Epidural Nerve Block

Overview

Epidural nerve block has become a significant advance in neuraxial anesthesia and analgesia. Dr. James Leonard Corning described the procedure in 1885[1] and Cuban anesthesiologist Manual Martinez Curbelo, in 1947, first used an epidural catheter.[2]

The procedure is commonly performed as a sole anesthetic or in combination with spinal or general anesthetic. The duration of anesthesia or analgesia is prolonged when epidural catheters are used. Patients are able to control their pain with patient-controlled epidural analgesia (PCEA) in a manner similar manner to that of intravenous patient-controlled analgesia (IV PCA).

Local anesthetic epidural blockade may be useful in conjunction with aggressive physical therapy or manipulation of a painful limb associated with joint stiffness or limited range of motion. Lumbar sympathetic blocks are more appropriate for evaluating and treating complex regional pain syndromes, as they provide a more selective evaluation by providing a discrete sympathetic block.

In comparison to epidural blocks, epidural injections of local anesthetic, steroids, or both are considered for the treatment of radicular pain symptoms secondary to disk herniation or postsurgical radicular pain. Epidural injections do not alter the course of the underlying process but may offer effective pain relief in selected patients. Epidural injections may be performed in the spinal region, including the cervical, thoracic, lumbar, and sacral regions. Fluoroscopic guidance may be necessary in patients with congenitally, surgically, or pathologically altered anatomy. The injections should be delivered into the area of the known pathology using midline, paravertebral, or transforaminal approaches. Caudal steroid injections should only be used for patients with leg pain of sacral origin or in whom direct access to the lumbar region is impossible.

When considering epidural nerve block, clinicians should follow a stepwise approach. First, an accurate diagnosis must be made by obtaining a pertinent neurological history and examination and performing the appropriate diagnostic confirmatory tests.

In the ever-expanding field of interventional pain management, epidural injections of pain medications like steroids play an important role in chronic pain management. Long-term indwelling epidural catheters are helpful in managing severe pain in cancer and noncancer chronic pain conditions. Certain conditions with sympathetic mediated or maintained pain are treated with the epidural local anesthetic since it provides sympathetic blockade.

Anatomy

The cephalad part of the spinal epidural space begins at the level of foramen magnum, where the periosteal and spinal layers of dura fuse together. The caudal part extends to the sacrococcygeal membrane. The anterior portion of the epidural space is formed by the posterior longitudinal ligament, which covers the posterior part of the vertebral body and the intravertebral disk. Posteriorly, the epidural space is formed by the anterior lateral surface of the vertebral lamina and the ligamentum flavum. Laterally, the epidural space is formed by the pedicles of the vertebrae and the intravertebral foramen. The ligamentum flavum is used as the key landmark for identification of the epidural space. It is thinnest in the cervical region. Also note that the epidural space is narrowest in the cervical region, with an anterior/posterior diameter of 2-3 mm. The images below show the interlaminar epidural space.

Spine model showing interlaminar epidural space.

Spine model showing lateral view.

Lumbar spinous processes are more horizontal.

An understanding of the basic anatomy of the epidural space also requires recognition of the following key anatomic features of the spine. The spine is composed of cervical, thoracic, lumbar, sacral, and coccygeal vertebrae. The cervical spine is much more mobile than the thoracic or lumbar regions of the spine. Unlike the other regions of the spine, the cervical spine has foramina in each vertebra for the arteries supplying blood to the brain. The vertebrae support most of the weight to the spine. A bony projection on either side of the vertebral body called the pedicle supports the arch that protects the spinal canal. The laminae are the parts of the vertebrae that form the back of the bony arch that surrounds and covers the spinal canal. A transverse process is on either side of the arch, where some of the muscles of the spinal column attach to the vertebrae. The spinous process is the bony portion of the vertebral body that can be felt as a series of nodules in the center of an individual's spine.

Between each vertebra in the spine are disks that act as shock absorbers and also permit some movement between the vertebral bodies. They are made up of a strong outer ring of fibers called the annulus fibrosus and a soft center called the nucleus pulposus. The annulus helps keep the disk's inner layer intact.

In addition to the invertebral discs, facet joints between each of the vertebral bodies allow the individual bones of the spine to move and rotate with respect to each other. Several muscle groups that move the trunk and the limbs also attach to the spinal column. The neural foramen is the opening where the nerve roots exit the spine and travel to the rest of the body. Between each pair of vertebrae are 2 neural foramina (1 on each side). Finally, the spinal cord extends from the base of the brain and ends at the lower level of the first lumbar vertebra and the top of the second lumbar vertebra. The group of nerves at the end of the spinal cord is called the cauda equina. The dura mater forms a protective watertight sac around the spinal cord and nerves. The spinal cord is surrounded by spinal fluid inside this sac.

Indications

Indications for epidural nerve block can be divided into the following categories:

- Sole epidural anesthetic
    - Orthopedics - Surgeries of lower limbs, including hip, knee, and pelvic areas
    - Vascular surgery - Lower limbs, amputations
    - Obstetrics - Cesarean delivery
    - Gynecology - Surgeries of female pelvic organs
    - Urology - Prostate and bladder surgeries
    - General surgery - Lower abdominal surgeries, including appendectomy, bowel surgeries, hernia repair
- Epidural anesthetic in combination with spinal anesthetic
    - This combination is referred to as combined spinal epidural (CSE).
    - All of the indications noted above for sole epidural anesthetic may also be performed with CSE.
- Epidural anesthetic in combination with general anesthetic
    - All of the indications noted above for sole epidural anesthetic may also be performed with CSE.
    - Pediatric surgery - Penile procedures, inguinal hernia repair, lower limb orthopedic procedures
    - Thoracic surgery -Thoracotomy, cardiac bypass, other cardiac surgeries
    - Epidural analgesia combined with general anesthesia reduces the incidence of postoperative pneumonia in patients with chronic obstructive pulmonary disease who are undergoing major abdominal surgery.[3]
- Epidural analgesia[4, 5]
    - Prolonged postoperative analgesia obtained by continuous or patient-controlled infusions of local anesthetics, opioids, adjuvants, or a combination thereof
    - Labor epidural analgesia
    - Single-shot epidural injection of depot form of morphine (Duramorph) can provide 6-24 hours of analgesia. DepoDur (EKR Therapeutics, Bedminster, NJ) is a formulation that provides more than 2 days of analgesia with a single injection.
- Epidural for chronic pain management[6, 7, 8, 9]
    - Disk herniation, degeneration, and spondylosis

- Radiculopathy -Cervical, thoracic, lumbosacral
- Spinal stenosis and facet arthropathy
- Sympathetic mediated/maintained pain of upper or lower extremities
- Pelvic pain - Aid with pelvic floor physical therapy

Contraindications

Absolute contraindications

- Patient refusal
- Uncorrected hypovolemia
- Increased intracranial pressure
- Infection at the site
- Allergy to local anesthetic (For more information, see Local Anesthetic Agents, Infiltrative Administration.)

