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Placing a Lumbar Epidural Catheter

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OVERVIEW

Placement of a catheter in the lumbar epidural space allows for the administration of analgesic and local anesthetic agents to a series of dorsal- and ventral-nerve roots that exit the spinal cord and traverse the epidural space, thereby providing anesthesia or analgesia to specific nerve-root distributions. This supplement to the video reviews the indications for and contraindications to the placement of a lumbar epidural catheter, the necessary materials and equipment, the relevant anatomy, and placement technique.

INDICATIONS AND CONTRAINDICATIONS

A lumbar epidural catheter can be used to induce surgical anesthesia, intraoperative analgesia, postoperative analgesia, or analgesia during childbirth. Other indications include placement for the management of pain related to malignant conditions or to other causes of chronic pain.¹

Absolute contraindications to the placement of a lumbar epidural catheter include the lack of patient consent, allergy to the local anesthetic, the presence of either primary or medication-induced coagulopathy due to the risk of an epidural hematoma, and the presence of elevated intracranial pressure, which could result in brain-stem herniation if a dural puncture occurs during the procedure. Relative contraindications include an anatomical abnormality (e.g., spina bifida or an abnormality caused by spinal surgery), a disease of the central nervous system (e.g., multiple sclerosis), severe cardiac valvular disease (e.g., aortic stenosis), sepsis, local infection at the site of catheter placement, and severe untreated hypovolemia.²

EQUIPMENT

The necessary equipment is often available in a sterile epidural kit. Although the exact contents of such kits may vary, certain components are essential for the successful placement of a lumbar epidural catheter (Fig. 1).

You will need certain medications, including 0.9% saline, 1% or 2% lidocaine, and 1.5% lidocaine with a 1:200,000 dilution of epinephrine. The kit may contain three needles: a 19-gauge, 3-cm filter needle, which filters out glass particles and other debris when drawing up medications; a 25-gauge, 5-cm local infiltration and finder needle; and a 17-gauge, 9-cm epidural needle (also called a Tuohy needle), which has markings at 1-cm intervals and includes a stylet. Finally, the kit should contain an epidural catheter and a loss-of-resistance syringe, which is a low-friction syringe specifically designed to help identify the epidural space. The epidural catheter has markings starting 5 cm from the tip and continuing at 1-cm intervals, as well as special markings that denote 5, 10, 15, and 20 cm from the tip.

In addition to the contents of the kit, a mask and head covering will be needed for each person present at the procedure. Sterile gloves, an antiseptic skin cleanser (preferably chlorhexidine with alcohol), a sterile drape, and sterile dressings will also be needed.

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Figure 1. Example of an Epidural Kit.

The contents of an epidural kit vary from institution to institution but should contain all the components necessary to place a lumbar epidural catheter. These components include an epidural needle, a filter needle, an infiltration–finder needle, a loss-of-resistance syringe, a basic syringe, lidocaine 1.5% with a 1:200,000 dilution of epinephrine, plain 1% or 2% lidocaine, 0.9% saline, an epidural catheter, antiseptic cleanser, a sterile drape, and sterile dressing.

ANATOMY

A thorough understanding of lumbar anatomy is needed to accurately place the epidural catheter and to induce analgesia or anesthesia in the appropriate dermatomes. Anterior landmarks are used to identify the dermatomal levels, and corresponding posterior landmarks are then used to determine the appropriate vertebral level at which to place the epidural catheter. Important anterior landmarks include the nipple line, which corresponds to the T4 dermatome; the xiphoid process, which corresponds to the T6 dermatome; the umbilicus, which corresponds to the T10 dermatome; the suprapubic area, which corresponds to the T12 dermatome; and the knee, which corresponds to the L4 and L5 dermatomes.³ Important posterior landmarks include the inferior border of the scapula, which corresponds to the T7 vertebral body; the most inferior aspect of the 12th rib, which corresponds to the L2 vertebral body; and the imaginary line between the posterior iliac crests, also known as Tuffier's line, which corresponds to the L4 vertebral body (Fig. 2).

The epidural space surrounds the dura mater, which forms the outermost boundary of the intrathecal space. The intrathecal space contains cerebrospinal fluid (CSF) and the spinal cord. The epidural space is bordered posteriorly by the ligamentum flavum and vertebral laminae, anteriorly by the posterior longitudinal ligament, laterally by the vertebral pedicles and intervertebral foramina, superiorly by the foramen magnum at the base of the skull, and inferiorly by the sacrococcygeal membrane. The epidural space contains fat, lymphatics, veins, and the nerve roots that traverse the space.⁴ There is no free fluid in the epidural space.

