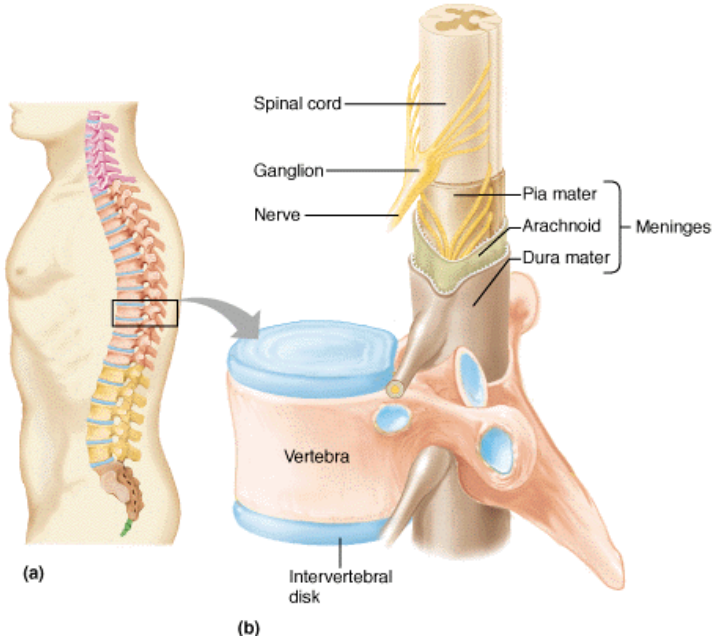
We will now talk about the 3 membranes that encase the spinal cord from the inside to outside, and then explain the spinal nerve root. A pneumonic to help remember the order is PAD. These layers help with PADding the brain and spinal cord.

The pia mater is the innermost layer.

After the pia mater is the arachnoid space. This is a thin membranous sheath. The subarachnoid space separates the arachnoid layer and pia layer. This space is filled with cerebral spinal fluid (CSF). This is where local anesthetic is injected for a spinal. The total CSF volume in an adult is 100-150 mL with 25-35mL residing in the subarachnoid space. The CSF is continuously produced and reabsorbed.

The dura mater is the outermost and has 2 layers. The dura and the epidural space. The epidural space, which is between the ligamentum flavum and dura, is a potential space that filled with loose fatty tissue and blood vessels. This is the space where epidural catheters are placed.

This picture to the right also shows how the nerve roots are assembled on the spinal column. The nerve root comes off the spinal cord to the dorsal root ganglion and then comes together to form the spinal nerve.




## Baricity of Local Anesthetic

Now we will talk about the baricity of local anesthetic, and how it affects the spread of local anesthesia in a spinal.

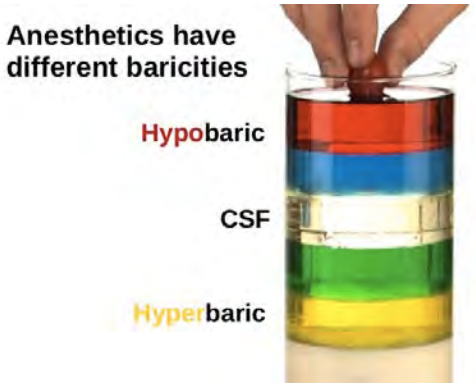
Baricity refers to the density of a substance compared to the density of the CSF. The term is used to describe how the local anesthetic spreads when it is injected into CSF.

It is important to know that the specific gravity of CSF is 1.003-1.008. The term baricity is used to compare the local anesthetic "heaviness" with that specific gravity.

Hypobaric is lighter than CSF and moves upward (cephalad). If the patient is sitting, the local anesthetic will move towards the patient's head.

Isobaric is about the same heaviness as CSF. So, the local anesthetic will stay within the general area of injection.

Hyperbaric is heavier than CSF. This moves with gravity downward (caudad). If the patient is sitting, the local anesthetic will move towards the patient's bottom.




## Spinal vs. Epidural

We will now discuss the difference between a spinal, epidural, and combined spinal epidural.

| | Spinal | Epidural |
|---|---|---|
| Mechanism of Action | Nerve roots blocked as they go through the CSF | Nerve roots blocked outside the CSF |
| Site of administration | Lower lumbar below termination of the spinal cord | Lumbar or thoracic area |
| Dose of local anesthetic | Small | Large |
| Instrument for administration | Needle | Catheter |
| Ability to redose | No | Yes |
| Onset | Rapid, intense blockade. May lead to Hypotension | Gradual, may have less intense blockade, gradual decrease in Blood pressure |

The mechanism of action for a spinal is to block the nerve root as it goes through the CSF.

The mechanism of action for an epidural is to block the nerve root outside of the CSF.

The spinal and epidural have different sites of administration. The spinal is administered in the lower lumbar below the termination of the spinal cord. The epidural is administered in the lumbar or thoracic area.

A spinal requires a smaller dose of local anesthetic and leads to a motor, sensory, and autonomic impulse transmission block.

The epidural blocks the nerve roots by blocking them outside of the subarachnoid space, and requires a larger dose. An epidural requires larger doses because the local anesthetic needs to allow for diffusion through anatomic barriers and spread horizontally and vertically within the epidural space. The epidural space is a fatty space, is less direct than a spinal, and is very vascular. Because of the larger dose needed, the chance of local anesthetic toxicity is higher due to potential intravascular injection.

A spinal is a single injection, and does not allow for repeat dosing. An epidural can be a single shot (this is called a caudal and is usually performed in peds), or a catheter can be placed, which allows for a continuous infusion and repeat dosing. This should be covered with a sterile dressing.

The level of blockade with a spinal is achieved much quicker than an epidural, and can lead to profound hypotension. An epidural may require more time when being placed because of the positioning of the epidural space, and ease of going right through to the dura leading to accidental injection into CSF. The epidural block is more gradual, and you don't see as much hypotension compared to a spinal.

A combined spinal epidural allows for the administration of a spinal anesthetic for immediate anesthesia, and then an epidural catheter is placed to extend the duration of the anesthetic and to assist with post op pain.

## Drugs injected

There are additional drugs that can be injected into the spinal and epidural along with the local anesthetic.

The local anesthetic provides motor and sensory blockade. Depending on the local anesthetic some will have more motor blockade than others.

Epinephrine can be added to the injection into a spinal for a few reasons. It prolongs the block, it causes vasoconstriction, which makes it less likely to get local anesthetic toxicity, and it can increase the safe amount of local anesthetic injected.

Opiates can be added to the spinal injection or the epidural to augment analgesia. Fentanyl can be added when patients have break through pain. It is important not to give fentanyl to close to delivery of a baby because it can cause neonatal respiratory depression. Morphine is often added to a spinal to provide more long-term relief up to 24 hours.

A steroid, usually Dexamethasone, can be added to the injection to prolong the blockade.

## Loss of Function after a Block

There is a specific order of loss of function and return of function after a neuraxial blockade.

The order of loss of function starts with the loss of autonomic sympathetic function, then sense of temperature, pain, touch, movement, and finally proprioception (which is the sense of body location).

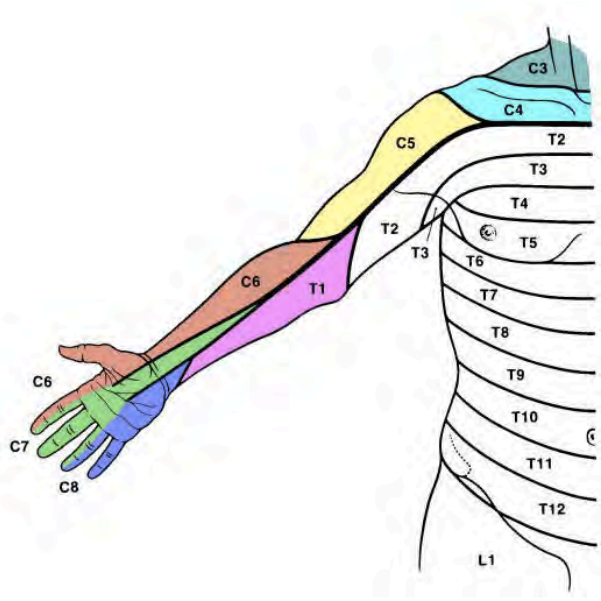
The order of return as the block is wearing off returns in the opposite order with proprioception returning first.

## Specific Dermatome Levels

It is important to know dermatome levels that are associated with cutaneous levels. It is especially important after a spinal to know what level block you have. If the level of the block keeps climbing, knowing the association can clue you into knowing about a possible high spinal

situation. The sympathetic level of a block is checked with an alcohol pad and the sensory level is checked with the tip of a needle. After first touching an unblocked area (like the shoulder), the patient determines when the alcohol pad's same temperature is felt again, or when the scratchy feeling of the tip of the needle is felt again. The sympathetic blockade is always blocked about 2 dermatome levels above where the sensory block is, which again is two levels above the motor block. The gold standard for determining the level of a block is sensory level.

- At C6 the patient will feel numbness or tingling in the thumb and first finger
- At C7 the patient will feel numbness or tingling in the middle finger
- At C8 the patient will feel numbness or tingling in the pinky and ring finger
- A T4 block will be numb below the nipples
- A T6-T7 block will be numb below the xiphoid process
- A T10 block will be numb below the umbilical




An example of when these dermatome and cutaneous level relationships are very relevant and important is when a spinal is placed for a cesarean section. A C-section requires a T4 level, which again is at the nipples. Also at the T4 level are the patient's cardiac fibers. So that means anything above a T4 level block will lead to major bradycardia and hypotension. After we place a spinal if the patient complains of tingling in their pinkies, the anesthetist may adjust the level of the head of the bed according to the baricity of the local anesthetic, which was mentioned earlier. We want to try and prevent the spinal from going any higher. So, if the solution is hyperbaric, and the spinal level is at the pinky's (C8), we will elevate the patient's head to try and prevent further spread cephalad. If the patient then complains of tingling in the thumb and first finger, we know the spinal is still climbing, and the anesthetist will start preparing for a high spinal.