Relative contraindications

- Coagulopathy
- Platelet count < 100,000
- Uncooperative patient
- Spine abnormalities and surgeries
- Sepsis
- Unstable spine from trauma
- Positioning problems
- General anesthesia (controversial)

Because of the rare occurrence of spinal hematoma associated with neuraxial anesthesia in patients taking anticoagulants, a consensus statement has been developed by the American Society of Regional Anesthesia and Pain Medicine (ASRA).[10] Recommendations from the consensus statement are depicted in the table below. For more information, see ASRA's consensus statement on Regional Anesthesia in the Anticoagulated Patient.

Table. ASRA Recommendations (Open Table in a new window)

Drug	Catheter Insertion	Catheter Removal
NSAIDs	No contraindication; may increase frequency of spontaneous hemorrhagic complications when combined with warfarin, heparin, or thrombolytics	No contraindication
Ticlopidine (Ticlid)	Discontinue 14 d before epidural block	
Clopidogrel (Plavix)	Discontinue 7 d before epidural block	
GP IIb/IIIa inhibitors*	Discontinue 8-48 h before epidural block	
Heparin	**SC/IV:** Do not heparinize until at least 1 h after the epidural block	Wait 2-4 h after last SC heparin dose or discontinuing IV heparin infusion; check PTT prior to removal
	IV infusion: Discontinue heparin infusion for 2-4 h	

	and check partial thromboplastin (PTT) prior to block	
Warfarin	Discontinue 4-5 d prior to neuraxial manipulation; INR should be **normal** prior to block	May remove catheter when INR is ≤ 1.5 after discontinuing warfarin
(Coumadin)		
Low molecular weight heparin (LMWH)†	Wait for 12-24 h after the last dose	Remove 2 h prior to first LMWH dose, which is given 24 hours postsurgery, provided that hemostasis is adequate
Thrombolytics‡	Data limited; follow fibrinogen levels; original contraindications called for avoidance of drugs for 10 days following puncture of noncompressible vessels	No definite recommendations; measure fibrinogen level to help decide between catheter removal or maintenance
Herbals	No definitive recommendations; watch for "3 Gs" (ginseng, garlic, ginkgo biloba) that are known to either have antiplatelet properties or enhance effect of antiplatelet drugs	

*GP IIb/IIIa inhibitors include tirofiban (Aggrastat), eptifibatide (Integrilin), abciximab (ReoPro)

† LMWHs include ardeparin (Normiflo), dalteparin (Fragmin), danaparoid (Orgaran), enoxaparin (Lovenox), and tinzaparin (Innohep)

‡Thrombolytics include urokinase, streptokinase, endogenous t-PA formulations (alteplase and tenecteplase)

- Table. ASRA Recommendations

Anesthesia

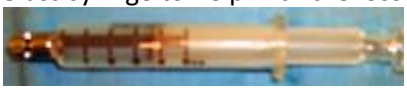
- Epidural nerve block is usually well tolerated. Apart from adequate counseling and allaying the fears of the patient, a dose of oral diazepam the night before the procedure might help.
- Midazolam and fentanyl may be titrated to respond to anxiety and pain from the procedure.
- Skin and subcutaneous tissues are infiltrated with a local anesthetic (usually lidocaine 1%). Adding sodium bicarbonate to lidocaine can minimize the burning sensation during the injection of lidocaine (usually 2 mL of sodium bicarbonate added to 8 mL of lidocaine).
- For more information, see Local Anesthetic Agents, Infiltrative Administration and Procedural Sedation.
- General anesthesia is commonly required for pediatric epidural procedures

Equipment

Commercial epidural kits are available, and manufacturers can customize kits to particular institutions. The kit in the author's institution contains the following:

- Tuohy epidural needle, 17 gauge (ga), 3.5" (see image below)
-  Tuohy epidural needle showing 1-cm marks.

- Glass syringe to help with the loss of resistance technique (see image below)



Glass syringe to check the loss of resistance.

- Epidural catheter, 19 or 20 ga
- Lidocaine 1%, 5 mL ampule, for skin infiltration
- Lidocaine 1.5% with epinephrine 1:200,000, 5 mL ampule, for epidural test dose and bolus
- Appropriate needles and syringes
- Povidone-iodine solution
- Tegaderm dressing
- Transparent drape with central opening and adhesive
- Preservative-free normal saline, 10 mL (Saline is sometimes used for the loss of resistance technique. Saline is also useful to expand the epidural space and to facilitate the passage of the epidural catheter.)
- The following image shows the entire epidural kit.

Epidural kit.

Other required equipment includes the following:

- Airway and resuscitation equipment, including oxygen, masks, bag-valve-mask, laryngoscopes, endotracheal tubes
- Intravenous access supplies, including fluids and tubing
- Procedure table that can be adjusted for height or Trendelenburg positioning
- Cushions and pillows for support and pressure point padding
- Step stool to support the legs
- Monitors, including heart rate and blood pressure, pulse oximeter, invasive monitoring ability (arterial line, central venous pressure [CVP], pulmonary artery [PA] catheter), capnograph (Standard monitors are applied according to American Society of Anesthesiologists [ASA] guidelines.)
- Essential drugs (eg, atropine, ephedrine, midazolam, fentanyl)
- Local anesthetics (eg, lidocaine, bupivacaine, ropivacaine)
- Adjuvants like clonidine
- Corticosteroids (eg, methylprednisolone, triamcinolone) that provide anti-inflammatory effects for chronic pain management
- C-arm fluoroscopy, lead protection coats, gloves, eye shields, radiography technician (also for chronic pain management)
- Sterile gloves, mask, gown, cap, shoe covers, and other precautionary equipment, according to institutional policies
- Latex-free equipment, when necessary

Positioning

- The sitting position is commonly employed. Instruct the patient rest his or her legs on a step stool and hold a pillow. Instruct the patient to arch forward like an angry cat to decrease lumbar lordosis.
- The lateral decubitus position is another possible position.
- The prone position is employed when epidural nerve block is used in chronic pain management; fluoroscopy is usually required.

