Techniques in Regional Anesthesia and Pain Management (2007) 11, 203-207

ELSEVIER

Techniques in
Regional Anesthesia
& Pain Management

Caudal blockade in children

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KEYWORDS:
Caudal anesthesia;
Pediatrics;
Epidural;
Ultrasound

Caudal epidural anesthesia is used as pain control for many subumbilical surgical procedures. The epidural space is accessed through the caudal space with ease. Once entered into the space, drug can be injected or other levels can be accessed using multiple techniques. Besides passing a catheter, one can inject drug to provide a block for a specific amount of time. Certain drugs have been used to increase the duration and intensity of the regional block such as epinephrine, clonidine and other newer used medications.

Epidural anesthesia has been used for many years in pediatrics not only as an adjuvant to a general anesthetic but also as a sole anesthetic for subumbilical procedures. The epidural space can be accessed from the caudal, lumbar, and thoracic levels. The caudal approach, in contrast to the lumbar or thoracic approach, is used in children due to the ease of access to the caudal epidural space via the sacrococcygeal ligament and the potential decreased risk of injury to neural structures at this level when compared with gaining access at the lumbar and thoracic levels. Newer local anesthetics as well as adjuvants to the local anesthetic have been researched to optimize the injectate of the caudal to increase the duration of the block. Furthermore, using this entry point, access to lumbar and thoracic levels can be obtained via a catheter either blindly or via newer approaches such as electrical stimulation, ultrasound, and electrocardiography. This has been described in detail in another section in this journal.

Techniques

With the patient in the lateral decubitus or prone position with a pillow under the pelvis, the area of entry is sterilely prepped with betadine. Commonly a short 20 or 22 gauge beveled needle is advanced at a 45° to 90° angle at the level of the sacrococcygeal ligament into the skin (Figure 1). The needle will traverse the dermis followed by subcutaneous tissues. Once the "pop" or loss of resistance through the sacrococcygeal ligament is felt, the angle of the needle is decreased to approximately 30° and is advanced a few millimeters. This advancement assures complete insertion of the tip of the needle, including the bevel into the sacral canal. However, too much advancement of the needle can cause penetration into the dura, so care should be taken to prevent this. The allowed distance that the needle can be advanced depends on age of the child as well as normal variations in the ending of the dural sac.

After entry into the caudal epidural space through the sacrococcygeal ligament, a single injection of local anesthetic with or without other medications is commonly done. The type of needle used for the caudal is not as important as the test that you choose to confirm your needle is in the epidural space. Smaller needle may bend on entry through the skin, making it hard to find and feel the loss of resistance across the ligaments. Furthermore, smaller needles may make accidental dural or venopuncture difficult to ascertain.[1]

Aside from a needle, as described above, an angiocath can also be inserted with the technique described. A 22- or 20-gauge angiocatheter is used, but a 45° entry point is used to prevent kinking of the catheter once the catheter is ad-

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doi:10.1053/j.trap.2007.09.001

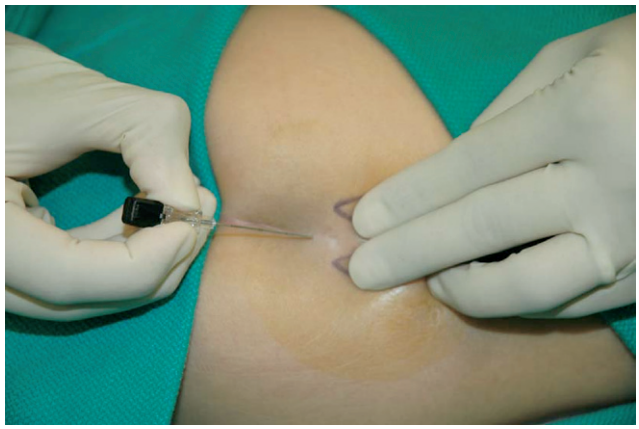

Figure 1 Caudal needle placement. The sacral cornu is identified (blue marks); a styletted needle is placed between the cornu and is advanced until a loss of resistance is perceived. The stylet is removed, and the local anesthetic solution is injected after a test dose in graduated increments. A total volume of 1 mL/kg is used. (Color version of figure is available online.)

vanced over the needle. As above, the loss of resistance is felt, the angle is decreased, and the needle is advanced a few millimeters. With the needle stabilized, the catheter is fed off of the needle into the epidural space.