## Complications

We will now go through all of the complications of a spinal, epidural, and combined spinal epidural technique. The complications we will talk about over the next several slides are local anesthetic toxicity, high spinal block, hypotension, nausea and vomiting, urinary retention, hypothermia, postdural puncture headache, hematoma formation, neurologic complications, transient neurologic symptoms, and cauda equina syndrome.

# Local Anesthetic Toxicity

This will be covered in the local anesthetic portion of this series of lectures.

## High Spinal Block

This is from excessive spread of local anesthetic. The signs/symptoms include having a high sensory block, nausea and vomiting, loss of consciousness, anxiety, hypotension, bradycardia or asystole, respiratory distress, or apnea. Treatment includes supporting the symptoms. This is generally self-limiting, but needs to be treated as the symptoms arise. As in possibly needing to treat bradycardia, or assisting the patient's breathing. As the concentration of the local anesthetic declines, the block of the spinal will start to recede.

## Hypotension

Hypotension is caused by a sympathectomy. Treatment includes administering fluids, or temporary vasopressors. If it is persistent, rule out other causes.

## Nausea and Vomiting

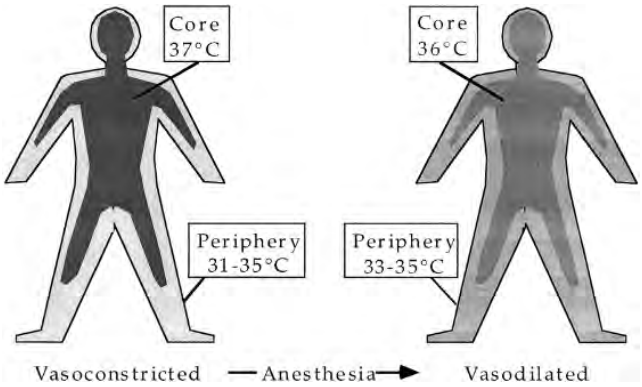
Nausea and vomiting is usually caused by a rapid drop in the patient's blood pressure. It is usually treated by giving a small dose of a vasopressor. Bringing the blood pressure back in normal range usually eliminates the nausea.

## Urinary Retention

Urinary retention is caused by autonomic blockade of the sacral nerves that results in a hypotonic bladder. The patient may exhibit restlessness, and incoherence. A bladder scan can help confirm retention. Treatment involves insertion of a urinary catheter to relieve the bladder.

## Hypothermia

Hypothermia is from a centrally mediated vasodilation and inhibits peripheral vasoconstriction. Blood is brought from the core to the periphery and heat is lost. The picture above shows a great visual difference between vasoconstricted and vasodilated hypothermia.




## Postdural Puncture Headache

A postdural puncture headache is caused by a leaking CSF hole in the dura. It can occur after a spinal, or during placement of an epidural when you have inadvertent dura puncture. Symptoms usually occur within 24-48 hours after the dura puncture and include a headache in the occipital-frontal region that intensifies when upright, and declines when lying down, nuchal rigidity, visual and auditory disturbances, and nausea and vomiting. Treatment at first includes

being supportive with fluids, bed rest, caffeine, and analgesics. If that doesn't work, the patient will need a blood patch. We will talk more about the blood patch next.

## Hematoma Formation

A hematoma formation is rare but can be devastating. This is considered a neurosurgical emergency. Symptoms include low back pain, motor changes, and/or bowel or bladder dysfunction. Treatment includes emergent decompression, but recovery is poor if it is delayed for more than 8 hours.

## Neurologic Complications

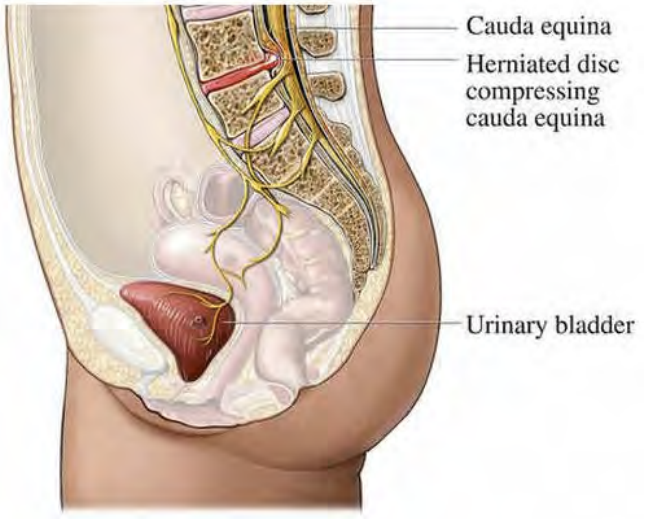
Neurologic complications have a very low rate of incidence, but possibilities include palsies, paralysis, or pain. It could be related to the placement of block from the position of the needle, hematoma or abscess formation, or neuropathy. It could also be caused from surgery from surgical stretch or compression, retractor injury, surgical hematoma causing compression or ischemia, or a positioning injury. Or it could be caused from the patient's medical history including from a preexisting neuropathy, preexisting tumor or lesion, or a congenital anomaly.

## Transient Neurologic Symptoms

Transient neurologic symptoms are usually associated with lidocaine, but can be with any local anesthetic. Signs and symptoms occur within 24 hours of block resolution and consist of low back pain that radiates to the lower extremities. Risk factors include obesity and lithotomy position. It is self-limiting, and patients usually have a full recovery in 2-7 days.

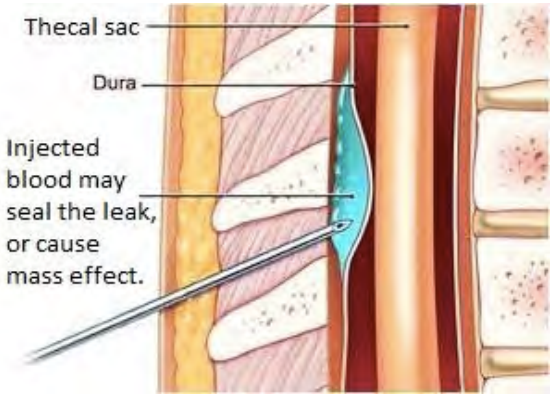
## Cauda Equina Syndrome

Cauda equina syndrome is associated with lidocaine and continuous spinal micro catheters. Symptoms include low back pain with radiation to the lower extremities, and sensory and motor changes. It has a poor recovery. This picture shows a good vizualization of how cauda equina syndrome occurs.



## Blood Patch

A blood patch is administered to try and help the postdural puncture headache. It is performed by the anesthesia team. It is administered with strict sterile technique. It involves accessing the epidural space below the original insertion point in the dura and inserting 15-20mL of the patient's blood to close the leaking hole.




## Common Peripheral Blocks

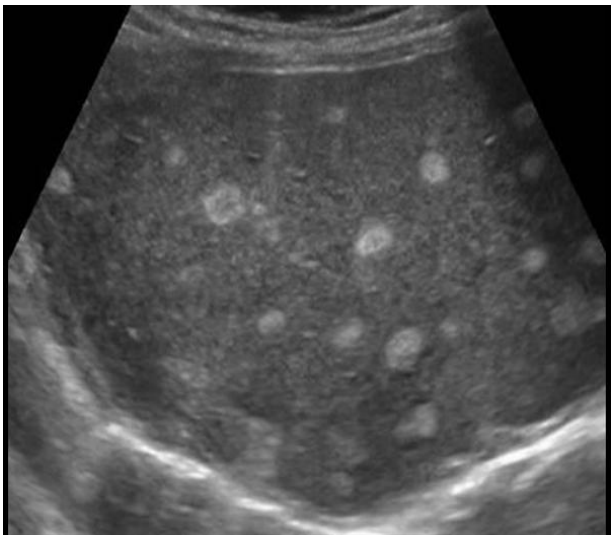
We will discuss some common peripheral nerve blocks including what surgeries they are used for, additional complications for that specific block, and if there are any contraindications for that block. Common peripheral blocks include the paravertebral block, transversus abdominus plane block (TAP), and the brachial plexus block specifically the interscalene, supraclavicular, infraclavicular, and axillary block. We will then go into the bier block, femoral block, sciatic block, popliteal block, ankle block, and peripheral nerve block catheters.

## Ultrasound Terms

Many of the peripheral nerve blocks are done with ultrasound technique, peripheral nerve stimulator technique, or the paresthesia technique. Before we talk about the ultrasound technique and how the block is completed with ultrasound, I think we need to understand a few basic ultrasound definitions first.

**Anechoic** is tissue with no reflective index and appears gray. An example is a fluid filled structure. In the picture to the right, you can see it is the dark black area.

**Hyperechoic** is when tissue with a high reflective index appears bright. An example is a bone or a tendon. In the picture to the right, you can see it is all the light gray spots. They are hyperechoic.



**Hypoechoic** is when tissue with a low reflective index appears dark. As you can see in the picture below, it appears just a slightly lighter gray.


An **echo** is the reflection of acoustic impedance and is collected by the probe from the tissue.

There is a curved and linear probe. When a **curved array probe** (picture to the right) has ultrasound waves transmitted, they are in a fanlike fashion. A curved probed provides a wide field of vision, but a lower resolution than a linear probe because of scattering of returning sound waves.