Technique

Identification of Epidural Space

Several methods can be used to identify the epidural space. They include the following:

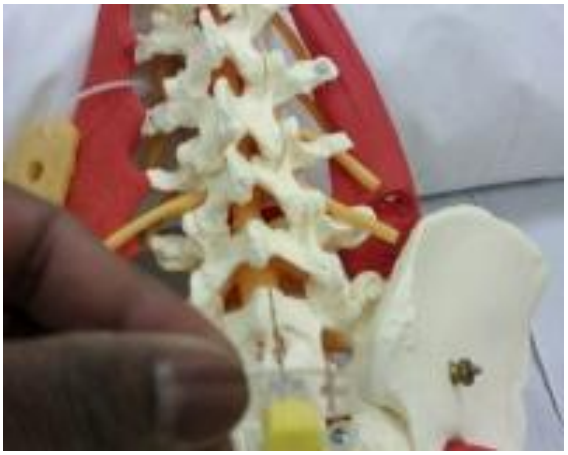
- Loss of resistance to air or preservative-free normal saline
- Compression of a small air bubble in saline (This method is the author's preference.)
- Hanging drop technique
- Pop-off feeling
- Nerve stimulation
- Ultrasound: Although often perceived as difficult to use in this capacity, ultrasonography is useful for identifying intervertebral levels, estimating the depth to epidural and intrathecal spaces, and locating important landmarks.[11]

Insertion Techniques

Interlaminar technique

In the interlaminar technique, the needle is introduced into the interspinous space and advanced between the laminae into the epidural space. The following 3 interlaminar approaches are available:

- Midline interlaminar approach (see image below)



Midline interlaminar approach.

- Paramedian interlaminar approach
- Lateral parasagittal interlaminar approach (see image below)

Lateral parasagittal interlaminar approach.

Transforaminal technique

In the transforaminal technique, the needle is introduced into the cephalodorsal portion of the concerned neural foramen. This technique is employed more often by interventional pain clinicians using fluoroscopic guidance.

level of Insertion

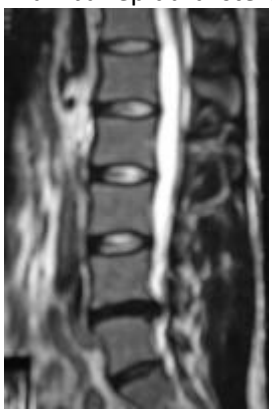
The level of insertion is determined by the indication for epidural placement.

Lumbar level

- Use the lumbar level of insertion for anesthesia and postoperative analgesia for lower abdominal, pelvic, and lower extremity procedures.
- Start a peripheral intravenous line to administer fluids and medications.
- Position the patient in the seated or lateral decubitus position with the back arched to minimize the lumbar lordosis.
- Prepare the back with povidone-iodine solution (eg, Betadine) and place a sterile drape. Use chlorhexidine gluconate (Hibiclens) for patients who are allergic to povidone-iodine solution.
- Palpate the spinous processes. The midline interlaminar approach is used in lumbar regions because the spinous processes are less angulated in these regions.
- After the skin and subcutaneous tissues are anesthetized with local anesthetic, introduce the Tuohy needle into the lower part of the interspace and advance for about 2-3 cm until the needle is firmly placed in the interspace.
- Attach the glass syringe (prefilled with air or saline 2 mL) to the needle and continue advancing in slow increments, frequently checking for loss of resistance. A gentle tap on the glass syringe piston is enough to determine the resistance. Sometimes, a small bubble of air in the saline is helpful. The bubble compresses with every tap on the piston.
- As the ligamentum flavum is reached, the resistance increases to a firm and gritty feeling. Once the epidural space is reached, resistance is lost. When the piston is gently tapped, it easily plunges in the syringe. The air bubble in the saline no longer compresses, and saline is easily injected into the epidural space.
- Once the epidural space is reached, aspirate to rule out cerebrospinal fluid (CSF) or heme.
- If performing a single shot procedure, inject the medication and remove the needle.
- If placing a catheter, gently advance the catheter through the needle for about 4-5 cm and then remove the needle.
- Connect a connector to the end of the catheter and remove the sterile drape.
- Secure the epidural catheter to the patient's back with sterile Tegaderm dressing, and inject a test dose of medication. The test dose rules out intrathecal or intravascular location of the catheter.
- With a successful neuraxial blockade, a zone of differential sympathetic nervous system blockade typically occurs at the spinal level. The zone of differential motor blockade may average up to 4 segments below the sensory level in epidural rather than spinal blockade.
- For interventional pain epidural injections, confirm the needle position with the loss of resistance technique as well as fluoroscopic guidance.
- Inject the radiopaque contrast medium and study the spread of the dye in the epidural space (epidurograph). The author employs the lateral parasagittal interlaminar approach to direct the medication to the site of pain and as close to the pain generators as possible.
- With disk herniation, the pain is usually generated in the disk-anterior epidural space interface. Therefore, the medication should be placed into the anterior epidural space rather than the posterior epidural space. In a study conducted in the author's institution, the lateral parasagittal and transforaminal approaches were compared.[12] The dye spread into the anterior epidural space more often with the lateral parasagittal approach. With this approach, the needle is placed as far lateral in the epidural space as possible, maintaining the parasagittal orientation of the needle until the epidural space is reached.

Lumbar epidural steroid injection

A lumbar epidural steroid injection may be used to treat a lumbar disk bulge, as shown in the images below.



Sagittal T2 weighted image showing L4-L5 disk bulge.

Axial T2 weighted image showing left posterior disk bulge at L4-L5, indenting the ventral epidural space.

Position the patient prone on the procedure table with a pillow under the waist to decrease the lumbar lordosis (see image below).

Positioning for lumbar epidural steroid injection.

Prepare the insertion site and field with povidone-iodine solution (see image below).

Povidone iodine preparation.

Cover the field with a sterile drape (see image below).


Sterile drape.

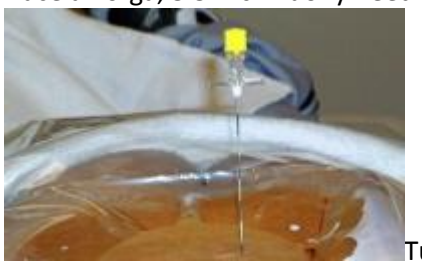
Place a skin marker to confirm laterality (see image below).


Skin marker.

Infiltrate the skin with a local anesthetic (see image below).


Skin infiltration with local anesthetic.

Place a 20-ga, 3.5-inch Tuohy needle (see image below). The needle has marking at 1-cm intervals.


Tuohy epidural needle placement.

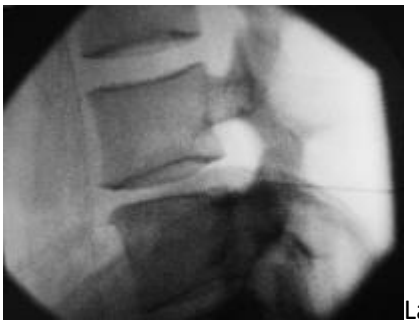
Advance the needle toward the epidural space, maintaining the lateral parasagittal orientation.

Connect a glass syringe filled with 2 mL of air to the needle and advance it with intermittent pauses while checking the resistance level and position of the needle with intermittent fluoroscopy. As the ligamentum flavum is encountered, the resistance increases slightly, producing a gritty sensation (see image below).


