

Pediatric Epidural Anesthesia

Adam C. Adler

A one-week-old child born at 38 weeks is coming to the operating room to undergo a laparotomy for repair of duodenal atresia. The mother inquires about the potential for regional anesthesia techniques and how they differ between adults and children.

How Would You Place an Epidural Catheter in a Small Child?

Epidural catheters can be placed via an interlaminar (lumbar/thoracic) or caudal approach after induction of general anesthesia. For interlaminar placement, the child is typically placed in lateral position with hips and knees flexed and spine arched to open the interlaminar space. Loss of resistance to saline as opposed to air is considered to be safer in neonates and infants, as even a small volume of intravascular air can cause a clinically significant air embolus in an infant or small child.

What Is the Depth to the Epidural Space in Children?

The epidural space is extremely superficial in small children, with several guidelines used to estimate the distance.

The mean depth to the epidural space is 1 cm in neonates, ranging from 0.3 to 1.5 cm.

Between 6 months and 10 years of age, the epidural space is estimated to be 1 mm/kg body weight of depth.

For a caudal approach, an 18-gauge intravenous catheter is first inserted into the caudal space via the usual technique and a wire-reinforced epidural catheter is threaded into the desired space/level. The level of the catheter tip can be confirmed via ultrasound, and/or fluoroscopy.

Should a Test Dose Be Performed in Children under General Anesthesia?

Regardless of technique, careful aspiration for blood followed by a test dose using local anesthetic and epinephrine should be considered to exclude inadvertent subarachnoid or intravascular injection. Typically, a test dose is conducted with 0.5 mcg/kg of epinephrine or 0.1–0.2 mL/kg of lidocaine 1:200,000 solution.

The most suggestive sign of intravascular injection (100% sensitivity) is an EKG T-wave amplitude increase of >25%. Other signs include a systolic blood pressure increase of >15 mmHg or heart rate increase of >10 beats per minute with a sensitivity of 95% and 71% respectively.

What Are the Risks and Benefits of Awake versus Asleep Epidural Placement in Pediatric Patients?

Epidurals have been placed safely in pediatric patients under general anesthesia for many years. Risks of the asleep patient include limited feedback of potential neurologic symptoms, whereas risks of the awake patient include limited patient cooperation and movement. The Pediatric Regional Anesthesia Network (PRAN) studies have shown similar or even lower rates of complications in blocks performed on sedated children as compared to those who were awake. Current recommendations suggest performing regional anesthesia in pediatric patients under general anesthesia or deep sedation.

Identify Some Major Differences in Epidural Placement between Neonates and Adults

- Toxicity in children, especially neonates may manifest by agitation, restlessness, and myoclonic activity and may be hard to differentiate.

- Neonates have a lower threshold for local anesthetic toxicity due to decreased protein binding of local anesthetics.
- The spinal cord and thecal sac end at L1 and S1 respectively in neonates while in adults these locations are at L3 and S3.
- The distance to the epidural space is shallower in children.
- In neonates, the ligaments and bone are less calcified resulting in less tactile feedback and more likely intraosseous injection.
- Neonates have a larger CSF volume/kg (4 cc/kg) than older children and adults (2 cc/kg).
- Neonates have a faster CSF production and absorption when compared to adults.

What Are the Common Local Anesthetic Solutions Used for Epidural Analgesia in Children?

Bupivacaine 0.1–0.125% or ropivacaine 0.1% in normal saline are the most commonly used local anesthetics for postoperative analgesia.

Epidural solutions are dosed based on the local anesthetic component.

Typical dosing regimens include: 0.1–0.4 mg/kg/h of local anesthetics with or without the addition of analgesic adjuncts.

Suggested Reading

Kozek-Langenecker SA, Marhofer P, Jonas K, et al. Cardiovascular criteria for epidural test dosing in sevoflurane- and halothane-anesthetized children. *Anesth Analg*. 2000;90(3):579–83. PMID: 10702441.

Kraemer FW, Rose JB. Pharmacologic management of acute pediatric pain. *Anesthesiol Clin*. 2009;27(2):241–68. PMID: 19703675.

Polaner DM, Taenzer AH, Walker BJ, et al. Pediatric Regional Anesthesia Network (PRAN): a multi-institutional study of the use and

incidence of complications of pediatric regional anesthesia. *Anesth Analg*. 2012;115(6):1353–64. PMID: 22696610.

Neonatal epidurals are often managed using 3% chloroprocaine by continuous infusion. Dosing includes a bolus of 1.5–2.0 mL/kg followed by a continuous infusion of 1.5–2.0 mL/kg/h. Chloroprocaine is often used in neonates due to its relative safety in this group as well as ability for fast plasma esterase degradation in the event of toxicity.

What Are Commonly Used Additives to Epidural Solutions?

- Clonidine 0.2 mcg/kg/h
- Fentanyl 1 mcg/kg/h
- Hydromorphone 1 mcg/kg/h
- Morphine 2.5 mcg/kg/h

Identify Some Contraindications to Pediatric Epidural Placement

- Parental refusal
- Overlying skin infection
- Sepsis
- Coagulopathy
- Spinal deformities (spina bifida)
- Baclofen pumps
- Prior spinal instrumentation