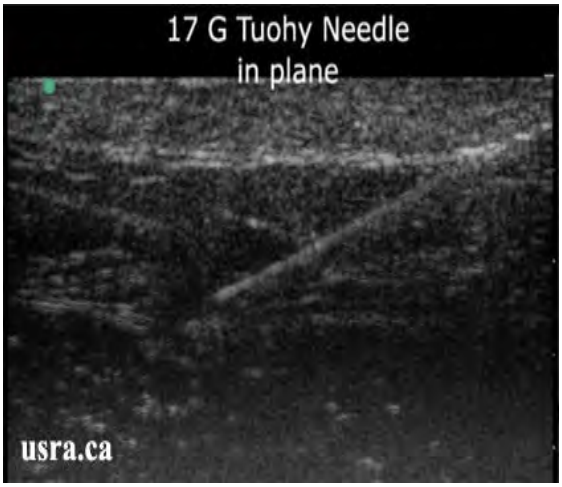
When a **linear array probe** (picture to the right) has ultrasound waves are transmitted, they are in a straight, frontal direction. A linear probe will have better images than a curved probe because the waves are transmitted in a linear fashion allowing the transmission of sound waves back to the transducer, but at the cost of a narrow field of view.

When something is **in axis**, it means that the ultrasound beam is oriented to view the nerve in its entirety.

The term “axis” is associated with the view of the nerve, and the term “plane” is associated with the view of needle.

**Out of axis or off axis** is when the ultrasound beam is oriented to view the nerve as a cross section.

It is really important when doing a block under ultrasound to always know where your needle is. In this picture, you can clearly see the needle, sometimes it doesn't always show up that clearly.



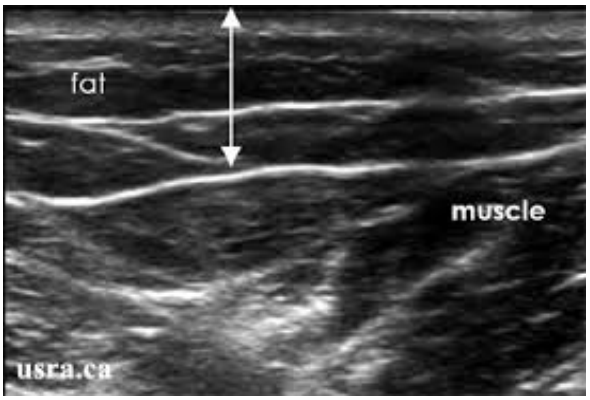

Something is **in plane** when the ultrasound beam is oriented to view the needle in its entirety.

**Out of plane or off plane** is when the ultrasound beam is oriented to view the needle as a cross section.

## Ultrasound

Many nerve blocks done under ultrasound, so we will talk about that for a bit just to get familiar with it.

The benefits of ultrasound include anatomic identification of structures in real time, confirmation of local anesthetic spread, increased success rate and quality, faster onset time for sensory blockade, decreased number of attempts, and identification of vascular structures. There is also now data coming out showing that using ultrasound improves patient safety during a block placement.



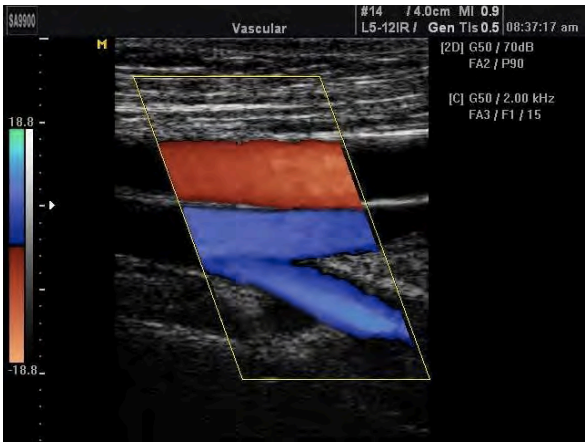

It is important to first identify the orientation of the transducer. Which can be done by pushing the skin under the transducer on one side and seeing where it appears on the ultrasound screen.

**Fat** appears on the ultrasound as hypoechoic with hyperechoic lines.

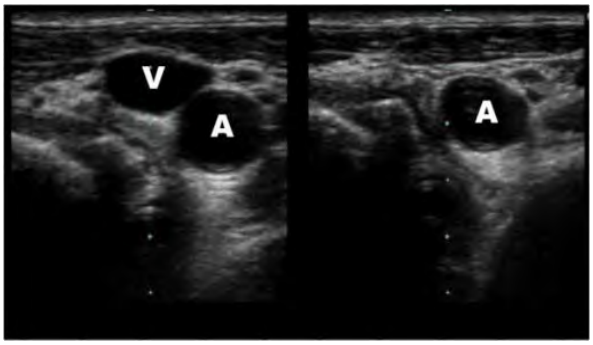
**Muscle** appears hypoechoic with several hyperechoic striations more numerous than those seen in fat. In the first picture on this page, you can see the difference between the fat and muscle.

**Fascial** layers appear hyperechoic.

Ultrasound cannot penetrate **bone**, and appears hyperechoic with dark shadows. In the second picture on this page the fascia, muscle, and bone are all clearly labeled, and you are able to see the different colors and looks between several different levels.




Arteries are distinguished from veins. Arteries cannot be compressed and can be seen as pulsating on the ultrasound. Veins remain still and can easily be compressed. Also, because they both contain blood, they appear as anechoic, which again means they do not reflect echoes. If you use color doppler, which is seen in the third picture on this page, that can also help distinguish between arteries and veins. Red is flow TOWARD the transducer, blue is AWAY from the transducer. In the picture at the bottom of this page, can see how the artery maintains a very circular shape because it cannot be compressed, and the shape cannot be changed. The vein is not as circular, because it can be compressed and lose that circular shape.




## Peripheral Nerve Stimulator

Blocks can also be done with a nerve stimulator. The nerve stimulator is mentioned in the neuromuscular block lecture, but we will just to briefly go over the technique. It involves using a needle, and as the needle gets close to the nerve, certain target muscles will start to contract, and the lower the intensity level needed for the muscle to contract, the closer the needle is to the target nerve.

The peripheral nerve stimulator can be used alone as a technique or with ultrasound guidance.

It is important to forewarn patients about the involuntary movement they will soon experience.

It has a positive and negative lead. The negative lead is attached to the needle, and the positive lead is attached to the patient with an EKG pad.

There are three common controls on the nerve stimulator. Current, which is the intensity of stimulation in milliamperes, pulse width which is the duration of stimulation in milliseconds, and frequency which is the frequency of stimulation in hertz.

The milliamperes control is what is manipulated during block placement. It is initially set higher to find the nerve, and as the needle gets closer to the nerve, it can be turned down and the same or similar response should be elicited. The dial is to turn it down on this machine. The goal is typically to get below 0.5. The screen is where you will see the milliamperes change when you turn the dial on the stimulator.

After the correct spot is located, aspiration is needed before injection of local anesthetic to be sure the needle is not in a vessel. Aspiration is needed at least every 5mL prior to the rest of the injection. It is also important to know how easy the local anesthetic is injecting. If it is difficult to inject the local anesthetic, it is possible that the needle is in the nerve, and the anesthetist performing the block will need to be notified of that. The needle may need to be repositioned to a place where injection is with ease.

## Peripheral Block Complications

Common complications of the peripheral nerve blocks are similar to the complications we mentioned earlier for neuraxial, but not exactly the same.

In all peripheral nerve blocks complications include local anesthetic toxicity, hematoma formation (which is not considered an emergency), nerve trauma, infection, intravascular injection, as well as block specific complications.

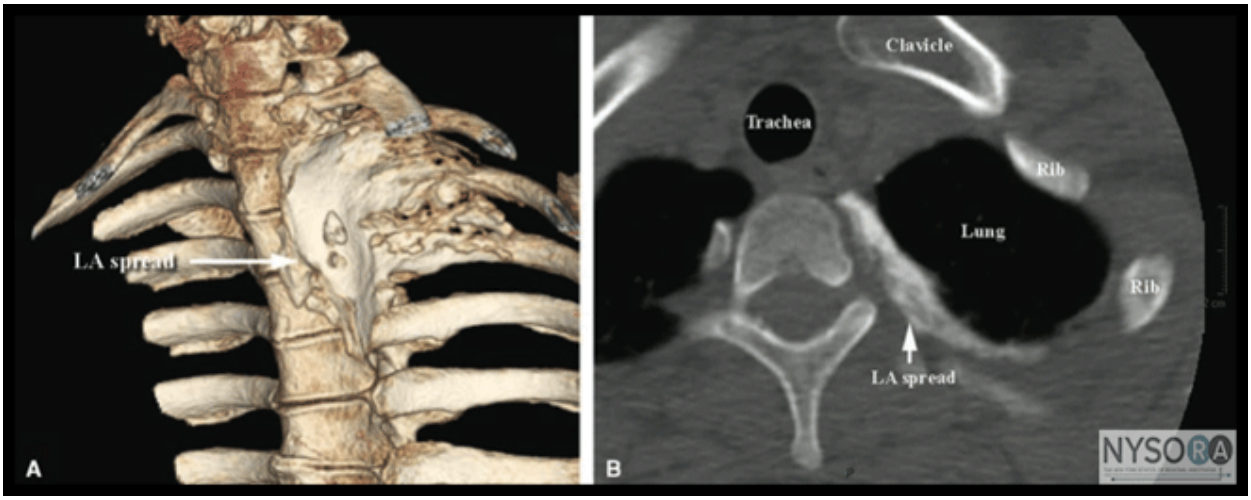
## Paravertebral Block

The paravertebral bock is performed in the thoracic or lumbar area and provides unilateral relief. A bilateral block can be performed if both sides are needed to be blocked for the procedure.