Loss of resistance technique using glass syringe.

Once the epidural space is reached, resistance ceases and the piston advances easily in the glass syringe. Take care not to inject too much air into the epidural space, and remove the glass syringe.

Obtain fluoroscopy view in the lateral projection to confirm the needle tip in the posterior part of the epidural space (see image below).


Lateral view showing the needle in the epidural space prior to dye injection.

Attach a syringe filled with radiocontrast dye to extension tubing and connect it to the epidural needle (see image below)


. Needle made immobile with extension tubing. Dye is injected.

After negative aspiration for heme or CSF, inject the dye. (Usually, 2-3 mL is sufficient to produce a good epidurogram.) See images below.


Lateral view after the dye is injected. The dye spread both anteriorly and posteriorly in the epidural space. Note the indentation made by the disc bulge at L4-L5 level.


Anteroposterior view showing left lateral parasagittal needle placement with the dye spreading predominantly in the left epidural space and along the nerve roots.

Once the epidurogram shows satisfactory placement of the needle, slowly inject the corticosteroid mixture (methylprednisolone [Depo Medrol] 80 mg, lidocaine 1% 0.5 mL, preservative-free 0.9% NaCl 1 mL). See image below.


Steroid injection.

After the steroid is injected, flush the needle with 0.5 mL saline and remove it.

Apply pressure at the injection site to prevent any bleeding. Cover the injection site with an adhesive bandage.

Observe the patient in the pain clinic until he or she is stable to go home in ambulatory condition. Give suitable written and verbal instructions. Advise the patient to follow up in the pain clinic in 3-4 weeks for reevaluation.

Thoracic level

At the low thoracic levels, the angulation of the spinous processes is increased, and less interlaminar space is available (see images below). Greater access to the epidural space is available when the paramedian approach is used; therefore, the paramedian interlaminar approach is easier and desirable at low thoracic levels.


Thoracic spine. Note the very narrow interlaminar spaces at this level.


Thoracic spinous processes. Note increased angulation compared to lumbar levels.

In the paramedian approach, insert the needle slightly to the side of the midline and advance it straight until the lamina is reached.

Subsequently, direct the needle in a cephalad and medial direction until it is walked off the superior aspect of the lamina, then advance it toward the ligamentum flavum, using the loss of resistance technique. Either air or saline can be used to aid with the loss of resistance technique.

The rest of the procedure is the same as described for the lumbar level above.

Thoracic epidural catheter insertion for postoperative analgesia

Place a peripheral IV prior to the procedure. The patient sits on the side of the bed with feet resting on a stool. Advise the patient to bend forward and support the arms on a rest or by hugging onto a pillow. Monitor vital signs throughout the procedure.

Prepare the skin with povidone-iodine solution (see image below).


Thoracic epidural catheter placement. Skin preparation.

Place a sterile drape.


Sterile drape.

Infiltrate the injection site with local anesthetic


Skin infiltration with local anesthetic.

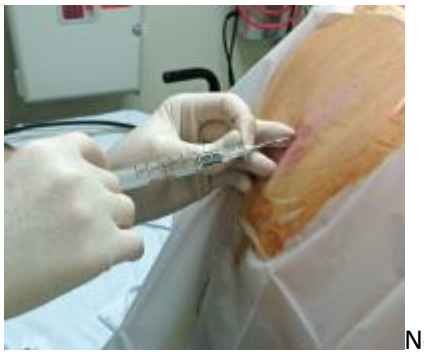
The skin entry site is just lateral to the spinous process of T6.

Advance the Tuohy needle at a perpendicular angle until the lamina is reached (see image below).

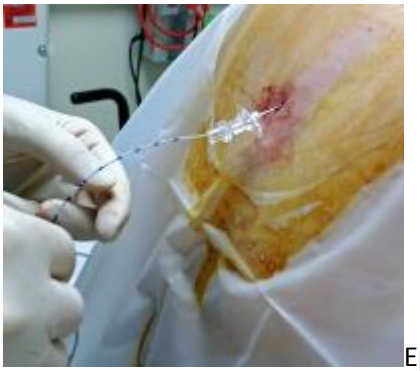

Tuohy needle placement. Note the paramedian approach and cephalomedial orientation of the needle.

Withdraw the needle slightly and orient it cephalad and slightly medially (see image above). Then, walk the needle off the superior aspect of the lamina, and attach the glass syringe filled with air.

Advance the needle until loss of resistance is obtained (see image below).


Needle advanced with loss of resistance technique. Note the glass syringe used for noting loss of resistance.

After negative aspiration for heme/CSF/paresthesia, advance the epidural catheter about 3-5 cm into the epidural space and remove the needle (see image below).


Epidural catheter advanced through the epidural needle after noting loss of resistance.

Connect the epidural catheter to the connector (see image below).

 Epidural catheter attached to the connector.

Secure the epidural catheter to the skin (see image below).

 Epidural catheter is secured to the skin using Tegaderm and paper tape. Note that the marks on the catheter are visible for future examinations.

Inject a test dose of lidocaine 1.5% 3 mL with epinephrine 1:200,000 through the catheter after negative aspiration for heme and CSF. The test dose rules out intrathecal and intravascular location of the catheter.

The epidural catheter is used postoperatively. To do so, mount an epidural infusion pump (see image below) with a bag containing 250 mL of epidural analgesic mixture (bupivacaine 2.5 mg plus fentanyl 5 mcg/mL). Patient-controlled epidural anesthesia (PCEA) settings can be set at 3 mL basal, 3 mL PCA dose every 30 minutes, with a 1-hr limit of 9 mL.  Epidural infusion pump.

PCEA provides excellent postoperative analgesia and is continued typically for 3 days. The patient is able to perform incentive spirometry and deep breathing exercises. The Anesthesia Pain Service in the hospital manages the PCEA.

Cervical interlaminar epidural steroid injection

The interlaminar approach is used in interventional pain management.

Take great precautions to ensure that dural puncture is avoided. The spinal cord is in close proximity.

All patients undergoing this approach should receive a peripheral IV for administration of emergency medicines and sedation if necessary.

The images below show cervical spine anatomy.


Cervical spine model.

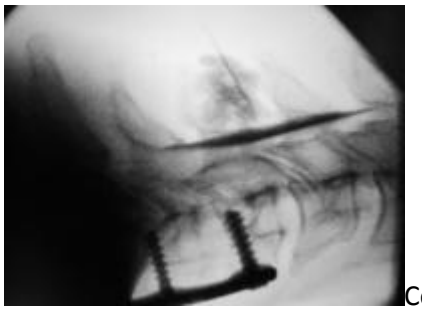
Cervical spine model. Note that the lower spinous processes are more prominent.

