

Workshop C5: Managing Epidurals - Caudal to Thoracic: Intra- and Postoperative Management

Baby Epidurals: A Review of Techniques

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Introduction

As greater numbers of the medical community have accepted that neonates and infants have the same or greater need for analgesia after major procedures as adults, the issue becomes how best to accomplish that goal. In many Neonatal Intensive Care Units (NICU), the standard of care has been either intermittent boluses of opioids or continuous infusion of opioid. As a consequence, many neonates have been “stuck” on the ventilator for longer than hoped for. Although the cause is largely intrinsic lung disease, the use of opioids and the variability in neonatal handling of them play a role. Of course, it is the opioids that are often blamed for causing the prolonged ventilatory requirement. The second, more theoretical, issue is the finding that neonates have both behavioral and physiological changes that occur in response to tissue injury. These responses are greater than those found in adult animal models, and are greater in more premature neonates than older ones. Extrapolating from what little human data exists, there may be a larger role for preemptive analgesia in this population than for older patients.

The stage is set for the use of epidural analgesia in neonates. However, there are both limitations as well as advantages to the technical approach to the neuraxis in neonates. Certainly the infants are small. The distance to the epidural space is measured in millimeters, and the bevel of a standard Touhy needle approximates the width of the spinal canal. On the other hand, the sacrococcygeal and lower lumbar interspaces are prominent, and the tissue in the epidural space more pliable than in older patients. Four approaches to placing an epidural catheter present themselves. The emphasis here is on epidurals whose site of action is the thoracic level. The lumbar regional may be approached similarly, and is technically easier at any rate. All four techniques discussed below can be used for infants of any age; we use them most for infants under 6 months of age. Older infants usually receive either lumbar or thoracic epidurals, depending on clinical need. Certainly anyone who is uncomfortable placing a thoracic epidural in an older infant or young child will find these approaches useful alternates. A few suggestions regarding post-operative management will follow the discussion of the intra-operative aspects of catheter placement. A note of caution: the anesthesiologist may be the first to really look at the child’s spine with an eye towards instrumenting it. Before proceeding with any neuraxial procedure, one must check the sacrum for evidence of spinal dysraphism (sinus tract, deep pit, hair patch).

Thoracic Approach

This is probably the most nerve-wracking epidural approach. Proponents of this technique suggest using a Crawford needle, due to its very blunt bevel. When using this needle, nicking the skin with a sharp needle first is useful. The advantages of this needle are twofold. First, the blunt nature of the needle allows for a distinct “pop” on loss of resistance. The second advantage is that the bevel enters the epidural space only minimally, once loss of resistance is felt. As with all pediatric epidurals, especially those done with the patient anesthetized, we strongly recommend loss of resistance (LOR) to saline with continuous pressure. This should decrease the risk of dural puncture.

The catheter is then threaded a short distance to the desired level and secured per routine. There are those who consider the risks of spinal cord injury too high with this approach and do not perform it. Certainly, it is not a technique for beginners.

Lumbar to thoracic Approach

The depth at the lumbar levels is deeper than in the thoracic levels. Additionally, the risks pursuant to a dural puncture are less, assuming that the puncture occurs below the conus medullaris. Note, however, that the conus is found at the L2-3 level in neonates, as opposed to the L1 level in older children and adults. Entering the epidural space at this level is not particularly difficult. Again, we prefer LOR to saline with continuous pressure. Although the epidural space is deeper here than higher up, it is still usually around 1cm...less in premature infants. Coaxing the catheter into the thoracic region can be challenging, but has not been problematic in our practice. Fluoroscopic guidance can be very helpful here, as there can be a tendency for the catheter to loop in the lumbar epidural space. Small amounts of radiocontrast will be needed to visualize the catheter. Note that only certain contrast dyes are appropriate for neuraxial use. Consult your radiologist about the brand and concentration used in your institution.

Modified Taylor Approach

This approach is our preferred technique. The reasons are several. The L5-S1 interspace is the largest in the neuraxis, allowing easy identification, and manipulation of the needle (see below). The ligament is relative thick promoting good LOR, and a dural puncture here would fall well below the conus medullaris in all neonates. In addition, the space is high enough above the anus to reduce the risk of stool getting under the dressing (as can happen despite the best efforts with caudal catheters).