The block requires an injection in the paravertebral space. In the picture below, you can see where the local anesthetic was injected for the block.

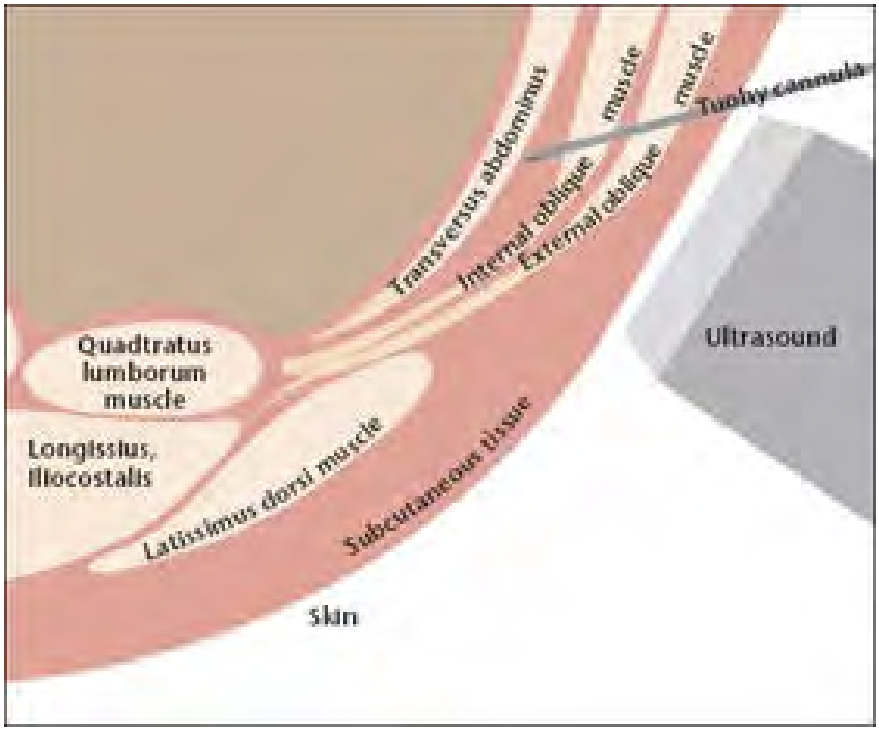
It covers thoracic, breast, abdominal, and pelvic surgery.

It requires a close injection to the vertebral column, which can lead to an inadvertent epidural, or subarachnoid injection (which can lead to a total spinal), pneumothorax, and intravascular injection which is a higher possibility do to the close proximity of the major vessels in that area.




## Transversus Abdominus Plane Block

The transversus abdominus plane (TAP) block is indicated for lower abdominal surgery (T7-T10) including hernia repair, appendectomy, C-section, abdominal hysterectomy, laparoscopic surgery, renal transplantation, or prostatectomy.




One tap block covers half of the abdomen (right or left). There are cases when a patient will have bilateral TAP blocks If the surgery involves both sides of the abdominal wall, or if there is a midline incision.

Landmarks are referred to as “the triangle of petit” and are located along the midaxillary line inferior to the lower costal margin and superior iliac crest.

You can see in the picture above; the site of injection is between the internal oblique and the transversus abdominus muscle layers.

This is mostly performed with the used of ultrasound.

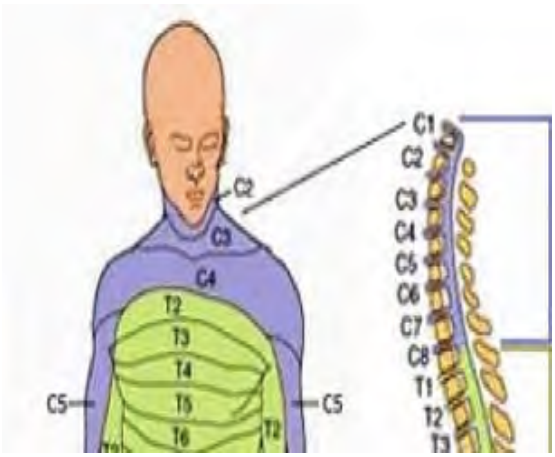
There are no additional specific complications for this block. Just the ones listed in the prior slide that include local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection.

This block also reduces post-op pain and narcotic requirement.

## Brachial Plexus Block

The Brachial Plexus can be blocked at a few different areas along the plexus and that leads to different blocks.

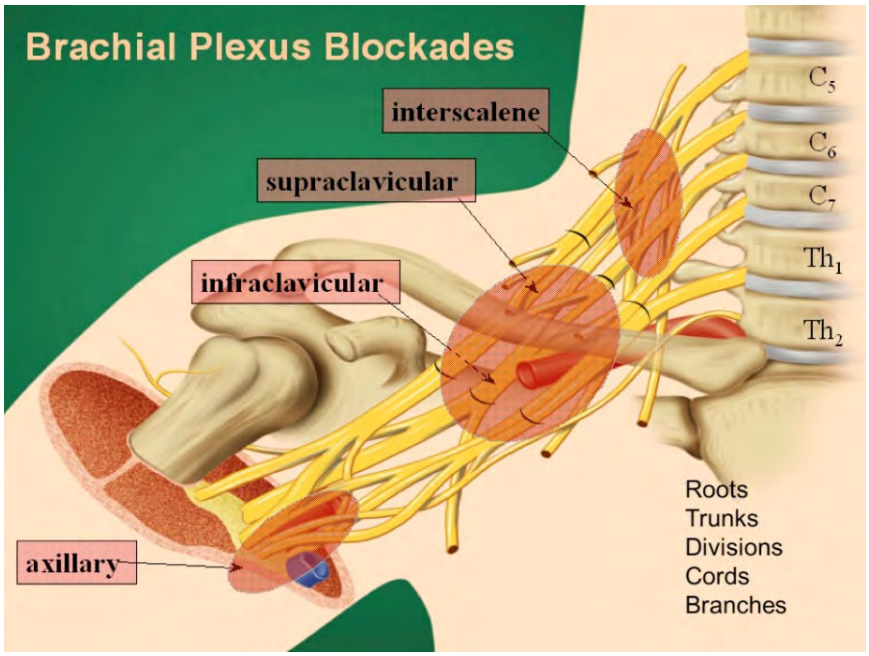
The picture to the right shows where C5-T1 is located on the body. The second picture on this page shows an up-close view of C5-T1, which is where this block is involved.

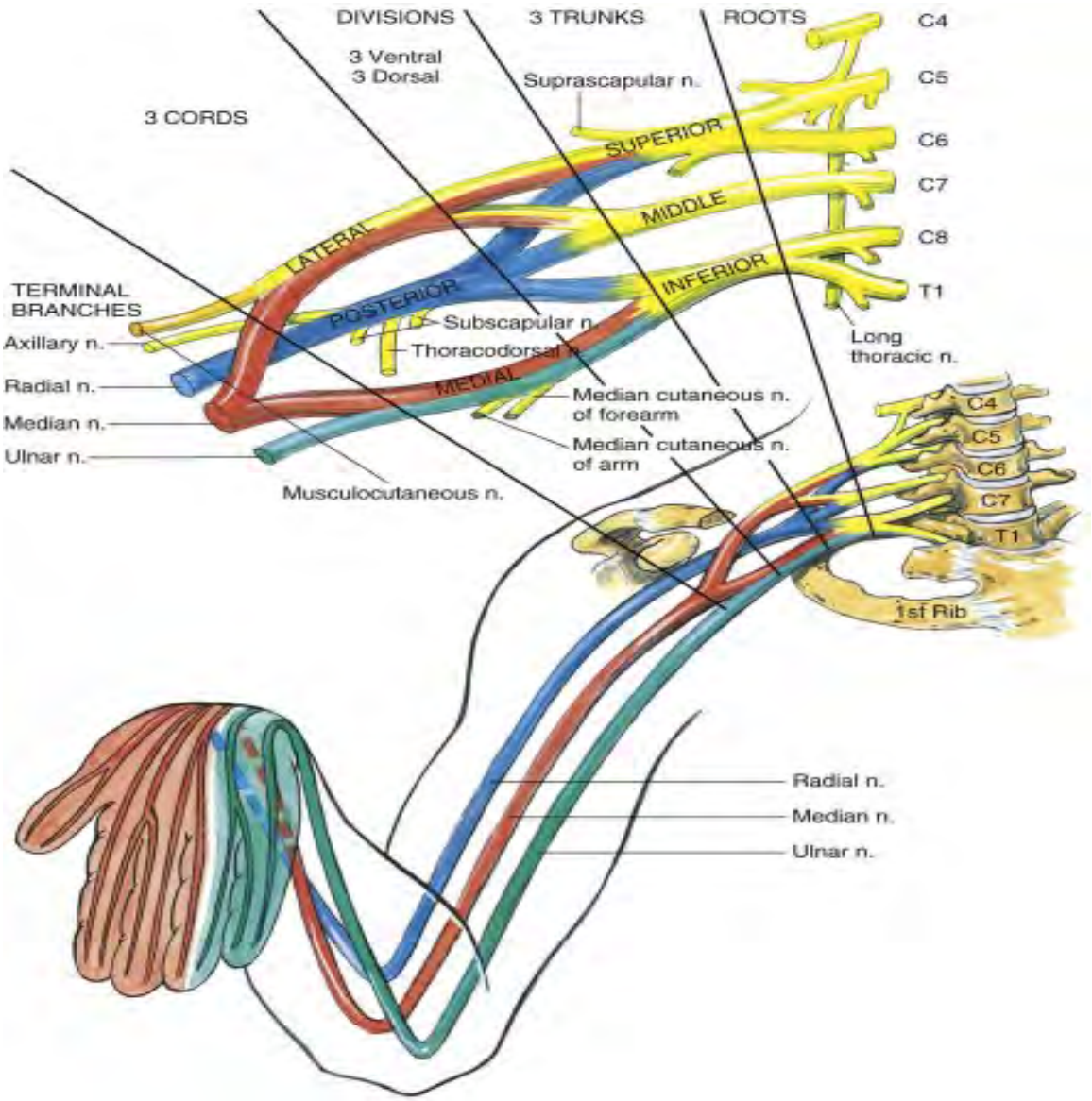



The block allows for placement of local anesthetic at the level of the trunks, cords, or terminal branches.