A seated position with the head rested on the table with a chin support is used for older patients who are unable to lie prone. If the patient is in a sitting position, then the author uses the hanging drop method of identifying the cervical epidural space. The sitting position is best avoided in younger patients, especially male patients, because of the high incidence of vasovagal episode. Prone position with the arms tucked to the side is the preferred position for younger patients. However, prone positioning makes it harder to visualize the lower cervical levels clearly on fluoroscopy. The author advises patients to bring their arms as low as they can for better visualization of the lower cervical levels.

The rest of the procedure is similar to the lumbar interlaminar approach.

While the midline is identified using an anteroposterior view, the needle is advanced with lateral fluoroscopy (see images below).


Cervical spine lateral view with the needle in the posterior epidural space.


Cervical epidurogram showing posterior epidural spread.

The transforaminal approach is used less because of the risk of spinal cord injury.

Caudal level - Transcaudal epidural injection using Racz catheter

The transcaudal approach is used for patients who have had previous lumbar spine surgery.

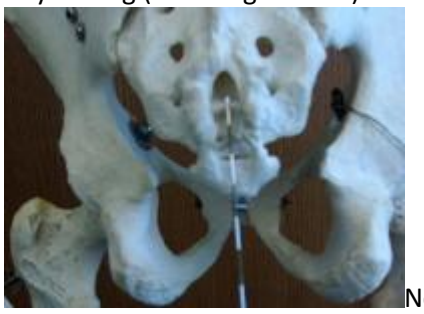
Position patients prone in the usual manner. The lowest part of the epidural space can be accessed at the caudal level.

Fluoroscopy is recommended for accurate placement of the transcaudal catheter.

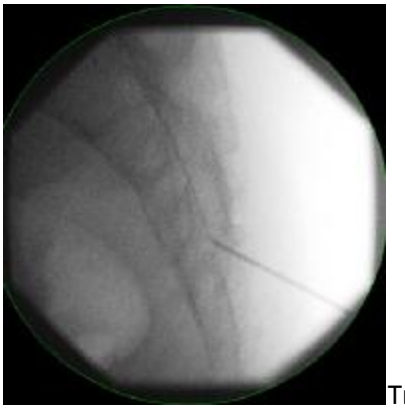
At the lower part of the sacrum, the sacral hiatus is formed by unfused sacral cornua, which allows easy access to the epidural space (see image below). The sacrococcygeal ligament covers the hiatus.

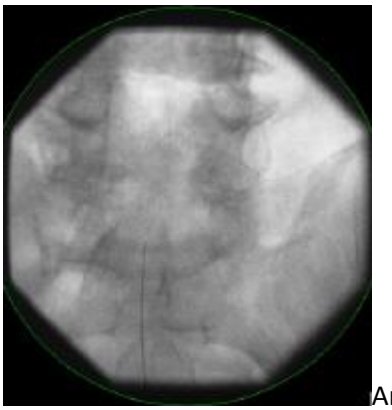

Sacral spine model showing sacral hiatus and entry into caudal epidural space.

After the usual skin antiseptic preparation and local anesthetic infiltration, insert the introducer needle midline, between the sacral cornua, and advance it until it penetrates the sacrococcygeal ligament with a pop-off or a give-way feeling (see image below). The lateral view fluoroscopy increases the accuracy.


Needle entry into caudal epidural space via the sacral hiatus.

Subsequently, remove the stylette and advance a radio-opaque catheter with fluoroscopic guidance until the lower part of the surgical area is reached (see images below).

 Transcaudal epidural catheter placement.

 Anteroposterior view if catheter being advanced into the lumbar epidural space after entry via transcaudal epidural space.

Usually, the cephalad advancement is limited to the L5-S1 level. If the catheter is advanced any more cephalad, the chance of dural puncture and subsequent spinal headache is high.

After negative aspiration for CSF and heme, inject iodinated contrast medium to confirm the epidural location. The epidurograph also provides valuable information on the cephalad cut-off due to the surgical scar tissue (see image below).

 Epidurogram, anteroposterior view, showing cephalad cut-off of the injected dye on the right side and caudal run-off in the epidural space and along the nerve roots bilaterally.

Gentle scar mobilization may be performed with the injectate.

The author uses Depo Medrol, 80 mg, with 3-4 mL of preservative-free normal saline and 0.5-1.0 mL of preservative-free lidocaine 1%.

Once the injection is performed , remove the catheter en bloc with the introducer cannula.

Apply firm pressure to prevent bleeding and place an adhesive bandage at the injection site.

Pearls

- Instruct the patient to arch forward like a mad cat to decrease lumbar lordosis.
- With disk herniation, the pain is usually generated in the disk-anterior epidural space interface. Therefore, the medication should be placed into the anterior epidural space rather than the posterior epidural space.
- Usually, 2-3 mL of dye is sufficient to produce a good epidurogram.

Complications

- Epidural and spinal anesthesia are used extensively, consistently, and securely in modern practice. Although the technique appears relatively straightforward in experienced hands, it is not free of potential complications.[13] Awareness of complications is required for a safe practice of these techniques.[13]
- Severe complications of regional anesthesia are far less commonly disclosed. According to a 2003 survey of 79 regional anesthesiologists and regional anesthesia fellows, the complication rates provided to patients may not match those cited in the literature.[14] The risks of regional anesthesia that are most commonly disclosed to patients by academic regional anesthesiologists occur frequently and are benign in nature.
- Severe complications (eg, spinal epidural hematoma) leading to temporary or permanent disability have been attributed to central neuraxial blocks.[15] Infections like meningitis and abscesses, or cerebral ischemia or hemorrhage have also been linked directly or indirectly to spinal or epidural anesthesia.[15] On rare occasion, central nerve blocks have caused permanent damage to the spinal cord or nerve roots.[15] The etiology of this damage in many cases remains unclear.
- Perhaps the clearest picture of the numbers and types of injuries from regional anesthesia is provided by the American Society of Anesthesiologists (ASA) Closed Claims Project database.[16] The report clearly noted twice the complications with general anesthesia than with regional anesthesia. The primary reason for death remains cardiac arrest associated with neuraxial blockade.[17] This complication now represents only 30% of deaths (vs 61% in the 1970s and 40% in the 1980s).[17]
- A database on early and delayed complications was collected in a prospective study of 6 weeks' duration.[18] Two hundred and fifteen patients who underwent 790 consecutive cervical epidural nerve blocks were observed. Unintentional dural puncture and superficial infection at the injection site were reported. This study concluded that cervical epidural nerve block has been reported as a safe modality in the treatment of various painful conditions.
- A report reviewed 32 studies published between January 1, 1995, and December 31, 2005.[19] The main objective was to investigate neurological complications of regional anesthesia. The review suggested that the rate of neurological complications after central nerve blockade is less than 0.04% and that the rate of neuropathy after peripheral nerve blockade is less than 3%.
- An epidural block interrupts both somatic and sympathetic nerve conduction; thus, cardiovascular changes, including hypotension and tachycardia, may occur. These cardiovascular changes can produce overwhelming complications if not promptly identified and treated. Respiratory compromise or failure can occur if the phrenic nerve or respiratory centers of the brain stem are inadvertently blocked. For this reason, epidural nerve blocks should be performed only by clinicians trained in airway management and resuscitation. Appropriate monitoring of vital signs is imperative, and resuscitation equipment must be readily available during the procedure.
- Minor adverse effects and complications of epidural nerve block include pain at the injection site, unintentional dural puncture, and vasovagal syncope. Major complications include damage to neural structures, epidural hematoma, and epidural abscess. These major complications are rare but can be life-threatening when they occur. Coexisting Harlequin and Horner syndromes after high thoracic paravertebral block have also been reported.[20]
- With the exception of the decreased incidence of inadvertent dural puncture, the complications of the caudal approach to the epidural space mirror those of the lumbar approach. Because of the proximity of the rectum, conscientious attention to sterile technique must be observed to avoid infection, which can easily spread to the epidural space via the Batson plexus. Because of the vascular nature of the caudal epidural space, the potential for local anesthetic toxicity remains ever present.
- During the postoperative period, patients should be observed closely to detect potentially treatable sources of neurologic injury, including expanding spinal hematoma or epidural abscess on neurologically vulnerable sites.[21] New neurologic deficits should be evaluated promptly by a neurologist to formally document the