Landmarks include the posterior superior iliac spines, which are almost exactly at the L5-S1 level. The spinous processes are not prominent, but the interspace feels like a large, soft depression in the midline. We use a Crawford needle and stylet catheter. The distance from the level of insertion to the desired final dermatome is measured prior to needle insertion. The initial approach is a relatively perpendicular one, using LOR to saline with continuous pressure. Once LOR is felt, we inject a small amount of saline to open the space, and drop the angle of the needle to ~20-30 degrees (almost parallel with the lumbar spine). The catheter is then inserted, being very careful not to use undue pressure to advance the catheter to the premeasured distance. If any resistance is felt, the catheter is withdrawn, and rotated slightly and readvanced. Sometimes a twisting motion can aid smooth advancement of the catheter. Other times, a little more saline is useful, or

dropping the angle of the needle will give the desired result. For study purposes, we initially confirmed placement with fluoroscopy. The rate of successful placement was high enough that we do not routinely use fluoroscopy. We use clinical signs (i.e. lack of response to incision and surgical stimulation) to confirm effective placement. There are times, though, that radiographic confirmation is useful and should be applied at practitioner discretion. There is literature that supports using fluoroscopy more often for all of the techniques described here, but the variability in use of stylets, types of catheter and exact technique make evidence-based decisions somewhat difficult to make.

Caudal to Thoracic Approach

This time-honored approach can be an effective one. The sacrococcygeal ligament is a large and easily identified structure. Gaining access to the space is straightforward, as for one-shot caudals done for hernia or hypospadias repairs. There are those who have used the caudal route with great efficacy and a high success rate. Others have found that advancing the catheter to the thoracic level to be a bit haphazard. Although we have had little difficulty reaching the correct level, the issue of keeping the catheter clean has vexed us, causing us to use the modified Taylor approach more often. However, for years we provided comfort to infants using this technique.

There are a couple techniques to this approach. One technique is to use a Crawford (or Touhy) needle with LOR to saline. A small amount of saline is injected to open the space, and the catheter advance carefully to the desired level, using the tricks described above as needed. Another approach (the one we use) is to insert an 18ga IV catheter as one would for a one shot caudal. Care must be taken to prevent advancing the relatively long-beveled stylet needle through the dura. The IV catheter is advanced over the stylet as far as possible, then the epidural catheter inserted through that. The advantage seems to be that the IV catheter tip is located a fair distance into the epidural space. This head start seems to reduce the chance that the epidural catheter will to coil in the lumbar space. Unfortunately, no data is available to compare one approach to another in terms of coiling rate (the one paper reviewing failure rates took all techniques together). Clinically, however, we have had a very high success rate, judging by clinical effectiveness. Once the epidural catheter is at the correct level, the IV catheter is removed along with the epidural catheter's stylet. The next issue is dressing the insertion site. The main challenge is that the site is just above, or at, the top of the intergluteal fold. Finding a way to prevent the dressing from being lifted off of the skin and stool from tracking along the intergluteal fold and under the dressing is daunting. Generous amount of mastic gum or benzoic acid products are required. Some propose using "mud flaps" constructed of a separate dressing or plastic sheeting to shield the dressing from contamination, but these can be cumbersome.

Post-Operative Issues

Once the catheter is in proper position, an infusion of medication can be started. There are several choices, and the decision to use one or another depends largely on personal preference. We use 1.5% chloroprocaine at rates between 0.3 – 1 ml/kg/hr.

Chloroprocaine has a half-life of roughly half a minute, even in cord blood. Therefore, the risk of build-up leading to toxicity is minimal. Of course, a small percentage of patients will have pseudocholinesterase deficiency and could have a progressive block, or develop blood levels that could cause toxic reactions. Therefore, we use apnea and cardiac monitors for these patients. No opioids are used in the epidural space, to reduce the risk for sedation and respiratory depression. In practice, however, it is not unusual for the babies to need small amounts of opioid as an adjunct to the epidural infusion. Others use mixtures of dilute local anesthetic and opioid. Care must be taken, as bupivacaine blood levels rise over the first days, and has been associated with cardiac arrests and seizures on rare occasions. Partly, this results from the reduced protein binding and slower clearance of local anesthetics in the younger infants. Be aware of the infusion rate and total number of milligrams of local anesthetic you administer.

One of the larger practical issues we have had to deal with is coordination of care with the neonatology team. Epidural analgesia is still a rather new modality in the NICU. We have made great efforts to educate the nursing staff and medical staff about the use of epidurals, the function and management of the pumps, and the role for adjunct medications. The neonatology team guards the patients well, and care must be taken to fit our post-op pain protocols into the flow of general care. This is true everywhere in the hospital, of course, but seems a bit more acute in the NICU.

One of the more common calls we get regards leakage of blood or fluid under the dressing. Be sure that the nursing staff knows that a large needle, small catheter, and minimal amounts of subcutaneous tissue will result in some bleeding and/or back leak. This is a normal occurrence, but can be distressing to the inexperienced.

Conclusion

Use of one or more of the epidural techniques can provide comfort to neonates and young infants safely and effectively. The above approaches to the neuraxis also can provide alternative routes of access to the thoracic dermatomes for patients into the toddler years, if practitioners are not comfortable with direct thoracic puncture. Education and communication are keys to success when starting a regional anesthesia program in the NICU. Hopefully, as we gain experience in this area, we can design proper studies to allow more evidence-based decision making.