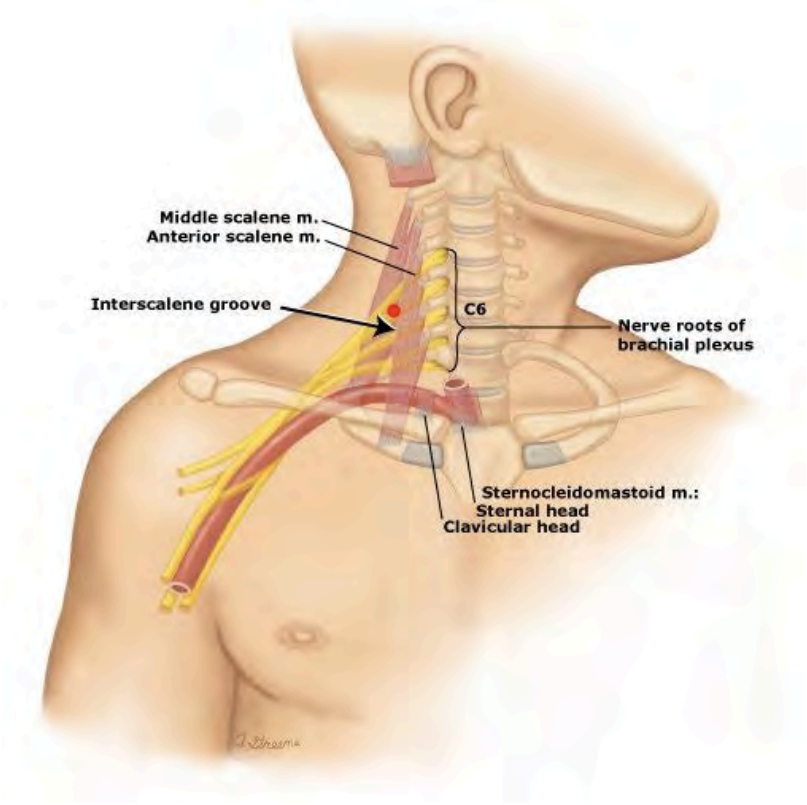
Most common blocks of the brachial plexus include interscalene, supraclavicular, infraclavicular, and axillary approach.

As you can see in the picture to the right, all 4 blocks are in different areas.





# Interscalene Block



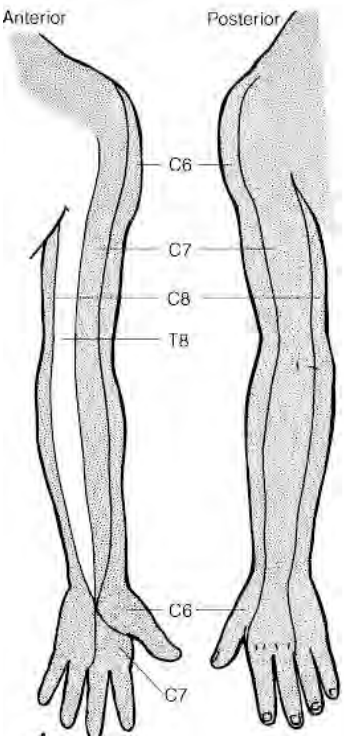

The interscalene block includes the upper, middle, and lower trunks that are located between the anterior and middle scalene muscles.

The picture to the left shows the targeted area for the block.

Positioning for the block is usually supine with the patient's head turned the nonoperative side.

Key landmarks for the block include the sternocleidomastoid muscle, interscalene groove, and cricoid cartilage, which you can see in the picture to the left.

The block can be performed with ultrasound, nerve stimulator, or paresthesia technique. With the paresthesia technique, you will have a subjective description of paresthesia in the upper arm and shoulder. With the nerve stimulator, you will see a contraction of the deltoid, biceps, triceps, pectoralis major, forearm, and hand when the needle is in the correct spot. On ultrasound you will identify the specific nerve roots or trunks to guide placement.




The gray in the picture to the right shows the area that is blocked.

This is used for surgeries on the distal clavicle, shoulder, and upper arm. It spares ulnar distribution.

Additional complications with this specific block include blockade of the phrenic nerve (if blocked, the patient would become dyspneic, caution must be used in patients with chronic respiratory issues), also a pneumothorax, Horner syndrome (which has a picture and description on the next slide), inadvertent epidural injection, inadvertent spinal injection (leading to a high spinal), as well as the complications listed for all peripheral nerve blocks which include local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection.

Signs and symptoms of a pneumothorax include dyspnea, decreased or absent breath sounds on the affected side, chest pain with deep inspiration, hyperresonance with percussion, and hypoxemia.

### Horner's Syndrome

Blockage of the stellate ganglion can lead to Horner's syndrome. Horner's syndrome leads to hoarseness, miosis (which is pupil constriction), ptosis (which is eyelid drooping), anhidrosis (which is decreased sweating and nasal congestion) all on the affected side. In the picture to the right, the right side on the picture (which is the patient's left side) is clearly affected. This is self-limiting, and reassurance is an important consideration.

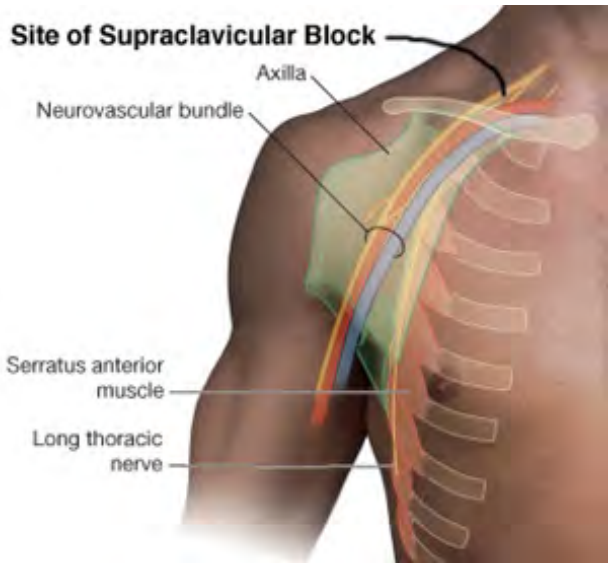
## Supraclavicular Block

The supraclavicular block is used for surgical procedures of the upper arm, elbow, forearm, and hand. This is also called "the spinal of the arm," because of how comprehensive the block is.

It is different than the interscalene block and cannot be used for shoulder surgery.

The patient is placed in the supine position with the head turned toward the nonoperative side.

Landmarks include the clavicle, sternocleidomastoid muscle, and subclavian artery.




Paresthesia technique of the arm or hand can be used. With the peripheral nerve stimulator technique, muscle contraction of the fingers is desired. Ultrasound technique relies on identification of the subclavian artery and trunks of the brachial plexus, which are located posterior to the artery.

The picture on the page before shows the area to inject.

Complications are similar to the interscalene block and include a pneumothorax, inadvertent spinal or epidural injection, local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection, with the addition of a hemothorax.

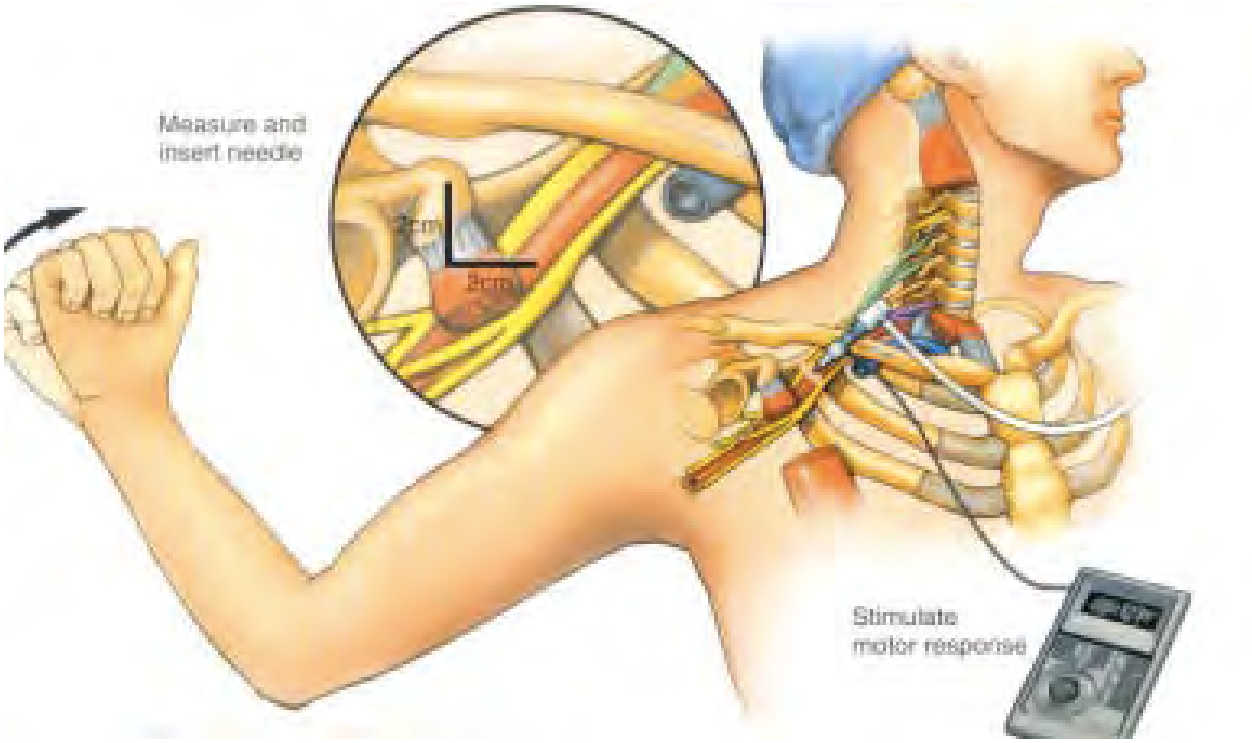
# Infraclavicular Block

The infraclavicular block, also called “the high axillary block.” Like the supraclavicular and unlike the interscalene block, the infraclavicular block cannot be used for shoulder surgery.