patient's evolving neurologic status.[21] If necessary, the neurologist can arrange further testing or intervention and provide long-term follow-up and prognosis.

- Cauda equina is formed by nerve roots caudal to the level of spinal cord termination. Cauda equina syndrome has been defined as low back pain, unilateral or usually bilateral symptoms in the distribution of sciatic nerve, saddle sensory disturbances, bladder and bowel dysfunction, and variable lower extremity motor and sensory loss. This may occur with neurotoxicity from local anesthesia. In the past, continuous spinal catheters with local anesthetics were associated with this syndrome. Those types of catheters and infusions are no longer in use.
- Neurotoxicity associated with lower back pain that radiates to the buttocks and posterior thighs is likely due to transient lumbosacral nerve root irritation.

Contributor Information and Disclosures

Author

Jasvinder Chawla, MD, MBA Chief of Neurology, Hines Veterans Affairs Hospital; Associate Professor of Neurology, Loyola University Medical Center

Jasvinder Chawla, MD, MBA is a member of the following medical societies: American Academy of Neurology, American Association of Neuromuscular and Electrodiagnostic Medicine, American Clinical Neurophysiology Society, and American Medical Association

Disclosure: Nothing to disclose.

Coauthor(s)

Meda Raghavendra (Raghu), MD Associate Professor, Interventional Pain Management, Department of Anesthesiology, Chicago Stritch School of Medicine, Loyola University Medical Center

Meda Raghavendra (Raghu), MD is a member of the following medical societies: American Association of Physicians of Indian Origin, American Society of Anesthesiologists, and American Society of Regional Anesthesia and Pain Medicine

Disclosure: Nothing to disclose.

Specialty Editor Board

Luis M Lovato, MD Associate Clinical Professor, University of California, Los Angeles, David Geffen School of Medicine; Director of Critical Care, Department of Emergency Medicine, Olive View-UCLA Medical Center

Luis M Lovato, MD is a member of the following medical societies: Alpha Omega Alpha, American College of Emergency Physicians, and Society for Academic Emergency Medicine

Disclosure: Nothing to disclose.

Mary L Windle, PharmD Adjunct Associate Professor, University of Nebraska Medical Center College of Pharmacy; Editor-in-Chief, Medscape Drug Reference

Disclosure: Nothing to disclose.

Laurie Scudder, DNP, NP Nurse Planner, Medscape; Clinical Assistant Professor, School of Nursing, George Washington University, Washington, DC

Disclosure: Nothing to disclose.

Chief Editor

Erik D Schraga, MD Staff Physician, Department of Emergency Medicine, Mills-Peninsula Emergency Medical Associates

Disclosure: Nothing to disclose.

WebMD Health Professional Network Terms of Use

The Services (as defined below) are provided to you subject to the following Terms of Use, which may be updated from time to time without notice to you. You will always be able to view the most current version by clicking on a link at the bottom of any page within the WebMD Health Professional network of websites. **By using the Services, you agree to these Terms of Use, whether or not you are a registered member of the WebMD Health Professional Network. If you do not agree to all of these Terms of Use, do not use these Services!**

Scope of these Terms of Use

We provide users of the WebMD Health Professional Network with access to a wide array of resources through our network of properties which may be provided to you in a variety of mediums and devices now known or hereinafter developed including mobile applications. These resources include without limitation news, reference tools and applications, sponsored programming, personalized content, continuing medical education, communication tools and discussion boards (collectively, the "Services"). The Services are intended for physicians and other healthcare professionals.

The WebMD Health Professional Network is comprised of several websites: medscape.com, medscape.org and theheart.org (referred to collectively as the "Professional Sites"), including any mobile optimized versions of the Professional Sites and the Medscape Mobile Device Application. These properties are owned and operated by our affiliated companies. For example, WebMD LLC owns and operates medscape.com and Medscape Mobile, and Medscape, LLC owns and operates medscape.org and theheart.org. References to "WebMD" in these Terms of Use mean WebMD LLC, including any company that WebMD controls (for example a subsidiary that it owns) and references to "Medscape" mean Medscape, LLC, including any company that Medscape controls. Reference to "we" or "our" means WebMD and Medscape.

Our Information

The information that we make available through the Services is intended for physicians and other healthcare professionals. While we hope you find the Services helpful, you should remember that it is not meant to serve as a substitute for your own clinical judgment as a healthcare professional. We do not provide medical advice. If you are a consumer who chooses to use the professional-level information available to you through the Services, you should not rely on that information as professional medical advice or use it to replace any relationship with your physician or other qualified healthcare professional. For medical concerns, including decisions about medications and other treatments, consumers should always consult their physician or, in serious cases, seek immediate assistance from emergency personnel. We each follow standard sets of editorial procedures for information that we each make available through the Services. However, we don't offer you any warranty or guarantee related to the Services that we provide. We specifically disclaim any warranties, express or implied, including implied warranties of merchantability or fitness for a particular purpose. It's your job to evaluate the information and results from Services we provide. If you are a healthcare professional, you should exercise your professional judgment in evaluating any information, and we encourage you to confirm the information made available or otherwise obtained through the Services with other sources before undertaking any treatment based on such information. If you are a consumer, you should evaluate the information together with your physician or another qualified healthcare professional.