Understanding the anatomy that is traversed by the epidural needle may help to facilitate safe identification of the epidural space. The first tissue layer you will encounter is the skin, followed by subcutaneous tissue. Then, as you enter the epidural space along the midline, the needle will traverse three ligaments: the supraspinous ligament, the interspinous ligament, and the ligamentum flavum. The ligaments provide resistance to the advancing needle and are dense enough to hold the needle in position even after the needle has been released. The ligamentum flavum is the last layer of connective tissue that you will encounter before the needle enters the epidural space (Fig. 3).

It is also important to understand vertebral anatomy because the epidural needle may come into contact with bony structures. A vertebra consists of the body, the pedicles, the superior and inferior articular processes, the laminae, the transverse processes, and the spinous process.

PATIENT PREPARATION

At a minimum, blood pressure should be monitored noninvasively, pulse oximetry should be performed to monitor oxygen saturation, and intravenous access should be obtained before the procedure is started. Pregnant women may require fetal monitoring. For most patients, anxiolytics and analgesics can be administered as needed. In patients who receive sedation, supplemental oxygen may also be needed.

Proper positioning of the patient is important to facilitate access to the epidural space.² The video demonstrates placement of an epidural catheter while the patient is in the sitting position, which is commonly used. An alternative position, the lateral position, is not demonstrated in the video. To place the patient in the sitting position, have the patient maximally flex his or her back. Then instruct the patient to relax the shoulders, flex the neck, and lower the chin toward the chest.

Once the patient is in this position, begin to palpate the anatomical landmarks of the back (Fig. 4). Although the epidural catheter will be placed at the level of a lumbar vertebra, palpating the thoracic spinous processes first may help you find the midline more easily and may allow you to detect any abnormal curvature of

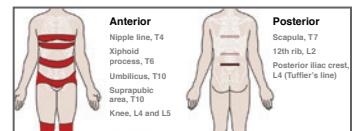


Figure 2. Anterior and Posterior Landmarks.

Anterior landmarks are used to identify the dermatomal levels, and corresponding posterior landmarks are used to determine the appropriate vertebral level at which to place the epidural catheter.

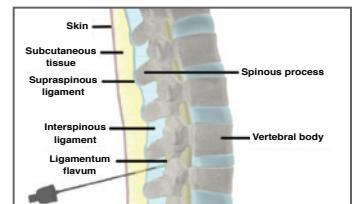


Figure 3. Relevant Anatomy of the Lumbar Spine.

Knowledge of the various soft-tissue planes, ligaments, and bones is important for the correct and safe placement of a lumbar epidural catheter.

the back, such as scoliosis. The spinal anatomy may be more difficult to palpate in obese patients. Recent literature supports the use of preprocedural ultrasonography of the back to identify the midline, particularly in obese patients⁵ (Fig. 5).

PLACEMENT OF THE EPIDURAL CATHETER

Sterile technique is very important for this procedure.² Don a mask, head covering, and sterile gloves. Adhere to the policy of your institution regarding use of a full sterile gown. The patient and anyone else in the room should also wear a head covering and mask. Open the sterile epidural kit and organize the contents so that you can readily find and use the equipment as needed. Use the filter needle to draw up the medications.

Apply the antiseptic skin cleanser in a back-and-forth motion for approximately 30 seconds. Allow the solution to air-dry for at least 30 seconds. Place the sterile drape over the patient's back so that the opening provides access to the planned site of catheter placement. The epidural catheter should be placed at a level that will provide anesthesia or analgesia for the particular procedure or for control of labor pain.

Use the infiltration and finder needle to infiltrate the skin and superficial tissue with 1% or 2% lidocaine to maximize patient comfort. You can also use this needle to identify the approximate depth of ligaments and bone. With the stylet in place, insert the epidural needle through the same entry point that you used with the finder needle. The purpose of the stylet is to prevent the tip of the epidural needle from becoming obstructed by patient tissue. One technique involves holding the epidural needle with the bevel facing up, using both hands, with the thumbs and index fingers holding each side of the hub. Advance the needle to pass through the supraspinous ligament and into the interspinous ligament, which in most patients is at a depth of approximately 2 to 4 cm.