It covers similar area to axillary block (which we will talk about on the next slide), but this block covers more area higher up on the arm.

Patients are positioned supine with the head turned toward the nonoperative side, and the arm abducted about 90 degrees, as you can see in the picture below. Anatomic landmarks include the clavicle, coracoid process, and subclavian artery.

Techniques are limited to the nerve stimulator and ultrasound. The peripheral nerve stimulator relies on the muscle contraction of the median nerve (which will show wrist-finger flexion), and radial nerve (which will show elbow-wrist extension), and ulnar nerve (which will show wrist-finger flexion).

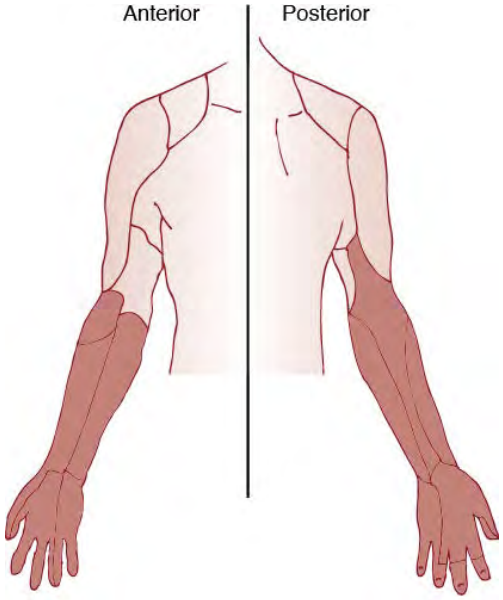



It is used for surgical procedures on the upper arm, elbow, forearm, and hand.

Complications are similar to the supraclavicular approach including a pneumothorax, inadvertent spinal or epidural injection, local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection with the addition of a chylothorax, which is accumulation of the lymphatic fluid within the chest and associated with left sided blocks. (Signs and symptoms are similar to a pleural effusion.)

# Axillary Block

The axillary block involves blocking the median, ulnar, and radial nerves.




In the picture to the right, the area in the dark red is blocked.

The patient is positioned supine or sitting. The arm is abducted, and the elbow is flexed at 90 degrees. The primary landmark is the axillary artery. Approaches include a transarterial technique where the needle is inserted through the axillary artery. When blood can no longer be aspirated, the local anesthetic is slowly injected with frequent aspirations to ensure the needle tip is not in the artery. Continuous monitoring is important to watch for intravascular injection. The paresthesia technique relies on subjective reporting by the patient. The ultrasound technique identifies the axillary artery and vein and the area surrounding them is injected.

This is used for procedures on the hand, forearm, and elbow.

Complications are rare and do not include any additional complications specific to this block. The general complications include local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection.

# Bier Block

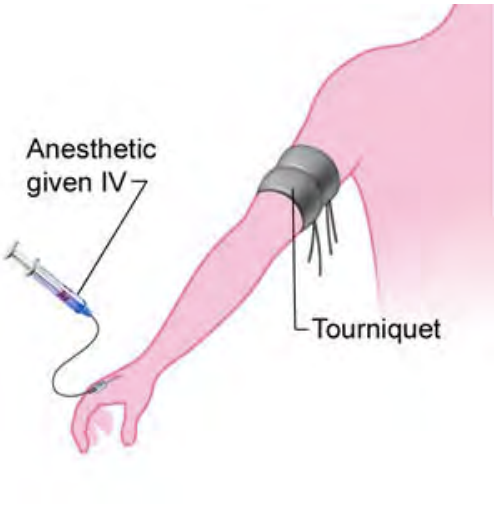
The Bier block is performed a little bit differently than the rest of the blocks.

It is used for procedures on the upper extremities, and is best used for procedures on the forearm or hand.

The block is contraindicated in patients with Sickle Cell disease, or Raynaud's disease.

To perform this block, the patient needs two peripheral IVs. One IV for the usual fluids, the other IV is for the block injection and is best positioned in the hand if possible. In the picture to the right you can see why the IV in the hand is necessary.

For administration, after blood is exsanguinated from the arm, a tourniquet is placed on the upper arm to prevent the injection from going into systemic circulation.




Usually lidocaine is the local anesthetic of choice. After the tourniquet inflated, the lidocaine is in injected into the IV on the same hand.

Once the procedure is over and tourniquet is deflated, the lidocaine then goes into systemic circulation. It is important to monitor for local anesthetic toxicity at that point.

It is also important to wait at least 20 minutes before letting the tourniquet down or the patient will get systemic toxicity because the lidocaine hasn't had enough time to distribute enough out of the vessels into the surrounding tissue.

The block usually lasts one to two hours.

Patient's biggest complaint is pain from the tourniquet.

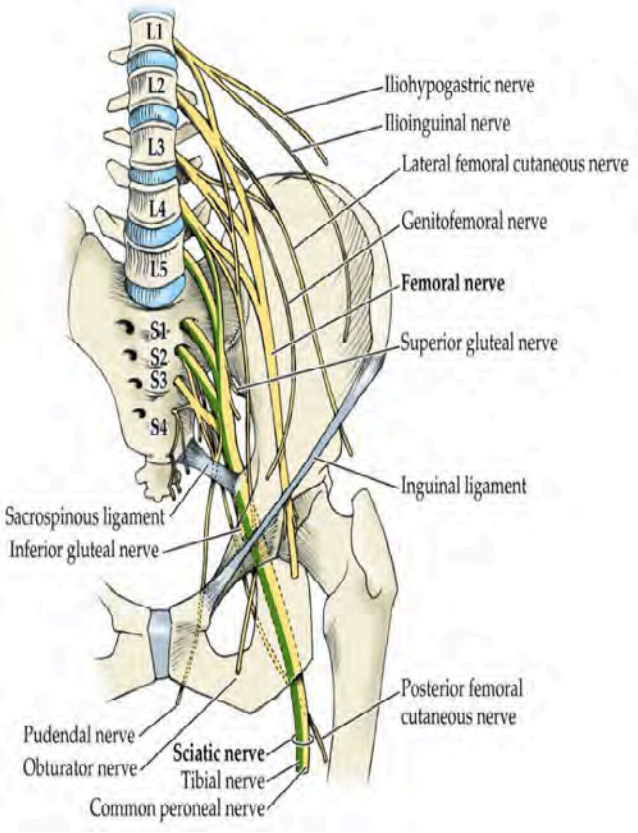
Complications include a higher risk of lidocaine toxicity (which can lead to cardiac arrest and seizures), compartment syndrome, thrombophlebitis, and bruising.

## Lower Extremity Block

Now we will talk about blocking the lower extremities. In the first picture on the left on the next page, you can see the major nerves and the correlation to where they come out of the spinal cord. We will go through the femoral block, sciatic block, popliteal block, and ankle block. These blocks require the blockade of the lumbar plexus, sacral plexus, or both.

You can see in the picture below on the right how the nerves run through the leg.

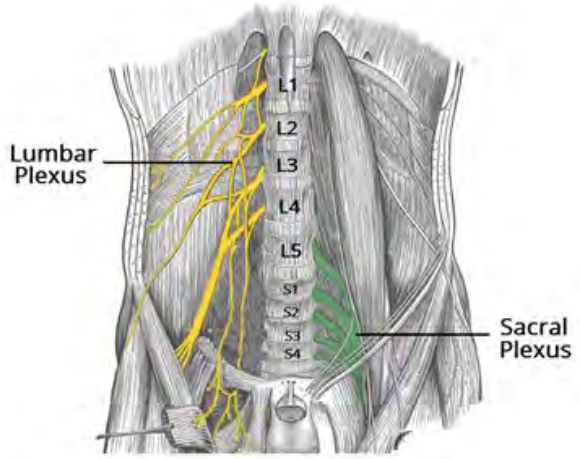
The lumbar plexus is formed after the anterior rami of T12-L5 and emerges from their intervertebral foramina. It forms several nerves including the iliohypogastric,

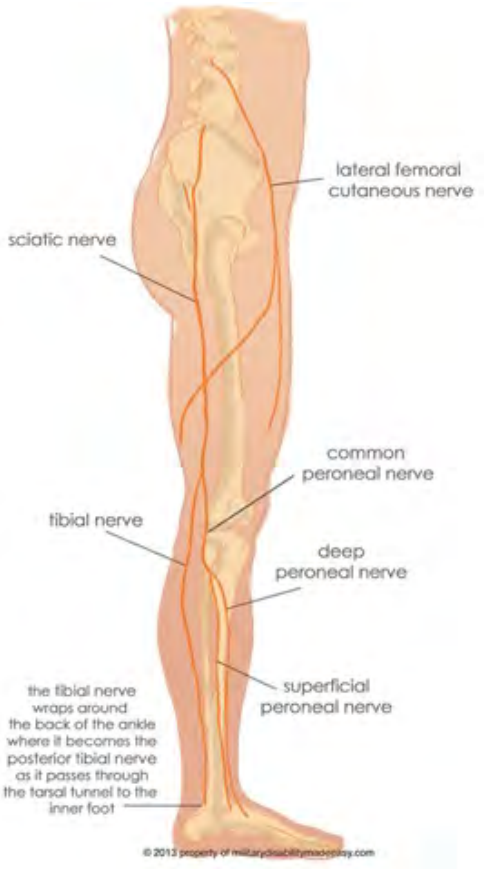


ilioinguinal, genital femoral, lateral femoral cutaneous, femoral, and obturator nerves (which you can see also see in the picture to the left).