Clinical Tools and Databases

The Services include clinical tools and databases intended for use by healthcare professionals. These tools do not give professional advice or recommend particular products. Physicians and other healthcare professionals who use these tools or databases should exercise their own clinical judgment as to the information they provide. Consumers who use the tools or databases do so at their own risk. Individuals with any type of medical condition are specifically cautioned to seek professional medical advice before beginning any sort of health treatment. For medical concerns, including decisions about medications and other treatments, users should always consult their physician or other qualified healthcare professional.

WebMD's drug interaction checker is based on two-drug combinations. The results returned by the checker reflect only paired interactions and compatibility and do not reflect interactions or incompatibilities arising from combinations of more than two drugs at a time.

WebMD Health Directory

The WebMD Health Directory is provided for informational purposes only. The WebMD Health Directory is provided on an "AS-IS" basis. WebMD and its licensors disclaim all warranties, either express or implied, including but not limited to the implied warranties of merchantability and fitness for particular purpose. Without limiting the foregoing, WebMD and its licensors do not warrant or represent that the WebMD Health Directory or any part thereof is accurate or complete. You assume full responsibility for the communications with any physician, pharmacy or hospital you contact through the WebMD Health Directory. The database of information which drives the WebMD Health Directory does not contain sufficient information with which to verify credentials under the standards of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), National Committee for Quality Assurance (NCQA) of the Utilization Review Accreditation Committee (URAC), and use of the WebMD Health Directory to verify the credentials of physicians is prohibited. The inclusion of a physician, pharmacy or hospital in the WebMD Health Directory is not an endorsement of any such physician, pharmacy or hospital by WebMD, any of its affiliates or any third party sponsor of any component of the Services.

Proprietary Rights

You acknowledge and agree that the Services and information, content and software presented to you through the Services or used in connection with the Services contain proprietary and confidential information that is protected under U.S. and international intellectual property laws, including copyright, trademarks, service marks, patents or other proprietary rights and laws. Except as

expressly authorized by us or our licensors, you agree not to sell, rewrite, modify, reproduce, redistribute, create derivative works, or rent any information presented to you through the Services, in whole or in part. Further, you are prohibited from using, downloading, republishing, selling, duplicating, or "scraping" for commercial or any other purpose any database, in whole or in part, in any medium whatsoever, underlying any of the Services including, without limitation, the WebMD Health Directory and the Medscape Drug Reference.

You may view information provided through the Services online, download individual articles to your computer or mobile device for later reading or print a copy of an article for yourself. You may not remove any copyright notices from our materials. We reserve all of our other rights not granted in these Terms of Use. You agree not to access the Services by any means other than through the interface that is provided by us for use in accessing the Services.

Linking to Us

Usually, we don't mind if you include a simple link from your website to one of our Professional Sites. However, you must first ask our permission if you intend to frame one of our websites or incorporate portions or one of our websites into a different site or product in such a way that is not clear to our users that we are the source of the content. You are not allowed to link to us if you engage in the publication or promotion of illegal, obscene, or offensive content, or if the link in any way negatively impact on our reputation.

Member Conduct when Using Community and Communication Services

If you use a community and communication feature of the Services, such as Medscape Mail, Medscape Connect, blog or discussion service (each, a "Community and Communication Service"), you are responsible for all communications, information, data, text, music, sound, graphics, messages and other material ("Content") that you upload, post, transmit, email or otherwise distribute through a Community and Communication Service. Neither we nor our licensors are responsible for the consequences of the Content posted by you or any other party through a Community and Communication Service, and as such, do not guarantee the accuracy, integrity or quality of such Content. You understand that by using a Community and Communication Service, you may be exposed to Content that is offensive or objectionable. In no event will we be liable in any way for any Content or for any loss or damage of any kind incurred as a result of the use of any Content uploaded, posted, transmitted, emailed or otherwise made available through a Community and Communication Service. In cases where you feel threatened or believe someone else is in danger, you should contact your local law enforcement agency immediately. If you think you may have a medical emergency, call your doctor or 911 immediately.

When you use a Community and Communication Service, you agree not to:

1. Violate local, state, national, or international laws;
2. Post, upload, email, transmit or otherwise distribute any Content that infringes on the intellectual property rights of others or on the privacy or publicity rights of others;
3. Post, upload, email, transmit or otherwise distribute any Content that is unlawful, harmful, obscene, defamatory, threatening, harassing, abusive, slanderous, hateful, or embarrassing to any other person or entity as we may determine in our sole discretion;
4. Harm minors in any way;
5. Post advertisements or solicitations of business;
6. Forge headers or otherwise manipulate identifiers in order to disguise the origin of any Content transmitted through a Community and Communication Service;
7. Post, upload, email, transmit or otherwise distribute chain letters, pyramid schemes, unsolicited or unauthorized advertising or spam;
8. Impersonate another person or business entity or stalk or otherwise harass another person;
9. Post, upload, email, transmit or otherwise distribute viruses or other harmful computer code designed to interrupt, destroy or limit the use of any computer software or hardware;
10. Harvest or otherwise collect information about others, including email addresses;
11. Allow any other person or entity to use your identification for posting or viewing comments;
12. Interfere with or disrupt a Community and Communication Service or computers, networks or other hardware connected to a Community and Communication Service, or disregard any requirements or policies of networks connected to a Community and Communication Service;
13. Engage in any other conduct that restricts or inhibits any other person from using or enjoying a Community and Communication Service, or which, in our sole judgment, exposes us or our customers or suppliers to any liability or detriment of any type;
14. Fail to respect other users' privacy. This includes revealing another user's password, phone number, address, instant messenger I.D. or address or any other personally identifiable information;
15. Create member names, or post solicit or send messages, text or photographs that are sexually explicit, that denigrate, threaten, abuse or harm others in any way; or

We may (but are not obligated) do any or all of the following without notice:

1. Record or pre-screen the dialogue in a public chat room;
2. Investigate an allegation that a communication does not conform to the terms of this section and determine in our sole discretion to remove or request the removal of the Content;
3. Remove Content which is abusive, objectionable, illegal, or disruptive, or that otherwise fails to conform with these Terms of Use;
4. Terminate your access to any or all Community and Communication Services upon our determination that you have violated these Terms of Use; or
5. Edit Content.

You agree that you must evaluate, and bear all risks associated with, the use of any Content, including any reliance on the accuracy, completeness, or usefulness of such Content. You acknowledge, consent and agree that we may investigate your use of a Community and Communication Service in order to determine whether a violation of the Terms of Use has occurred or to comply with any applicable law, regulation, governmental request or legal process.

You agree and acknowledge that the processing and transmission of a Community and Communication Service, including your Content, may involve transmissions over various networks and devices and necessary modifications as required for such transmissions.