Many different techniques are used to further confirm proper placement of the needle as well as the injectate solution. The absence of subcutaneous bulging of tissues and the lack of resistance with injection of local anesthetic are some common signs used to assure proper needle placement.

Alternatively, a description of the whoosh versus modified swoosh is described by injecting 1 mL of air or saline, respectively, while listening with a stethoscope over the lower lumbar spine. If a "swoosh" or "whoosh" sound is heard, there is a 96% positive predictive value that one is in the proper place. However, there is no statistical significant difference between clinical predictors stated above and the "whoosh" or "swoosh" technique. The risk with the "whoosh" technique (air injection) is that of venous embolism and a patchy block. However, if saline or local anesthetic is used, the risk of air embolism is diminished with the caveat of possible dilution of the local anesthetic with saline.[2]

Ultrasound is another technique used to confirm placement of the needle in the epidural space. Nerves can be hyperechoic or hypoechoic depending on the size of the nerve and the angle of the ultrasound beam. Therefore, on a cross-sectional view of a nerve, the hypoechoic region can be the nerves, whereas the hyperechoic region can be the connective tissue or vice versa (see section on newer modalities for epidural and caudal analgesia for detailed description of above technique).

An advantage of ultrasound guidance in pediatrics is the direct imaging of the structures and being able to observe the proximity of the needle to those surrounding structures to prevent damage to them.[3,4] Ultrasound can allow visualization of the intrathecal structures, the dural sac, the epidural space, and the cauda equine. Also, direct visualization of the injection of local anesthetic can be seen in real time. However, ultrasound imaging can be difficult due to ossification of the vertebral column but can be accomplished.[5]

Despite the difficulty, ultrasound can be used to visualize the tip of a needle in the epidural space as well as the advancement of a catheter in the epidural space in very small infants. In a study of 35 preterm infants, all of the neural structures could be seen because of the incomplete ossification of the vertebral column. One could see the spread of local anesthetic in the epidural space in a longitudinal view of the structures. The biggest advantage they saw of ultrasound was being able to identify actual epidural puncture and subsequent advancement and final placement of the tip of the catheter. Real-time viewing of the needle also allowed direct vision of the tip of the needle to avoid damage to surrounding neural structures.[6,7]

Electrical stimulation is yet another technique used to confirm needle placement. Tsui describes the anal sphincter stimulation using an insulated needle. With nerve stimulation of 1-10 mA at 1 Hz, contraction of the anal sphincter causes an "anal wink" or anal sphincter contraction reassuring with almost 100% certainty of epidural needle placement. However, an insulated needle needs to be used, which often may make it difficult to feel the loss of resistance once entering the sacrococcygeal ligament. Furthermore, these needles are not styletted and are more costly.[8]

Catheters

Because the duration of analgesia of a single-shot caudal epidural is limited, catheters are often placed to allow prolonged intraoperative as well as postoperative analgesia. Multiple techniques are available for catheter placement: blind, ultrasound-guided, stimulating, and using electrocardiography.

The caudal technique to access lumbar and thoracic epidural spaces is commonly used due to the risk of damage to the spinal cord with either direct insertion at those higher regions. The caudal technique is usually saved for children less than 1 year due to difficulty in passing the catheters in older children because of the increased lumbar lordosis that comes with age.

The blind catheter technique is similar to the blind single-shot caudal. A commercially available caudal catheter kit that includes a Crawford needle may be used, or an 18-gauge Angiocath® may be used to enter the epidural space. In the case of the Angiocath®, once it is felt that the needle is in the epidural space, the angiocath is advanced and the needle is removed. The styletted catheter is then measured along the spine from the sacrum to the desired level to estimate the proposed depth the catheter needs to be inserted. The stylette, once the catheter reaches the desired distance, is removed. The stylette is used to prevent caudal catheter coiling or kinking while passing it. If resistance is