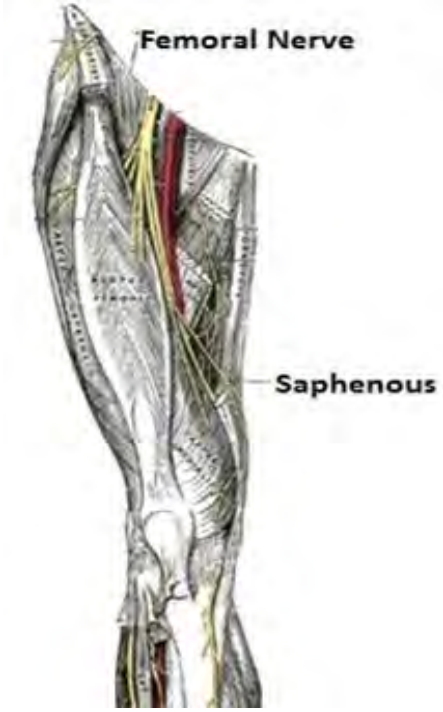
The sacral plexus is formed by the ventral rami of L4-S4 and forms the gluteal and sciatic nerves.

The picture below identifies left lumbar plexus, and the right sacral plexus.

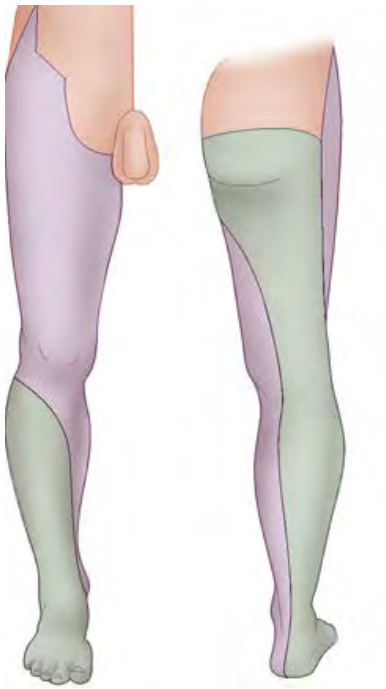



## Femoral Block




Now we will talk about the femoral block. The picture to the left shows the femoral nerve location. The picture to the right shows the area covered with the femoral block. It is the purple area in the picture seen.



Blocking of the femoral nerve provides anesthesia and analgesia to the anterior potion of the leg including the thigh, knee, medial ankle, and medial foot.

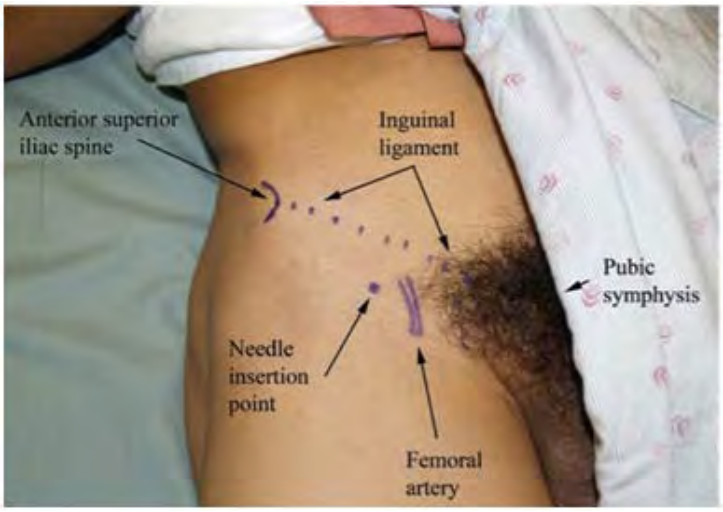
The femoral nerve innervates the quadriceps, pectineus,

and satorious muscles and provides sensation to the anterior and medial thigh, as well as medial foot and ankle.

Contraindications include infection to the groin area, or history of a femoral graft.

This block can be used in conjunction with a sciatic nerve block to effectively block the remaining portion of the leg, which is innervated by the sacral plexus.

Common approaches include a peripheral nerve stimulator or ultrasound. The peripheral nerve stimulator relies on muscle contraction of the quadriceps and patellar muscle.



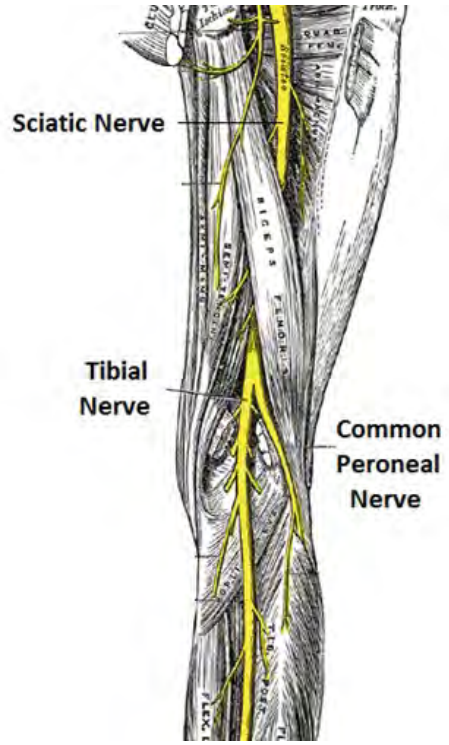

The patient is positioned supine and landmarks are identified which are the superior corner of the pubic tubercle (which identifies the inguinal ligament) and the femoral artery. The femoral nerve is located medial to the femoral artery. You can see the landmarks in the picture above.

Complications include the ones listed for all peripheral nerve blocks including local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection, with the addition of being at risk for falls.

Patients should have a knee immobilizer placed and ambulation should be with assistance.

## Sciatic Block

Now we will talk about the sciatic block. The picture to the right shows the sciatic nerve location. The picture below top shows what area the sciatic block covers. It blocks the area in green in the picture seen.




Trivia fact: The sciatic nerve is the largest nerve in the human body!

It originates from the sacral plexus (L4-S4) as you can see in the picture in the lower left.

It leaves the pelvis and runs down through the posterior buttocks and is located between the greater trochanter and the ischial tuberosity.

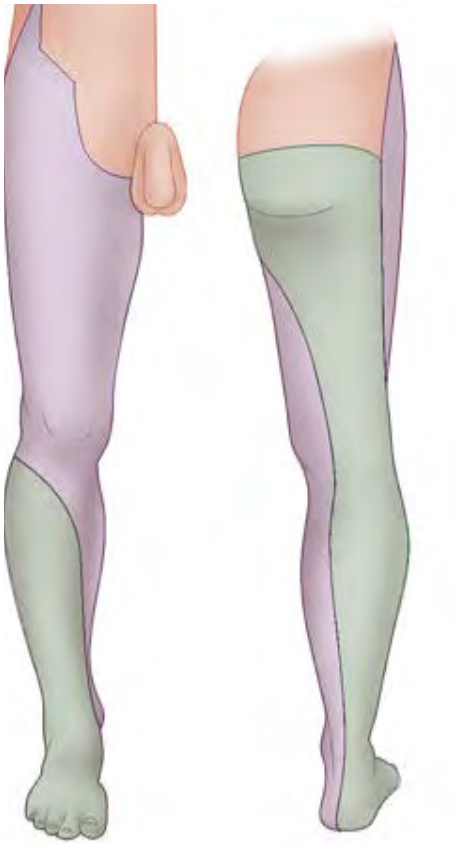
It provides innervation to the hamstrings and all the muscles below the knee.

Sensory innervation includes the posterior portion of the knee as well as the lower leg except for the medial portion of the lower leg, which is supplied by the saphenous nerve (which is a branch of the femoral nerve).

The sciatic nerve has a poor blood supply and is at risk for trauma through the pressure exerted from the large volumes of local anesthetic, tourniquet, and positioning.

It is important to avoid local anesthetic injection with epinephrine due to possible vasoconstriction.

These blocks are placed with ultrasound or peripheral nerve stimulators. Single injection or peripheral nerve catheters may be placed. Nerve stimulation technique relies on contraction of the hamstring or gastrocnemius muscle, dorsal-plantar flexion of the foot, or both. Positioning of the patient varies depending on the comfort level of the anesthetist, it can include lateral decubitus position, lithotomy position, or supine position.