Next, remove the stylet from the epidural needle and attach the loss-of-resistance syringe, which should contain no more than 2 to 3 ml of either air or saline.¹ Before you advance the needle further, make sure that resistance is present by gently tapping the plunger of the syringe. The plunger should not advance. Next, slowly advance the epidural needle in small increments of 2 to 3 mm at a time. After each advancement, check for the presence or absence of resistance by gently tapping the plunger with one hand, making sure to keep the epidural needle stable with the other hand.

You will know you have entered the epidural space when there is loss of resistance, as indicated by a smooth collapse of the plunger into the syringe. Once you feel this loss of resistance, the epidural catheter can be placed. First, refer to the markings on the needle to note the depth at which the needle has entered the epidural space. For example, if you insert a 9-cm epidural needle and 4 cm of the needle remains outside the patient's skin, the distance from the skin to the epidural space is 5 cm. Note that longer epidural needles are available for use in obese patients.

Gently pass the epidural catheter through the epidural needle to a depth that is at least 5 cm past the tip of the epidural needle. Do not withdraw the catheter through the epidural needle, which would increase the risk of shearing or dislodging the catheter. Withdraw the epidural needle over the catheter, being careful not to dislodge the catheter. Then slowly withdraw the catheter, leaving 3 to 5 cm of the catheter in the epidural space. For example, if the loss of resistance occurs at 5 cm, the catheter should be taped at the markings between 8 and 10 cm. Attach the hub to the distal end of the catheter, which stabilizes it and allows syringes to be attached.

Make sure that the catheter has not entered either the intrathecal or the intravascular space. This check involves two steps. First, aspirate the catheter with a



Figure 4. Palpation of the Surface Anatomy of the Back.

The surface anatomy of the back provides landmarks for the correct entry point of the epidural needle.



Figure 5. Ultrasonography of the Lumbar Anatomy.

Preprocedural ultrasonography helps to identify the midline of the spine and the approximate depth of ligaments and bone.

syringe and look for blood or CSF. The absence of blood or CSF is a good indicator of correct placement, but it does not rule out intrathecal or intravascular placement. Second, inject a test dose through the catheter. Usually, 3 ml of 1.5% lidocaine with a 1:200,000 dilution of epinephrine is used. After the test dose has been injected, ask the patient to report any symptoms that occur, such as palpitations, a metallic taste, tinnitus, or sudden motor or sensory changes in the legs.

If the epidural catheter is in the intravascular space, the epinephrine component of the injection will cause hemodynamic changes. For example, the heart rate may increase by 10 beats per minute, and the systolic blood pressure may increase by 15 mm Hg over the values that were obtained immediately before the test dose. The lidocaine component may cause a metallic taste or tinnitus.

If the epidural catheter is in the intrathecal space, the lidocaine component will cause abrupt neurologic changes, such as loss of sensation and a decrease of motor function in the legs. If the patient has no response to the test dose, you can infer that the catheter has not been placed in the intravascular or intrathecal space, and further medications can be administered.

Use sterile dressings to secure the catheter to the skin. Once a local anesthetic has been injected through the catheter, you may test the efficacy of the catheter by testing for changes in sensation. For example, you could use an alcohol wipe on the skin to test the response to temperature change, or you could tap the skin with a blunt needle at various dermatomes to test for nociception.

COMPLICATIONS

Placement of a lumbar epidural catheter is generally a straightforward procedure, especially if proper preparation and technique are used. However, several complications may occur. These may include inadvertent dural puncture, which can result in a postdural puncture headache. This complication can be managed with hydration and analgesics or with the administration of an epidural blood patch.

Inadvertent intrathecal injection of medication may result in a high-level spinal block, which can cause hypotension, bradycardia, or apnea. In such cases, supportive treatment, such as the administration of fluids or vasopressors and airway management, may be necessary.

Inadvertent intravascular injection of medication will result in inefficacy and possibly in systemic toxic effects of the local anesthetic agent, for which further care, such as lipid emulsion therapy, would be necessary. Epidural hematomas and epidural abscesses are exceedingly rare and require neurosurgical evaluation.^{2,4}

SUMMARY

Placement of a lumbar epidural catheter requires knowledge of the indications and contraindications, familiarity with the equipment, and knowledge of the relevant anatomy. Placement can provide significant benefit to patients during surgical procedures or childbirth.

No potential conflict of interest relevant to this article was reported.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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