Information that You Provide to the Services

When you submit information to areas of the Services that are publicly available, you give us an irrevocable, perpetual license to use, reproduce, modify, adapt, publicly perform and publicly display that information in connection with the Services. For example, if you post a comment to Medscape Connect, you grant us the right to display that comment through the Services for as long as we want. We will consider requests to remove information that you make publicly available through the Services on an individual basis (contact us at the email address we provide at the end of this document). For information that you submit to areas of the Services that are not publicly available, please see our Privacy Policy for an explanation of how we use that information and your rights to change or delete it. We provide the link to our privacy policy later in this document. We ask that you not post any messages with misleading, false, or inappropriate language or statements. We reserve the right to remove any content that we deem offensive or fraudulent at any time without your consent, as further described below. We cannot and do not assume any responsibility or liability for any information you submit in connection with the Services, or your or third parties' use or misuse of information transmitted or received using the Services.

Dealing with Advertisers

Your correspondence or business dealings with, or participation in promotions of, advertisers found on or through the Services, including requests for and delivery of goods or services, and any other terms, conditions, warranties or representations associated with such dealings, are solely between you and such advertiser. You agree that we shall not be responsible or liable for any loss or damage of any sort incurred as the result of any such dealings or as the result of the presence of such advertisers on the Services.

Privacy Policy

The purpose of our privacy policy is to identify the information we may collect about you when you use the Professional Sites and related Services and describe the uses we may make of such information, the security measures we take to protect it, and your options for controlling such information. You can review our privacy policy at http://www.medscape.com/public/privacy.

Laws that Govern this Agreement

We control those components of the Services made available through our respective websites from our offices within the state of New York in the United States of America. The Services can be accessed from any of the United States and from other countries worldwide. Since the laws of each State or country able to access the Services may differ, by accessing the Services, you agree that the statutes and laws of the state of New York, without regard to choice of laws principles, will apply to all matters relating to use of the Services. No waiver of any of these Terms and Conditions shall be deemed a further or continuing waiver of such term or condition or any other term or condition. We make no representation that materials made available through the Services are appropriate or available for use in other locations, and accessing them from territories where their contents are illegal is prohibited. If you access the Services from outside the United States, you are responsible for compliance with the laws of your jurisdiction.

The following provisions survive the expiration or termination of these Terms of Use for any reason whatsoever: Liability, Member Conduct, Proprietary Rights, Indemnity, Laws that Govern this agreement and Consequences.

Consequences

We may also take any legal action we think is appropriate. If your violation of these Terms of Use causes harm to others, you agree to hold us and our affiliates harmless against any liability for that harm. If there is any dispute between us concerning these Terms of Use or your use of the Services, you agree to submit the dispute to non-binding mediation, followed by binding arbitration. Both the mediation and the arbitration will be governed under the rules of the American Arbitration Association, and the venue for the arbitration will be New York.

Termination and Modification

You agree that we may, *under certain circumstances and without prior notice*, discontinue, temporarily or permanently, the Services (or any part thereof) or eliminate your account, any associated email address, and remove any information you uploaded or provided to the Services with or without notice. Cause for termination shall include, but not be limited to, (a) breaches or violations of these Terms of Use or other incorporated agreements or guidelines, (b) requests by law enforcement or other government agencies, (c) a request by you (self-initiated account deletions), (d) discontinuance or material modification to the Services (or any part thereof), (e) unexpected technical or security issues or problems, (f) extended periods of inactivity, and/or (g) your engagement in fraudulent or illegal activities. You agree that all terminations for cause shall be made at our sole discretion, and we shall not be liable to you or any third party for any termination of your account, any associated email address, or access to the Services or any portion thereof.

Liability

Your use of the Services is at your own risk. The Services and information included therein are provided on an "as is" basis. WE AND OUR LICENSORS AND SUPPLIERS, TO THE FULLEST EXTENT PERMITTED BY LAW, DISCLAIM ALL WARRANTIES, EITHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT OF THIRD PARTIES' RIGHTS, AND FITNESS FOR PARTICULAR PURPOSE. Without limiting the foregoing, we, our licensors, and our suppliers make no representations or warranties about the following:

1. The accuracy, reliability, completeness, currentness, or timeliness of the Services or information contained therein.
2. The satisfaction of any government regulations requiring disclosure of information on prescription drug products or the approval or compliance of any software tools available through the Services.

In no event will we, our licensors, our suppliers, or any third parties mentioned on any Professional Site be liable for any damages (including, without limitation, incidental and consequential damages, personal injury/wrongful death, lost profits, or damages resulting from lost data or business interruption) resulting from the use of or inability to use the Services or information contained therein, whether based on warranty, contract, tort, or any other legal theory, and whether or not we, our licensors, ours suppliers, or any third parties mentioned with the Services are advised of the possibility of such damages. We, our licensors, our suppliers, or any third parties mentioned within the Services shall be liable only to the extent of actual damages incurred by you, not to exceed U.S. $1000. We, our licensors, our suppliers, or any third parties mentioned within the Services are not liable for any personal injury, including death, caused by your use or misuse of the Services or any information contained therein. Any claims arising in connection with your use of the Services must be brought within one (1) year of the date of the event giving rise to such action occurred. Remedies under these Terms of Use are exclusive and are limited to those expressly provided for in these Terms of Use.

Indemnity

You agree to defend, indemnify, and hold each of us and our respective officers, directors, employees, agents, licensors, and suppliers, harmless from and against any claims, actions or demands, liabilities and settlements including without limitation, reasonable legal and accounting fees, resulting from, or alleged to result from, your violation of these Terms of Use.

Notice and Take Down Procedures and Copyright Agent

If you believe any materials accessible on or from the Services infringe your copyright, you may request removal of those materials (or access thereto) from the Services by contacting Medscape Customer Support at MedscapeCustomerSupport@webmd.net and providing the following information:

1. Identification of the copyrighted work that you believe to be infringed. Please describe the work, and where possible include a copy or the location (e.g., URL) of an authorized version of the work.
2. Identification of the material that you believe to be infringing and its location. Please describe the material, and provide us with its URL or any other pertinent information that will allow us to locate the material.
3. Your name, address, telephone number and (if available) e-mail address.
4. A statement that you have a good faith belief that the complained of use of the materials is not authorized by the copyright owner, its agent, or the law.
5. A statement that the information that you have supplied is accurate, and indicating that "under penalty of perjury," you are the copyright owner or are authorized to act on the copyright owner's behalf.
6. A signature or the electronic equivalent from the copyright holder or authorized representative.

In an effort to protect the rights of copyright owners, we maintain a policy for the termination, in appropriate circumstances, of subscribers and account holders who are repeat infringers.

Complete Agreement

Except as expressly provided in a particular "legal notice" on the website, these Terms of Use constitutes the entire agreement between you, WebMD and Medscape with respect to your use (and prior use) of the Services.

Questions or Concerns about Our Terms of Use

For questions or concerns about these terms of use, please send an email to MedscapeCustomerSupport@webmd.net