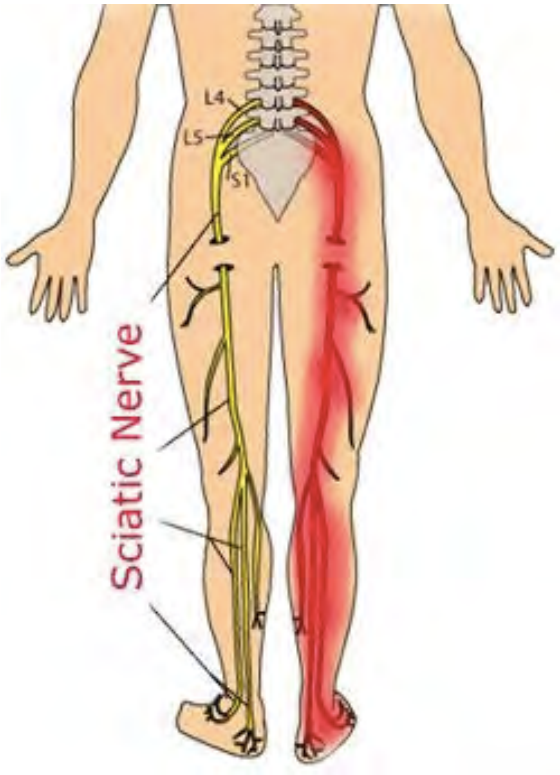


This is used for procedures on the hamstring, posterior portion of knee and calf, and shin area. It does not cover the medial portion of the leg.

Relative contraindications include diabetes and neuropathies.

The same complications as the rest of the peripheral nerve blocks apply including local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection, as well as intraneural injection (when the patient would get foot drop).

Again, positioning is important to be sure that the patient does not have any additional pressure on that sciatic nerve that does not have much blood supply.



## Popliteal Block

We will now talk about the popliteal block.

The popliteal blocks the area in green in the picture to the right.

The sciatic nerve divides into the common peroneal and tibial nerves 7-10 cm above the popliteal fossa.

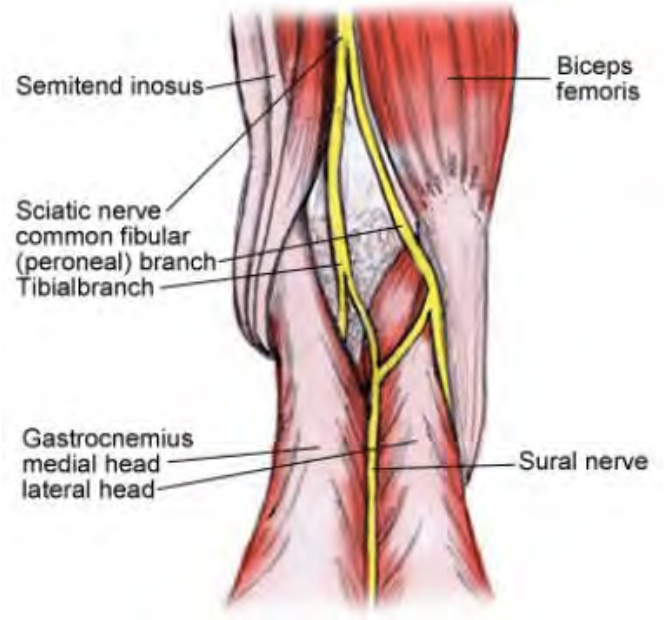
The lateral border of the fossa includes the biceps femoris while the semitendinosus and semimembranosus form the medial border. You can see how the nerves divide in the picture below.

The saphenous nerve provides sensory innervation to the medial ankle and may be supplemented.

Common techniques include the peripheral nerve stimulator and the ultrasound. Peripheral nerve stimulators seek motor movement of the ankle, foot, or toes. Patient positioning is either prone or supine.

This is the same as sciatic block, it just doesn't cover as high up on the leg.

It is used for procedures on the ankle and foot, but spares the medial aspect of the leg.




No local anesthetic with epinephrine due to poor blood supply.

Relative contraindications are the same as sciatic block and include diabetes and neuropathies.

Complications are the same as sciatic and include local anesthetic toxicity, hematoma formation, nerve trauma, infection, intravascular injection, and intraneural injection (which is when the patient would get foot drop).

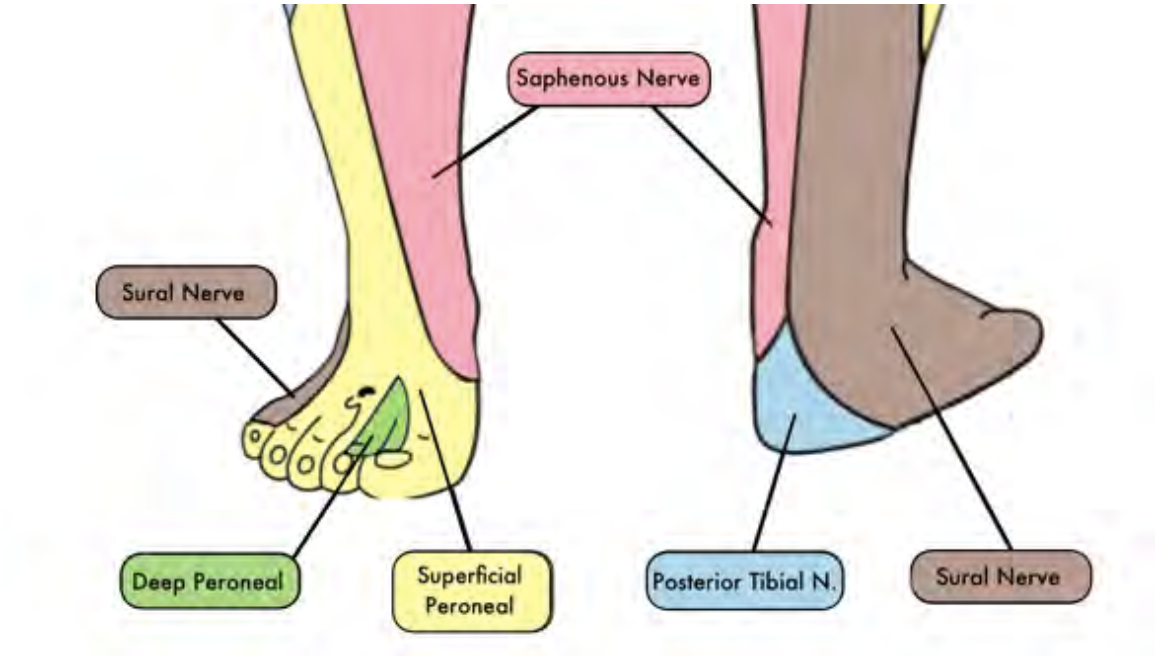
## Ankle Block

The ankle block requires the blocking 5 nerves seen in the picture below including the superficial peroneal, deep peroneal, posterior tibial, sural, and the saphenous nerve.

The saphenous is a major branch of the femoral nerve.

Major landmarks include the medial and lateral malleolus, posterior tibial artery, Achilles tendon, and flexor hallucis longus tendon.

The patient is positioned supine for the block.




Ultrasound may be used, but this is a basic block and can be placed easily with landmarks.

Local anesthetic with epinephrine should be avoided due to poor blood supply and can lead to ischemia.

Additional serious complications are unlikely, but it still has the same basic complications as the rest of the peripheral nerve blocks including local anesthetic toxicity, hematoma formation, nerve trauma, infection, and intravascular injection.

It is important to help with ambulation and positioning after block.

## Peripheral Nerve Block Catheter

Peripheral nerve block catheters are great to be used for postop op pain.

The catheter will have markings on it that tell you how far in the catheter is. As you can see in the picture below, the catheter has lines to be able to tell how deep the catheter is placed.

The catheters can be stimulating or nonstimulating.

Stimulating catheters are used for placement with a peripheral nerve stimulator where the target nerve is located with a needle. After the correct spot is found, the catheter is threaded inside the needle, and then a test dose helps confirm placement.

Nonstimulating catheters can be placed under ultrasound guidance with direct visualization, so nerve stimulation is not needed.

The catheters can be placed preop or postop. Nurses are required to monitor vital signs for inadvertent vascular injection, and to be sure the technique is sterile. The site should be monitored for drainage or dislodgement and should be covered with a sterile dressing.


## Post Peripheral Block Recovery

Post peripheral block requires monitoring until full function returns.

It is important to monitor for block specific complications.

The blocked limb will need protection including no sudden dropping of limb, padding of pressure points, and proper alignment with the patient's body. The patient should change positions slowly.

You want to avoid direct pressure on the affected limb.

The injection site should be assessed for possible hematoma formation.

In patients with peripheral nerve catheters, you will want to be sure all of the connections are tight on the infusion line. Be sure the sterile dressing is clean, dry, and intact. Make sure infusion rate is correct for what provider ordered.

It is very important to teach patients. He/she needs to know about how to prevent injury until feeling has returned (perhaps they will need a sling, or crutches). As sensation returns, it is normal for the patient to feel numbness, tingling, or burning with discomfort.

Thank you all for your time and attention! I hope you have a good day ☺

# Bibliography

Odom-Forren J. Drain's Perianesthesia Nursing - A Critical Care Approach. Vol 7th ed. St. Louis, MO: Elsevier; 2018.

Schick L, Windle PE. Perianesthesia Nursing Core Curriculum. Vol 3rd ed. St. Louis, MO: Elsevier; 2016.

Miller RD (ed). Miller's Anesthesia. Vol 7th ed. (Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish HP, Young WL, eds.). Philadelphia, PA: Churchill Livingstone, Elsevier; 2010.

Barash PG, Cullen BP, Stoelting RK, Cahalan MK, Stock MC, Ortega R. Clinical Anesthesia. Vol 7th ed. Philadelphia, PA: Lippincott Williams & Wilkis; 2013.

Flood P, Rathmell JP, Shafer S. Stoelting's Pharmacology & Physiology in Anesthetic Practice. Vol 5th ed. Philadelphia, PA: Wolters Kluwer Health; 2015.